Spatial-Topological Interpretation in Modern Urban Housing of South Korea, China and Japan

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韓国 ・ 中国 ・ 日本の近代都市住宅における空間位相的解析

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ABSTRACT

An attempt is made to investigate South Korea, Japan, and China's housing culture to answer the question: how do old spatial values interact with a new domestic setting? The argument of this research relates to the cultural interpretation of the housing plan morphology. It demonstrates how social values and domestic space are interrelated and how their interactions have driven housing evolution through the twentieth century.

For hundreds of years, housing form and culture in South Korea, Japan, and China have been inconsistent with minor changes. After the 2nd world war(1945), however, a fast and fundamental change was started. A massive house was constructed with a modern design concept that is entirely different from that of the traditional house.

The analysis focuses on the diachronic process where the traditional house, which used to be a single dwelling prototype for centuries, is transformed into modern houses. Using space syntax methods shows how old behaviors are re-accommodated and their symbolic meaning re-negotiated in the modern setting.

Synthesizing these analyses, it is evaluated that what appears on the surface to be a radical change preserves at a deeper level the genotypical value of space that generates a gradual and continuous evolution. Therefore, the old and new houses in South Korea, Japan, and China are separate only at the physical, not at the spatial level.

TABLE OF CONTENTS

LIST OF FIGURES

Shanghai

Figure 3.23 Plan of experimental housing in 1964

Figure 3.24 Inner-yard apartments in Fangunong, Shanghai

Figure 3.25 Housing for workers in Nanjing

Figure 3.26 Plan of the No.1 Experimental apartment in Tianjin 1974

Figure 3.27 Plan of an apartment building in Heilongjiang 1974

Figure 3.28 Plan of a residential building in the Wenchong Shipyard, Guangdong province

Figure 3.29 The standard apartment building of 1974~1975 in Sichuan province

Figure 3.30 Chang in design from hallway to a small-lighted living room: from design No. 301, No. 9014 to an apartment building with a small-lighted living room

Figure 3.31 The concept of territory distinction

Figure 3.32 Traditional house in Ming and Qing Dynasty (Siheyuan), Old Lilong house in Shanghai 1876, and apartment house in 198

Figure 3.33 Distribution and type of “one bright, two dark” Siheyuan

Figure 3.34 Spatial composition of traditional Siheyuan in Beijing

Figure 3.35 Traditional domestic code < 0 > in the Siheyuan and “ —” shaped block

Figure 3.36 Old Lilong house and domestic code < 1 >

Figure 3.37 Early apartment houses and domestic code < 2 >

Figure 3.38 China 301-II type standard design in 1956 (left) Soviet Union II-04 type standard design in 1955 (right)

Figure 3.39 303-I type standard design (left) 305-I type standard design (right)

Figure 3.40 Beijing Youanmen Experimental Housing Plan

Figure 3.41 plan coefficient (K)

Figure 3.42 Soviet Union housing plan, 1956

Figure 3.43 New residential floor plan, 1957

Figure 3.44 Overlapping-bedroom housing housing

Figure 3.45 Small scale housing and domestic code < 3-1 >

Figure 3.46 Overlapping-bedroom housing and domestic code < 3-2 >

Figure 3.47 Early Ting type housing and domestic code < 4 >

LIST OF TABLE

Chapter 1

Introduction: study questions and problem definition

1.1 Aims and motives

1.2 Housing evolution : changing characteristics of domestic space in time

1.3 Changing housing culture

1.3.1 Changing housing culture in South Korea
1.3.2 Changing housing culture in China
1.3.3 Changing housing culture in Japan

1.4 The questions of study: the problem definition

1.5 Literature review

1.5.1 Previous studies review
1.5.1 Discussion and differentiation

1.6 Theoretical considerations

1.6.1 From the pre-requisites of the study towards a study methodology
1.6.2 The problem of domestic space and its association with social meaning
1.6.3 Change of housing culture seen through the formal transformation process
1.6.4 Floor plan morphology and graph theory
1.6.5 Space syntax: theoretical statement and critical evaluation
1.6.6 Summary and discussion

1.7 Structure of the argument and the layout of the study

1.8 Study morphology

1.1 Aims and motives

This study examines the modern house in the Far East Asia region(South Korea, Japan, and China) constructed in the twentieth century to show how an old living concept could have been instilled into a new domestic setting. The house reflects the values and needs of the people in a given society. In the natural progress of housing evolution, it tends to follow the changing needs of the people. However, in an unusual case, a new type of house is introduced by a small number of planners with an expectation to change the living style of the people. The modern houses developed in each region from the middle of the twentieth century can be an excellent example of this unusual case.

For hundreds of years, until the earlier period of the twentieth century, the housing form and culture in South Korea have been consistent with minor changes. After the Korean War(1950-1953), however, a fast and fundamental change was started. During the second half of the century, where the country's wholesale reconstruction was backed up by rapid economic growth, a massive amount of housing was constructed. It was complete with an unprecedented modernist design concept - thus cutting off the hundreds of years' consistency in-dwelling style. The modern type of housing that has been evolved in the west was suddenly transplanted to this Far Eastern region without much consideration. Consequently, this radical change has imposed tremendous pressure on the builders and dwellers; they had to adapt to the new type of modern dwelling that was not tested and evaluated before.

Similarly, Japan and China have experienced various social and economic changes; the rapid modernization, urbanization, and industrialization are influenced by tradition and culture while the role of housing and construction is undeniable. Consequently, the housing layout and traditional housing system underwent a fundamental transition (Kobyashi 2016, Hirayama and Ronald 2012, Ronal 2009, Soren and Okata 2010, Okata and Murayama 2011, Karan and Kristin 1997).

On the hidden side of this change, old spatial values started to operate in two ways. For the designers who were full of energy to renovate and thus enhance what they believed to be an ancient housing culture, these values were not something to be openly advocated; but at the unconscious level, their picture of the new house was deeply rooted in the image of the old house in which they grew up. For the dwellers who still carried the old domestic behavior,

the new house was, first, interpreted as a re-arrangement of the old house; they tried to map each of the old spaces to a new one. In this process, some of the new spaces were re-interpreted against the designers' will, and sometimes in extreme cases, the inhabitants tried to modify the house's structure.

Dealing with this unusual housing evolution process in the Far East Asia region(South Korea, Japan, and China), this thesis's whole argument has been designed to answer the question: ***how do old spatial values interact with a new domestic setting?***

1.2 Housing evoution : changing characteristics of domestic space in time

Environment implies what surrounds us; it can both allow and constrain our behaviors, and thus, in the long run, it imposes conditions that regulate and affect the way we live. When its properties are changed over time, it provides, perceptually and behaviourally, different spatial exploration. The environment can change us, but at the same time, it can be changed by us. Amongst all sorts of environments, which can be actively designed and modified by human beings, is the architectural environment.

Formal change in the architectural environment reflects social change; what is ordered and arranged in space by human intention mirrors the time's social minds. In return, the architectural environment regulates and orders human lives and thus re-generates society's cultural norms implicitly. Therefore, Hillier and Hanson (1984) denied the conventional view of the man-environment paradigm as it only sees the two as a static cause and effect relation. They contended that because, in this paradigm, the physical environment has no social content and society has no spatial content, it does not represent the real world where social implications are embedded in the spatial configuration and interact with human agents. In this study, following this line of thought, architectural space is interpreted as an essential source in which the makers' social minds are preserved and then interpreted by the space users as if reading a text or rather a book. Further discussion on this issue comes in the next section when the related literature is reviewed.

This studies tries to illuminate the changing domestic culture in housing. Containing small-scale social activities that are particular to a cultural setting, housing has served as a best and solid manifestation of a society that suggests many viewpoints from which its culture

can be interpreted. People change, their home-lives change, and so do their houses. In some societies, these changes occur slowly but in others very rapidly. Historically, the twentieth century was when these changes were made at an unpriced and, geographically, Far East Asia region(South Korea, Japan, and China), which can be regarded as having experienced one of the most radical changes. The changing nature of domestic space in time is regarded as an evolutionary process in this study. The most critical point in this conceptualization is that it is not the house as a thing alone from which the evolution is measured; it is the capability of a given society to generate houses that evolves. It would bring about an untidy merely copying the existing pattern with minor variations – thus making a steady heredity line of housing style. In contrast, in the industrialized modern world, many variations are made. Therefore, the trial and error process is going very fast; new materials and construction methods and new design styles are introduced to encourage designers to make more trials and, therefore, risk more errors. In an extreme case, such as the modern housing construction in the East Asia region(South Korea, Japan, and China) after world war II. A small number of planners designs the many new housing types in a short period - thus making the Darwinian evolution process extremely fast.

There is, however, one aspect of housing evolution that does not conform to the Darwinian analogy. In Darwinian evolution, variations are created randomly without purpose or meaning, but in housing evolution, they are created with designers' intention - thus, they have evolutionary direction in a Lamarckian sense as Steadman noted:

“Darwin's theory implied...that evolution was without direction, without any over-riding purpose or plan. The theory of Darwin, using Lederberg's terms, is an “elective' theory, where the environment chooses appropriate changes in organisms from the range offered by variation. Lamarckism is an 'instructive' theory, where the environment is imagined to be able to exercise a direct effect on organisms, and to “teach' them to change themselves in appropriate ways. It is the fact that cultural evolution is an ‘instructive process in an analogous sense which gives it its 'Lamarckian' characteristics.” (Steadman 1979, 187)

Even though there are some characteristics in cultural evolution that do not conform to biological evolution', this analogy is still useful in this research since it helps to capture the concept of the changing process of housing more effectively.

1.3 Changing housing culture

1.3.1 Changing housing culture in South Korea

At the beginning of the 20th century, Korea was a small country unknown to the world. Seoul was a small capital city of Korea. It was located above the Han River with 200 thousand population. The central area was surrounded by a Wall of the Joseon Dynasty(figure 1.1). Although the city had been the capital city for more than 500 years, the country's political and economic systems were maintained without much change under the rule of the Joseon Dynasty(1392-1910). They thus were not expecting the explosive growth for the rest of the country. This central place in the agricultural society started to change around 1900 when the country was forced to open its harbors by foreign forces, including Japan, the USA, China, and Great Britain(Lee 2001,33).

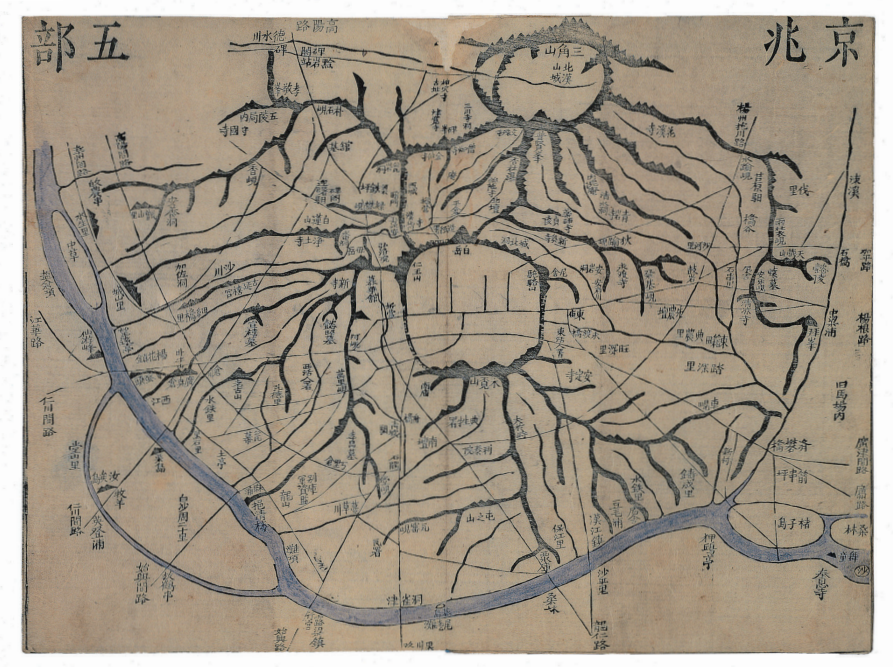


Figure 1.1 Old map of Seoul (seoul 2006, 21)

The western culture, which had not been experienced before, gradually influenced all aspects of society, and thus, the living environment was not the exception.

At this period, foreign settlements appeared within and around the city, the inter-city and intra-city railways were constructed, and the urban grid was renewed and expanded. Simultaneously, those western-style buildings like schools and hospitals, and train stations built in the city introduced a new architectural style and changed the built environment's existing concept. Around this time, electricity and running water began to be provided in the city for the first time. It also has direct and powerfully influenced the domestic environment of the houses. From 1910, when Korea was colonized by Japan, until the end of World War II in 1945, the city structure was planned and modified by the Japanese colonial government, and more Japanese settlements were built in the city, making the Japanese

house style more familiar to the public. In the meantime, the number of citizens kept growing to reach 400 thousand in 1935 and 1 million in1942. A growing number of foreign houses were built in the city during this colonization period; they were mainly Japanese houses and a comparatively small number of western-style houses. Built mainly by Japanese builders and western builders in their own style, these houses could hardly be the prototype from which Korea's traditional housing style was deeply affected. Some high-class houses adopted some features, but they did not have a critical impact on the housing culture. On the contrary, the Japanese gradually adopted Korean housing features, including Ondol, the traditional floor heating system, in their houses to adapt to the Korean climate. Korean people preferred the traditional courtyard house. Therefore, the real massive change in housing style starts from the middle of the 20th century when modern houses' mass development began(Son 2001).

One noticeable change in housing style in this colonial period is the development of the traditional urban house. It was a simplified type of traditional courtyard house developed by the private sector Korean builder to fit small urban plots. It was usually built in multiple numbers from 6 to 7 and sometimes 30 to 40(son, ibid, 241). From the 1930s to the 1960s, the urgent demand for houses by middle-class families was successfully alleviated by the city's compact. It was sometimes called the 'modified traditional houses' because it used new materials like bricks, glasses, and galvanized iron.

In 1941, the colonial government set up the 'Joseon Jutaeg Yeoungdan'(Chosun housing institute) for housing development. The government's first plan was to build 20 thousand homes in four years(5 thousand per year), but they ended up building 12,184 homes countrywide, including 4,488 in Seoul until the colonial regime's collapse due to the defeat in the War in 1945. The colonial house has meaning. It was the first generation of the modern house; however, it was not accepted as a favorable modern housing prototype because it intentionally adopted too many unfamiliar Japanese features to assimilate Korean people to Japanese culture. While the colonial house could not have much impact on the general public due to its limited quantity and heterogeneous style, it is assumed in this thesis that at least the layout pattern od the house, i.e. the two-row layout of rooms linked by a central corridor, has influenced Korean and planners. For them, it must have been thought of as an attractive suggestion for the new house they were about to plan in the following decades.

After Korea was liberated from the Japanese regime in 1945, soon there was a Korean War(1950-1953) dividing the country at the peninsula center. Even though the Japanese dwellers in the city went back to their country, the city's population was still growing fast.

Those Korean people who escaped the colonized country a while, and the refugees from the communist regime in the north were returning, accelerating urbanization speed. By the middle of the 50s, the population was already reaching 2 million.

From 1955, as housing deficiency became the most severe social issue, many public institutes, finance corporations, charity organizations, and the government started to participate in the public sector's housing supply. The primary funding source was from UNKRA(United Nation's Korean Reconstruction Agency), while minor funds were made by providing the government and other organizations. The public sector detached houses built by these parties were named in many different ways but were generally called 'gongyeung jutaek', which literally means 'prosperity housing.' By the end of 1961, the total number of public housing built in Seoul amounted to 17,137. The ICA houses funded by the Korea Industrial Bank were 6,487, and Buheung houses built by the Korea National Housing Corporation were 1,372(Seoul metropolitan government 1988). According to the national statistics in 1960, there were only 260,399 houses in Seoul, including the public housing, while there were already 447,089 households, 41.8% of housing the deficiency rate. This means that more than 180 thousand households were living in a rented room without their own houses. Therefore, the supply rate of public housing in this period could not meet the increasing demand. The public housing built in the 50s has an essential meaning in the history of housing development in Seoul.

Figure 1.2 Guro Residential district (http://photoarchives.seoul.go.kr)

Although its quantity was far below the city's growing housing demand, it suggested a new prototype for the modern house with its westernized spatial layout and thus affected and facilitated the subsequent housing development in the private sector. Besides, as the houses were mainly planned in the outskirts or unused parts of the city, the infrastructure could be expanded to allow more residential areas to be developed nearby. From the 60s that the systematic development of housing was started, compared to those in the 50s, bigger scale construction covering broad areas was executed based on the government's urban land use program.

Figure 1.3 Mapo Apartment Housing in 1962

(from KNHC 1970, 71)

Two different types of housing development should be noted in this period. First, more actively, KNHC initiated mass developments of housing(figure 1.2). For example, they built 30 thousand homes in the Hwagok area and 60 thousand in the Gaebong area, each as a single residential district. Second, from the middle of the 60s, the government began to think that it is ideal to build apartment houses in the city rather than detached houses to meet the growing housing demand. While there were no qualified developers and builders in the private sector who could build this new type of housing, the government and KNHC planned "Mapo apartment houses" in 1962 as a first scheme in the country that is based on a site planning concept whit multiple numbers of building blocks(figure 1.3).

From the 70s on, apartment housing gradually became the most popular dwelling type in the city. Tins housing type has made a primary contribution in supporting what has become a city of 10 million people. In 2000, there were already more than one million apartment units in the city, accommodating more than a third of the citizens.

However, on the other side of this success, criticisms come that it has created a monotonous living environment. The thin slab shape of the building, which is regarded as the best choice

for the highest density, became the typical form of housing all around the city and, one by one, residential areas turned into a town filled with the stereotyped concrete buildings without identity. Moreover, since this typical building shape has necessarily imposed similar unit layout patterns, it took away the change of for the customized design for different groups of people.

Apart from its evaluation for success or failure, it is true that the apartment house in Seoul has been accepted as the most preferred type of dwelling and the spatial layout of the plan effectively sustains the everyday lifestyle of the citizens. Through tests and trials in the 60s to 70s, a small number of typical plans have been selected and have become ubiquitous throughout the city. Therefore, in a broad sense. It can be said that domestic life at home in Seoul is relatively homogenous even in this post-modern world where all kinds of different values for life are coexisting. It can even be generalized that if the typical traditional courtyard house molded the ordinary home life in Korea until the middle of the twentieth century, now it is the typical apartment house that takes this formative role.

1.3.2 Changing housing culture in China

China is a country with a long history and large population. Big cities appeared early and, in feudal China, were mainly capitals or commercial and handicraft centers where land shortage and crowded living conditions were the two significant factors affecting housing. Because of the highly centralized rule of feudal dynasties, capitals were usually huge. Many big cities appeared during the Tang Dynasty (A.D. 618-907), boasting populations of several hundred thousand and propelled forward by booming commerce and flourishing handicraft industry. Chang's (today's Xi'an), the Tang Dynasty's capital, and Dongjing (today's Kaifeng), the capital of the Northern Song Dynasty, were huge, with populations of over one million. A typical urban problem such as overcrowded living and prevalence of fire and crime had already appeared, and, as a consequence, corresponding measures were taken to tackle them. At this time, traditional Chinese courtyard housing was a popular form that maintained privacy for families while also blending into the crowded urban environment.

However, by the mid-nineteenth century, fundamental social transformation forced urban housing development in China in a complicated direction. The period from 1840 to 1949 was a significant era in Chinese history. It was when China moved gradually from a feudal society

into what Mao Zedong defined as a semifinal and semi-colonial organization. Many urban developments were undertaken amid drastic political, economic, and social transformation, and urban housing first appeared in the modern sense. Moreover, it was different from traditional Chinese housing in almost all aspects, including investment and construction methods, layout, architectural forms, structure, and technology. After someone hundred years, these developments became a coagulated history, starting from initial formation and then going through prosperous times followed by a decline, an arc corresponding to China's social and economic development(figure 1.4).

During this period, China's urban housing modernizations proceeded in two directions, with the first based on traditional Chinese houses. As improvements were made to meet the new requirement, they gradually become incorporated into what became modernized urban housing. The second direction involved importing Western from housing and adapting them to the Chinese lifestyle with a particular large condition. China's social and economic development levels were also different, and there were different forms of housing in different regions.

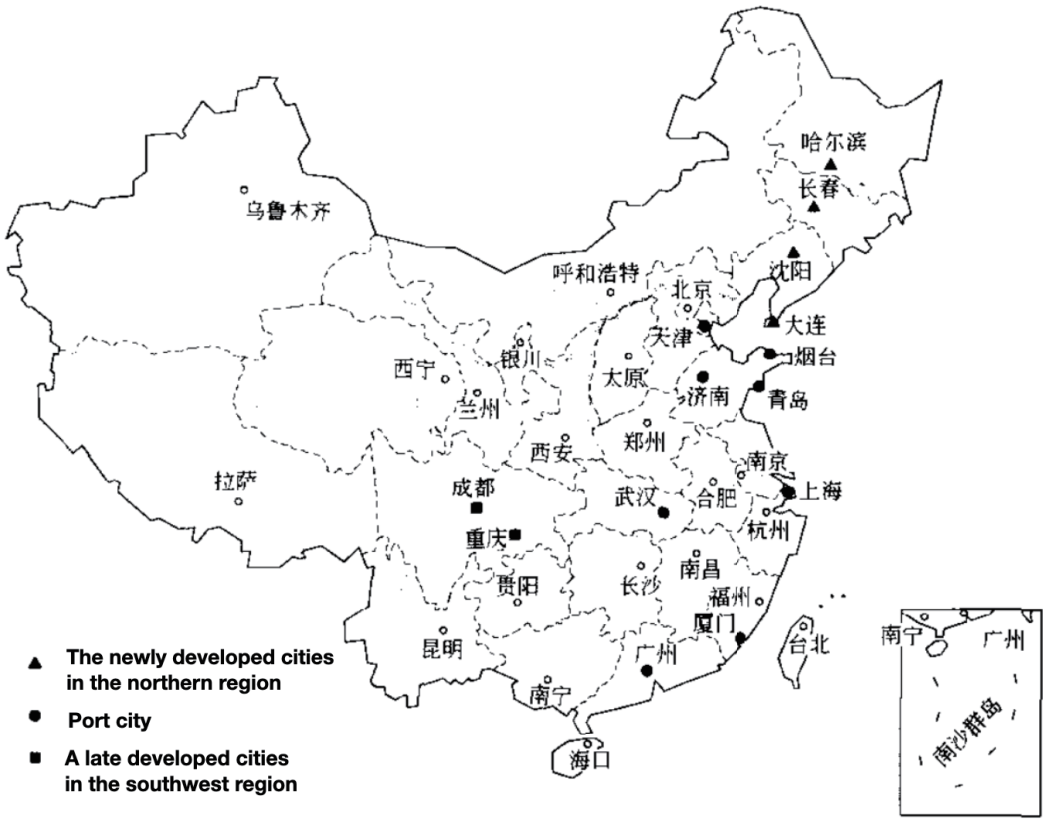


Figure 1.4 Cities where urban housing increased rapidly from 1840 to 1949

(reproduced from Lu Junhun 2001, 30)

The initial period of China's real estate business and modern urban housing development occurred from the mid-nineteenth century to the early twentieth century. The Opium War from 1840 to 1842 was a turning point when China began to change into a semi-colonial and semi-feudal society. As feudal economic structures disintegrated along with the invasion of foreign capitalism and the emergence of a Chinese capitalist economy, the seep of growth was rapid in a particular city, particularly the trading ports. The population concentration in these cities created an urgent demand for urban housing different from the last time. As a result, real estate businesses flourished, and urban housing became commercialized and market-oriented, in direct contrast to the traditional development model, where each household built its own house according to its circumstances. Over time, sizeable urban housing areas were developed by real estate developers, either for rent or for sale, and entirely new urban housing types emerged.

In particular, the shikumen Linong housing in Shanghai and the courtyard Linong house in the north were representatives of this period. They were outgrowths of a traditional house with features added to cater to people's new demands. Besides, collateral improvements, represented by urban infrastructure and management progress, reflected changes in lifestyle and progress in architectural technology. This housing also conformed to feudal etiquette, traditional philosophy, the prevailing city environment, and available construction technology, and it was reasonable and practical.

From early in the 20th century until 1937, before the outbreak of the War of Resistance against Japan, Western powers stepped up their military and economic aggression against China. During this time. China's national industry and commerce also developed, as trading port cities and industrial and commercial cities in inland areas entered a period of stable prosperity. It was also the peak period in the early development of China's city construction and urban housing development, with distinctive features including diversified means of investment in housing development, enriched housing forms, and rapid progress in building technology.

In short, there were different kinds of housing developers, as real estate developers invested in residential construction of varied quality. Specific factories and enterprises also built houses for their employees, and the city government became involved in housing development to solve love particular housing problem. In terms of housing form, old-style Linong housing was still being built, and there were various other kinds of housing with different local features. In the meantime, Western housing types were introduced to China in the form of detached houses, apartment buildings, and houses with gardens. Generally, these first appeared in the concessions of trading port cities before gradually spreading to

other cities. Simultaneously, Russian-style and Japanese-style detached houses, apartment buildings, and open-corridor houses were built, along with the development of the railway in northeast China. Progress in building technology was embodied in improvements to internal facilities, employment of new materials and construction techniques, increases in the number of stories in buildings, and, in particular, the appearance of high-rise buildings.

After 1937, China entered the War of Resistance against Japan and the War of Liberation. Although many cities' population increased, all city construction and housing development stopped, except for one or two places such as Chongqing. Almost uniformly, urban housing conditions worsened. In summary, during the one hundred years of China's embarkation along the road of modernization, urban housing gradually grew out of traditional forms. It evolved into new, diversified housing with distinctive Chinese elements. Influenced by many factors, the general trend as follows. First, closed courtyard houses suitable for large traditional families were replaced by smaller but open housing satiable for the modern, small-sized families. Second, considerable progress was made in architectural technology and building materials. Third, internal facilities and outside environments were modernized. Finally, architectural styles were diversified.

After establishing the People's Republic of China, socialist public ownership within a planned economy was established. By acquiring privately owned houses and developing public properties, most urban housing gradually becomes publicly owned. Between 1949 and 1978, China's urban housing development was always constrained and influenced by the State's industrial development policies, which gave priority to heavy industry. Throughout, the State adopted a strategy of high accumulation and low consumption to guarantee large sustainable investments for heavy industry. Consequently, a dual social and economic structure was shaped in both the cities and countryside, with rules and regulations concerning urban resident's salaries, welfare, and household registration. This system, in turn, effectively constituted the basis of urban housing development. Guided by the principle of "serving production as well as people's livelihood," industrial production preconditioned housing development intending to meet basic residential needs while giving priority to industrial development.

Urban the socialist planned economy, China developed a complicated urban housing welfare system. The State kept control of housing development and readjusted policies in the light of situations reflected in the national economy. This system divided urban residents into different categories and imposed control over them. As a result, people whose work units were of different ownership -implying a different social status- ended up living in

different housing conditions. With this system, two types of housing also appeared in the city; houses managed by enterprises or institutions and publicly owned houses managed by urban housing management departments of local governments. Furthermore, both had a profound influence on the formation of the cityscape.

The state policy of "production first and livelihood second" kept urban housing standards low. As far as planning and design were concerned, the objective was to keep housing construction costs and standards of a provision under control. To develop rapidly, the state propagated standard designs for housing. However, although industrialization of housing was an objective of this approach, it did not make progress, being restricted by general levels of economic and industrial development and less than favorable levels of investment. Industrialized housing did not advance much beyond brick and concrete structures with a low technological involvement level during thirty years. Moreover, because of active state involvement, urban housing development -including planning and design- was only able to progress when the national economy was prosperous. When the national economy met with difficulties, housing development slumped accordingly. Generally, a housing development in this period can be divided into three stages. The first was from 1945 to 1957, corresponding to the first Five-Year Plan, when the national economy recovered. It was a time of stable and normal urban development in China when the investment level in housing was about 10 percent of the total investment in capital construction. The housing systems, designs, and technical standards provided the foundation for housing development for the next thirty years. In the early days of the Peoples' Republic of China, massive housing construction began to ease housing shortages.

As the First Five-Year Plan was put into practice, the emphasis shifted towards production, supported by building standards, design methods, and industrial procedures introduced from the Soviet Union. In the later period of the First Five Year Plan, the adverse effects of unbalanced industrial development emerged. Under the state policy of "production first, livelihood second," housing construction standards dropped for the first time. Subsequently, in an attempt to seek a mode of housing construction that suited China's situation, the Central Party Committee(CPC) put forward the policy of "let a hundred flowers blossom and a hundred schools of thought contend." Encouraged by this, architects and resident's living habits. Aesthetic issues became less important, and the controversy over socialist realism and functionalism was brushed aside in favor of a more pragmatic attitude. Unfortunately, however, all of this resulted in poor housing design for a long time to come. The second stage lasted from 1958 to 1965, beginning with the Great Leap Forward and followed by readjustment and the national economy's rectification. These ups and downs in political and

economic development also caused jolts in housing development. The Great Leap Forward and the People's Commune Movement resulted in a severe imbalance in the national economy structure, and housing development was sacrificed. Investment in housing development dropped sharply, and housing construction standards declined to the lowest level since the People's Republic's founding. To practice, the tough economy became the prevailing principle, as the critical problem was how to cut costs.

Meanwhile, strongly influenced by ideology, the People's Commune Movement appeared in cities, albeit for a brief period, and from 1961, economic readjustment and rectification occurred, enhancing urban housing development. Influenced by an atmosphere conducive to research, insightful ideas about housing design were expressed; discussions about housing layout promoted research and development of small apartment buildings and the diversified design of residential areas. However, as leftist ideology gained ground again, the idea that "thrifty was revolutionary" became predominant in housing circles.
The third stage lasted from 1966 to 1978, covering the Cultural Revolution and its immediate aftermath. The political turmoil sweeping the whole country did devastating damage to China's social, political, and economic development. The result was that housing development stopped and did not recover again until the 1970s. Population growth and backward agricultural practices forced the state to impose strict control over land use to guarantee grain production, and land shortages in cities hindered housing development. To keep city size from expanding and to save the land, high-rise building was encouraged by the state, while the general building density of residential areas was increased.

Although housing development turned out for the better during the later period of the Cultural Revolution, the leftist idea of taking class struggle as a critical component was not brought to an end. Instead, its influence lasted until 1978. Then a crumbling economic situation, a virtual standstill in housing development, and a swelling population created severe housing shortages, and reform became inevitable.

There was no lack of ups and downs in housing development during the period of reform and opening-up. However, compared with the period before the Cultural Revolution, the general development was more continuous and steady, which largely could be attributed to stable policies in social and economic development. Although housing development itself did not display clear-cut stages during this period, this exposition is based on the time-frame of social, economic, and political change to reveal better internal relations with housing policy and production.

In 1979, China entered a period of sustained and rapid development, with reform and opening-up to the outside world as the guiding policy. In the twenty-two years, from 1978 to 2000, China made significant progress in understanding socialism and a socialist economy, and this progress can be divided into their phases. First, the Third Plenary Session of the Eleventh Party Central Committee, held in December 1978, guided by the policy of emancipating the mind and seeking truth from facts, produced a shift in the party and state focus from class struggle to socialist modernization. Against this political background, people began to re-examine the numerous problems in the planned economy -established under the strong influence of the former Soviet Union- and began to explore an economic system suitable for China's national conditions. Second, at the end of 1984, the Third Plenary Session of the Twelfth Party Central Committee made clear the policy of building a planned commodity economy based on public ownership. It represented a new understanding by the Communist Party about the commodity. It changed the ideology toward establishing a planned economy with a commodity economy, even though the ideological issues involved remained a focal point of discussion and controversy. Third, in 1992, the late Chinese leader Deng Xiaoping made a creative ideological break-through regarding issues that had long been disputed and affected economic development. Essentially, Deng defined the nature of socialism as "to unfetter and develop the productive forces," and later on, the Fourteenth National Congress of CPC explicitly advocated building a socialist market economy with Chinese characteristics.

After numerous debates, adjustments, and experiments, a market economy has returned to China, including real estate development, albeit in evolving socialist form. Sharp rises in relative income for many, together with external events, like the Southeast Asian economic crises of 1997, have pushed the state to adopt a posture of encouraging individual housing. Now, with widening gaps in personal income and housing opportunity, a diversity of housing has appeared once more in China, although, for reasons of land and other economic constraints, primarily confined to multi-story and high-rise buildings in burgeoning urban areas. From around 1985 onwards, apartment-style living, with a full complement the evolution, as it were, of the modern dwelling. Today, China faces many of the same housing problems encountered elsewhere in the developed and developing world. With many similar market mechanisms and institutional programs of catch-up and accommodating the rapidly rising future urban population increases. Nevertheless, like most if not all nation-states, its future in housing also belongs in its past. There, one finds some very distinctive episodes of broader interest and features that seem to have persisted despite China's chaotic and inconsistent pattern of modernization.

1.3.3 Changing housing culture in Japan

Over time, Japan has experienced a various range of social-economic changes, rapid modernization, urbanization, and industrialization are influenced by bu tradition and culture, while the role of Housing and construction is undeniable. Consequently, the housing layout and traditional housing system in Japan was undergoing a fundamental transition.

The year 1868 marks the Maiji restoration and is known as the beginning of rapid modernization and urbanization in Japan. Japanese house designs have changed over the last decades while maintaining some traditional features. By the late 19th century, the traditional elements of Japanese Housing had developed(Nakagwa, 2002) and continued to be transformed into Japan's modern era. In the Meiji era, the new social classes have emerged due to industrialization and economic development, such as salarymen, teachers, civil servants, soldiers, bank clerks, etc. Salaryman starts working for private and public offices and receiving monthly salaries. Work was separate from the home, making their lifestyles utterly different from the farmers and merchants(Kobayashii 2010, Aoki 1982, Suzuki 1988).

Japan became divided into an upper class of business executives and high-status public servants and a lower-class of workers and daily laborers. It is a shift in the middle class's composition from disbanded samurai and successful merchants to white color employed salarymen. At the same time, Housing for the new class has emerged, such as; "Interior corridor houses," "Living room central house," and "Apartment house." The roots of the modern Japanese houses are in the homes of the lower-middle-class samurai. (Kobayashi 2010)

In the 1910s, world war I caused the first step of industrialization, therefore, a vast number of workers moved to cities, and the population concentration was Tokyo and other cities. For the first time in Japan and as a step toward modern housing policy and planning, modern city planning and construction systems were established to deal with overcrowded residential areas without sufficient amenities. By involving in world war II in the 1930s, the housing standards bought down(Housing Bureau 1988) By involving in world war II in the 1930s, the housing standards bought down(Housing Bureau 1988)

After world war II, Western-style building construction and metatarsal were integrated and

mixed with traditional Japanese house elements. In 1950 the building standard law as a general law that applies to all buildings throughout Japan was enacted to protect Japanese people's life, health and property by supplying minimum standards concerning the site, construction, equipment, and building usage(Tomohiro 2013). The housing system in Japan, which formed after the Second World War, was based on a modern family norm that led to the overwhelming provision of Housing for 'standard families,' consisting of an employed husband, a homemaker wife, and two children. The dwelling type denoted 'n-DK,' which is composed of multiple separate bedrooms, their number expressed by 'n,' with dining kitchen (DK), was introduced in the early 1950s as a modern Japanese dwelling form and expanded in response to increasing housing demands at the time. Between the 1950s to 1970s, the Housing layout was transformed from a traditional wooden house to a more modern and westernized type.

In the 1950s, to cope with a severe shortage of housing and supply low-cost housing, the initial approach in housing policies was quantitative (Kobayshi 2016, Noghuchi and Poterbal 1994); mass housing was a suitable solution. The Japan government constructed public housing complexes which called 'danchi' Danchi are a large group of concrete structure building with specific design for multi-family Housing. Besides that, following rapid economic growth and internationalization, a large number of people from inner-city areas moved to cities and suburbs where danchi were built to answer the needs of Housing. Furthermore, the demand for electrical goods rose that was more suitable for modern residential buildings. Besides, many wooden tenement houses were also built to meet the housing demand. The dwelling area was tiny, and all necessary amenities such as toilets, shower, and kitchen were located outside of the building. During the period, the construction of these wooden houses was five times more than RC apartments.

With rapid economic growth during the 1960s, the Japan housing corporation was founded due to progressive urbanization that led to the housing shortage. The mass housing results in modern society and a new lifestyle with improvements in living standards. The development of mansion condominium housing(a single building subdivided among the large numbers of owners) and low rise building in high densely residential areas that inherited the modern style houses was carried out in that period, and in 1962 the condominium law was enacted, and private developers had a prominent role in developing condominiums. As fast growth continued, the land price rose. The tendency in medium-rise and high-rise buildings followed by social problems and the unfavorable impact was surrounding areas, such as building shadows and blocking sunlight. As a consequence of high land prices, housing development head to suburb areas, and detached houses

become permanent. Japan experienced stable economic growth in the 1970s, and the primary concern in housing shifted from quantity to quality to improve the housing and living environments. Private rental houses become popular, which has a bathroom and kitchen inside the building and contributed to housing quality improvements. Traditional wooden houses were demolished to use prefabricated construction techniques to reflect the international style of houses, and also the production of semi-detached and low-rise houses became dominant. The construction of high rise buildings in the late 1970s contributed to difficulties in purchasing houses and preparing a dwelling with affordable. Also, the number of private rental houses with wooden or concrete structures went up after the 1980s. Besides, the end of the 1980s economic bubble's implosion resulted in a decline in the housing market since the early 1990s.

By the first of the twenty-first century, the housing market in Japan experienced a tremendous decrease. As a result of a decline in housing demand, large-scale housing is not favorable anymore. The post-war style of housing has already been broken up, and the new form of housing layout and types are shaping, and enhancement of the quality of houses has become an essential part of housing policies. The emphasis is now on improving the quality of residential life and especially the residential environment.

1.4 The questions of study : the problem definition

This study examines the changing housing in Korea, China, and Japan with a question: ***how do old spatial values interact with a new domestic setting?*** This general question can be more effectively answered by splitting it into three specific sub-questions: first, *how is old spatial organization mapped onto a new setting that is formally and functionally different?*; second*, how is an old conceptual dimension in space transferred through a transformation process?*. third, *How is the difference in the spatial composition of the domestic setting in each country?* The previous section described that change of housing style and tendency in the city was initiated by a small number of planners, developers, and government departments in a short time after the Wars(The opium war, World War II, Korean War, etc). Since many housing developments were assisted by foreign aid, including funds and human resources mainly from the Western countries, these planners could have a reasonable chance, for the first time, to learn western-style housing. In Korea, efforts were made to generate new housing plans, combining their real experience of the

existing housing types, i.e., the traditional courtyard house and the colonial house, and their indirect experience from the imported architectural references to modern housing. In China, efforts were made to generate new housing plans, combining their real experience of the existing housing types, i.e., the traditional courtyard house, and their indirect experience from the imported architectural references to modern housing. In Japan, efforts were made to generate new housing plans, combining their real experience of the existing housing types, i.e., the traditional Mid-Level Samurai House, and their indirect experience from the imported architectural references to modern housing. This particular setting caused the highest degree of change in the middle of the twentieth century in each country within the long process of housing evolution in the city. In other words, it was the point in time where the old and new values collide most fiercely. Even though most of the city's houses were still remaining as before in their traditional forms, builders' and designers' 'architectural competence' in Glassie's term was moving fast to the next phase of design evolution. Therefore, it was now the citizens' turn to change their domestic space concept and adapt themselves to the new house that would soon be the standard type of dwelling. Both for the designers and the citizens, the new house, with its unprecedented spatial layout, demands a change of thinking. Hence, the big question of this study comes: ***how do old spatial values interact with a new domestic setting?***

To investigate the interaction of these two heterogeneous ideas, i.e., the old spatial values and the new domestic setting. It is needed to translate the amorphous concept of 'the old spatial values' into a material entity – the old domestic setting. The next step is to compare these two to find out the clue that would explain how one is transmitted to the other. In this respect, the big question of the thesis can be more precisely modulated to become the first sub-question: ***how is an old spatial organisation mapped onto a new setting that is formally and functionally different?***

When people move from one house to another, they have to adapt to the new environment. It is not only their material belongings that need to be redistributed into the new space; their living pattern, which includes all kinds of everyday activities. It needs to find proper ways to be accommodated in the new environment in such a way as to maintain the same or an adapted way of domestic living. Suppose the old and new houses share the same design style and thus have similar spatial layouts. The job would be simple and straightforward; by mapping each functional space of the new house to that of the old one, materials and activities can be easily categorized in the same manner as they were in the old house.On the other hand, if the old and new houses do not share any style and thus have fundamentally different internal space arrangement types, it is impossible to make a one-to-one mapping

of functional spaces. In this case, inhabitants have to find a new way to decompose their materials and activities and then redistribute, as happened in each countryin the 50s and 60s.

The second sub-question above is answered by examining the "space-behaviors" interaction based on this conceptual frame. The house reflects the ideal of a given society. It is not a simple mechanical device where necessary functions are allocated practically into divided sections efficiently. Instead, it is a cultural manifestation where the meanings and values of the time pervade. It is also a mythical place where all kinds of symbolic dimensions exist: male/female, divine/secular, non-polluted/polluted, inside/outside, family living space/reception, Senior generation / younger generation space, etc. In this conceptual perspective, domestic space is not symmetrical; it integrates asymmetrically distributed spatial significances in which different symbolic qualities are co-present. Thus, the second sub-question is asked to deal with this particular issue: ***how is an old conceptual dimension in space transferred through a transformation process?***

The third sub-question above is answered by examining the factors that cause differences in spatial composition. The three countries in East Asia belong to similar cultures and have influenced each other for a long time. Different symbolic characteristics coexist in the house, which is expressed in asymmetrically distributed spatial composition. The asymmetrical spatial composition has a unique distribution that can identify each country's elements. Through comparison of these factors, it is possible to clarify the commonalities and differences of houses in each country. Thus, the third sub-question is asked to deal with this particular issue: ***how is the difference in the spatial composition of the domestic setting in each country?***

1.5 Literature review

The living environment is an essential element of architecture, and research continues in various fields. The field of research dealing with the living environment has a broad and diverse range of relevance. It is mainly studied in almost all fields of sociology, humanities, and environmental design. Anthropology, psychology, sociology, geography, history, economics, urban planning, architecture, Etc., are representative research fields and show different research results.

Therefore, there is a limit to reviewing all of the broad research fields. Therefore, there is a need to classify research fields based on research methods and targets. The existing studies related to this study are divided into three categories: first, a study on transformations of urban housing based on Typological perspective. Second, a study on transformations of urban housing based on Culture-Anthropological perspective. Third, it is a comparative study on the transformations of urban housing between Korea, China, and Japan. This section reviews each country's existing literature on housing evolution and establishes a beneficial direction for this study.

1.5.1 Previous studies review

Typological research is a traditional method of studying houses and aims to extract typical types from various changes. Besides, to track changes in the building's physical configuration, it analyzes the area, Building structure, and combination patterns of functions.

In Korea's research case, Joo (1965) classifies the types of houses from the Goryeo Dynasty to the Joseon Dynasty in "*A Study on the Change and Development of Korean Housing*," It was Considering the changed elements based on the decorative aspects of houses and the structure of buildings. In particular, space is classified by categorizing the floor type (ondol, wooden floor, earthen floor). Besides, in 1971 "*A Study on the Architectural History of Korean Housing from Last years of Yi-Dynasty to A.D 1945*", it is classified based on the building structure and decorative elements of high-class, middle-class, and low-class housing. Kim (1984) analyzed the changing process of functional combination patterns of

detached houses in Seoul in the 1945-the 1980s in "*A Study on the Transition of Floor Plan Composition of Eclectic House in Korea*." Detached houses in the 1950s had a traditional composition, and in the 1960s, they changed to a Korean-Japanese eclectic style (living room-kitchen). It is described that detached houses transformed it into an "L + DK" type and tow-story house in 1970.

Koh (1985) investigated the change of detached houses in Seoul in the 1960s and 1980s in "*A Study on the Transition of Ordinary Detached Houses in Seoul.*" The layout of the building, the floor plan, and the elevation are essential factors to establish the analysis criteria. The results of the research are as follows; a) The traditional courtyard space gradually reduced and the function changed to a garden after 1970, b) In terms of the functional aspect of the area, the conventional Maru changed to a Western-style living room, c) The location relationship between the kitchen and the master room changed. Besides, it points out the characteristic that the same functional pattern is repeatedly used in the transition of the floor plan. This is the middle class's economic cause and the conscious characteristic of securing space for rental, as described in the results.

Song (1988) newly recognized the improved Hanok built in urban areas between 193 and 1960 as a type of modern urban housing in *"A study on the types of urban traditional housing in Seoul from 1930 to 1960"*. Explain that traditional Hanok evolves while forming interrelationships with modern urban organizations. It is argued that urban Hanok has the meaning of a critical plan that connects traditional and contemporary houses. Analyze the shape and arrangement pattern of the improved Hanok to explain the difference from the conventional Hanok. In the process of constructing a traditional Hanok in a narrow urban area, many parts were omitted, and space was rearranged. In particular, since all rooms are arranged around one courtyard, the isolation is increased. Besides, a double-layer gate building that controls entry from the outside is being emphasized. Yim (1988) analyzed Korean urban dwellings' typological changes in *"A Study on typological continulty and change of Single-detached urban dwellings in Korea."* The explanation is divided into three periods, focusing on the house's functional spatial composition and elevation; a) one-story house construction period, b) transition period, c) tow-story house construction period.

Lee (1997) analyzed the process of residential floor space changes due to conversion of fuel supplied to houses in *"A Study on the Transformation Process of Urban Dwelling Space-Focused on the Change by Conversion of Domestic Fuel."* The Researcher collected the floor plan of detached houses and row houses for each period, and surveys were conducted in response to temporal changes through interviews with residents. As a result of the investigation, the difference in the fuel used for heating and cooking points out space in

each house as the leading cause of the change. In particular, it describes that the structure that physically connects the main bedroom and the kitchen has been removed by dividing the type of fuel used for heating and cooking so that DK and LDK-type houses have settled in Korea. Choi (1996) analyzed the unit floor plan of apartments built in the metropolitan area from 1960 to mid-1990 in ***"Changes in Residential Lifestyles in the Contemporary Korean Society in the Context of the Changes in the 3LDK Apartment Unit Plans in the Metropolitan"***. The results indicate the following : corridor-type apartment building layout is no longer used in the 1990s and this suggests that now the Koreans seek privacy from neighboring units instead of social interaction with them ; the number of new prototype for 3LDK apartment units developed per each year is increasing, and the space layout patterns originally developed for 4LDK units are now fully adapted to 3LDK units, both of which suggest that the Koreans began to consider not only the quantity of their residential space but also the quality; layout changes in the kitchen / dining area indicate that the traditional role and relative position of women have changed to being more or less equal with those of men ; and finally, layout changes in the bedrooms demonstrate that the Western concept of bedroom was initially set into the Korean apartments, but as time goes on, the traditional concept of bedroom which embraces both private sleeping quarter and public familial living quarter has taken in.

Kim (1992a, 1992b, 1992c) presents a chronological analysis in ***"Inflexible Patterns of Apartment Unit Plan (Part 1, 2, 3)***". The study sampled more than 1,000 designs that have been built in the private sector in the Seoul metropolitan area from 1973 to 1990. Focusing on spatial composition and architectural design of apartment housing units constructed by the private sector, this research aims to analyze characteristics and clarify their trends of the plans by construction year and unit net area. Analyzing the built year of unit plans and locational characteristics of spatial composition, we grouped them into seven. Among the groups' trends, the first trend we can indicate is that spatial composition seems to be determined by access type. The second is that little variations of current spatial composition are likely to lead to a monotonous living life since there are a few basic and diverse unit plans of each group. Finally, increasing the area of units tends to increase the number of rooms or enlarge each room, failing to create unique unit plans for the area.

Part 2 research aims to review planning trends and progress of apartment unit plans used in Korea national Housing Corporation by investigating the spatial composition and architectural planning characteristics of the unit plans. Using the plans of 16.1 to 171 square meters built between 1962 and 1990, we attempted to categorize them in terms of unit net area, built year, spatial composition, access type, and apartments' bay. Based on the categorization, several aspects were analyzed. They included architectural planning

characteristics, emergence periods, and ranges of its distribution. The apartments built by Korea National Housing Corporation for thirty years were classified into seven types. One of the findings was that unit plans and spatial composition of each type by unit area is invariable regardless of time. The unit plans showed specific uniform trends concerning room arrangement and spatial composition in each period, which would lead to a fixed pattern in the future.

Part 3 research utilizes a qualitative, chronological analysis of almost all design samples built in Seoul and five metropolitan new towns between 1962 and 1990. The study goal is to identify whether there are historical consistencies and patterns in the designs. A critical study finding is that most of the builders and designers in both design patterns are clearly identified that have adopted consistently (temporal) and ubiquitously (geographical). Some considerations are made and presented regarding these unchanged design patterns, such as the most parsimonious design in economic terms.

Choi (1986) analyzed the living room space of the unit floor plan of an apartment house, constructed by Korean Housing Corporation during 1970-1980 in Seoul in ***"A Study on the Living Room Space of Unit Floor Plan of Apartment House."*** This study aims to grasp the flow of living room space composition and suggest future living room type trends that are convenient to dwellers in apartment houses.

The 54types of unit floor plans were analyzed. The results of the study are summarized as follows.1.LDK type was the most frequent one in the case of below 25pyung apartment house, and L type, in over 26pyung.2.8 unit floor plans had living room space below 15m2(the minimum space of living room) among 54, The property of living room space was 22.61% in the case of below 25pyung apartment house, and 23.66% in over 26pyung.3.The type of living room has been changed L type to LDK type. The type of LDK is more prevalent in latter period(1976-1980) than the former(1970-1975)4. The living room area properties between the latter and former period were not so different much.5. The living room's most popular arrangement was "Hall-type" that living room is located in the center of the house.6.LD type seems better than L or LDK type for the Korean lifestyle.

In the case of Japanese studies, Toshiaki Ooka (1994, 1996, 1997, 1998a, 1998b, 1999a, 1999b) investigated the "samurai houses," which can be considered the origin of the urbane detached houses of Japanese cities. in ***"A study on the principle of planning in the urban detached house (Part 1, 2, 3, 4, 5, 6, 7)."*** Part 1 results can be summarized as follows; (1) Zashiki is facing the entrance of the grounds how matter which direction (2) This planning is

generally seen in many feudal clans (3) These houses are open to all directions keeping the continuity between the houses and gardens. This is hugely different from modern houses, which are relatively closed to the surroundings. Part 2 study investigated the arrangement of houses and rooms of independent urban residences built from the Meiji Era in Fukuoka city. Conclusions: a) The houses and rooms of samurai residences of Fukuoka-clan have been arranged in a "front-facing" style. Two zashiki-room (front and back) have been arranged in tandem. b) Urban independent residences in Fukuoka city from the Meiji Era through the Shouwa Era before world war II had zashiki-room facing the same direction as the front entrance of the land independent of its direction. Besides, these houses inherit the characteristics of the samurai houses. Part 3 study investigated the changes and developments of the arrangement of houses and rooms of independent urban residences built after World War II in Fukuoka City. Conclusions; It was during the post-War Showa Period when the "front-facing style" had been replaced by a new one. The old principle originated in Edo Era's samurai residences, lasted through the Meiji and Taisho Eras until right before World War II. The process of this change was quick. The new principle characterized by "a style that respects south-facing" is the root of these days' housing plan. Zashiki rooms, which used to face the north due to the north entrance of the house designed according to the "front facing principfront-facingo the south which used to be the family space. The idea underlying this change was the house planning principle that respects south facing.

Part 4 study investigated the change of the housing plan from samurai houses to independent urban residences, from the Meiji to Showa eras (before world war II). We aimed to clarify the succession and the modification of the "front-facing principle," the primary factor underlying the modification, and the modification time. Conclusions; (1) The "zashiki" rooms of samurai houses in the Tsuyama feudal clan faced the front entrance of the land following the so-called "front-facing principle." Besides, there was a ground plan unique to the Tsuyama feudal Clan. (2) This "front-facing principle" and Tsuyama's unique ground plan have been succeeded by matching plan of independent urban residences build after the Meiji Era, that is, south-facing "zashiki" on south-facing land and north-facing "zashiki" on north-facing land. (3) However, south-facing "zashiki" rooms on the north-facing lands emerged in the Taisho and early Showa eras. (4) The lateral arrangement of "zashiki" rooms in samurai houses shifted to the Meiji Era's tandem arrangement. Part 5 study investigated the change of the housing plan from samurai houses to independent urban residences, from the Meiji to Showa eras (before world war II). He aimed to clarify the succession and the modification of the "front-facing principle," the primary factor underlying the modification, and the modification time. Conclusions; The "zashiki" rooms of samurai houses in the

Hirosaki feudal clan faced the front entrance of the land following the so-called "front-facing principle." Besides, there was a ground plan unique to the Hirosaki feudal Clan. This "front-facing principle" and Hirosaki's unique ground plan have been succeeded by matching the plan of independent urban residences build after the Meiji Era. That is south facing "zashiki" on south-facing land and north-facing "zashiki on north-facing land. South facing "zashiki" rooms on the north-facing lands, however, emerged in the early Showa eras. Part 6 study investigated the change of the housing plan from samurai houses to independent urban residences, from the Meiji to Showa eras (before world war II). We aimed to clarify the succession and the modification of the "front-facing principle," the primary factor underlying the modification, and the modification time. Conclusions; a) The principle of samurai houses in the Kanazawa feudal clan differed depending on the position in the samurai society's hierarchy. Large middle-class houses take the so-called "front-facing principle" with "zashiki" rooms facing the land's front entrance. Small houses of the lower class, on the other hand, take the so-called "back facing principle" with "zashiki" rooms facing the backside of the land. b) Little is succeded from There is little advantage in the "front-facing principle in the planning of large urban independent residences built in and after the Meiji Era. The "front-facing principle" has changed into the "back facing principle" with "zashiki" rooms facing the backside of the land during the era of Meiji and Taisho. South-facing zashiki for the houses with north entrance and north-facing zashiki for the houses with the south entrance. Despite these changes of "zashiki" rooms in location, the houses' fondness and openness are well conserved.

In part 7 study, Modern detached urban residences embody principles that respect Facing south too much the samurai; houses and detached urban residences in. After the Meiji era differed very much from today's houses, the principle must have changed sometime after the Meiji era. The problem was what caused this change and what was the historical background for it. In the present study, we focus our discussion on this point. Modernist thoughts on house planning have been strongly influenced by modernism, following the Western-style Meiji era was the primary cause of the change of principle. One of the criticisms made in the Taisho era, for example, was that old conventional houses were built, giving too much consideration to the guests. Consequently, living rooms for the family were neglected. One of the criticisms points out that guest rooms occupied the house's best position, and the living rooms were pushed away to the north side. However, we found that more than half of the houses investigated had living rooms on the southern side of the houses, indicating that the criticism mentioned above is incorrect.

Hiroki Yuasa (2013) aims to clarify the periodical change of planning on the detached house

in *"PERIODICAL COMPARISON OF PLANNING ON THE DETACHED HOUSE IN THE TERM OF DIVERSIFICATION"*. The data were collected three times in the 1980s, the 2000's and the 2008's by fliers of the newspaper. Conclusions are four points described below. a) Standardization in the combination of the number of rooms and enlargement of the common room. b) Popularization of the "Center-Living Room" plan-type. c) Remarkable decrease of Zashiki and the change of role of Tatami-room. d) Standardization to the plan-type of kitchen separated. As a result, the planning of a detached house in Japan tends to be standardized in the term of diversification.

Shoji Sumita (1983) investigated the plan configuration of detached houses in ***"Locality of modern housing."*** Conclusions are four points described below. a) The metropolitan area was settled as LDK type, local area as Tsuzukiaima type, and rural area as 田 type. b) It is pointed out as the cause of the nationwide spread of Tsuzukiaima typ's housing, as a transitional character in which the influence of urbanization across Japan and Ima's expansion and the value of preservation of Tsuzukiaima conflict. c) In Hokkaido and Okinawa, Ima-centered houses dominate the majority, making the region its own residential culture.

Nobuaki Morimoto (1993a, 1993b) analyzed the relationship between LDK space and Zashiki composition based on the area level in *“LOCALITY OF HOUSING PLAN CLASSIFIED BY ARRANGEMENTS OF LIVING ROOM, DINING ROOM, AND JAPANESE CONNECTING ROOMS: Planning type of detached houses loaned. by HLC (Part 1, 2).”* Conclusions are points described below. a) As the total area increases, there is a tendency to differentiate the space, and the DK type exists to some extent regardless of the total area. b) For tatami rooms, there are many cases where at least one room is secured on the first floor and Tokonoma is installed. c) Describe that the Tsutsukima type tends to increase as the total floor area increases.

Wei Yuan (2012) collects and analyzes data from 1980 to 2005 for Iwate, Fukushima, and Oita regions in *“A STUDY ON THE FLOOR PLAN TREND OF THE NEWLY-BUILT HOUSES SEEN ON THE ADVERTISEMENT IN NEWSPAPERS.”* Conclusions are points described below. a) It aims for the unification and continuation of the living room and the Tatami room, b) The form of concentrating the internal flow around the living room is increasing rapidly. c) Although there are regional differences in the plan configuration, it is stated that this trend is seen nationwide in Japan.

Masao Aoki (1984, 1985, 1986) *“A study on the plans for middle-class housing (Part 1, 2, 3)”* tracks the transition of middle-class housing formed after the Meiji era. In particular,

converting Zashiki direct-entry houses derived from traditional samurai houses into inner corridor houses is investigated. The reason for the transformation is explained by introducing the inner corridor to solve the problem of the emergence of the middle class and the reduction of reception events according to modernization, and the movement of toilets and female maids.

Shigekazu Sugiyama (1991) analyzes the area ratio of apartment complexes built in the 1960s and 1990s to investigate design trends at the time in ***"A study of norms for planning collective housings."*** Conclusions are points described below. a) There is a trend of densification of multi-family housing in Japan's metropolitan areas, and high-rise housing is being built in areas close to large cities. Small-scale, middle-rise houses are being built in suburban areas. b) It is explained as a general trend to limit the width and increase the depth of the house to secure the residential area and floor area ratio. c) The flatform settled in the 1960s was fixed as a characteristic common to the current multi-family housing. And a bedroom in the north). However, it is described that it is difficult to define a typical floor plan after 1980 due to the diversification of houses.

In the case of Chinese studies, Uekita Yasufumi (1995a, 1995b) investigates the change of spatial composition of housing from traditional Chinese housing to apartment complexes in the 1980s in ***"Spatial Principles of the Chinese Traditional Housing and its Transmutation through the Modernization (Part 1, 2)"***. Are doing. The composition principle of space is divided into public space and private space and examines siheyuan members, Lilong housing, socialist housing, and multi-family housing after opening. He suggests that the separation of public and private spaces is clearly revealed by increasing apartment houses' number and area after the economic opening. He also pointed out that the corridors and Menting that connect each space were arising from the tendency to be emphasized as the nuclear family became a nuclear family, and pointed out that this is acting as an element to dismantle the spatial order of China.

Xin He (2011) investigated the spatial composition of apartment complexes built in four cities in southern China since 1990 in ***"CHARACTERISTICS OF SPATIAL ORGANIZATION AND MODERNIZATION OF LIFESTYLE AT THE CONTEMPORARY MULTIPLE DWELLING UNITS IN THE SOUTHERN PART OF CHINA."*** As for southern China's spatial characteristics, the living room connection type was overwhelmingly large. Although it is changing modernization, it is described that it preserves China's unique spatial characteristics. The unique characteristics of Chinese apartment complexes are as follows; a) securing the bedroom's privacy, b) a clear separation of public and private spaces, c) an open dining

space-a closed kitchen space.

Shinobu Fujita (1995) surveyed houses built in the 1990s in nine cities including Beijing, Harbin, Guangzhou, Nanjing, and Shanghai in China in ***"A study on the modernization process of multi-family housing in eastern Asia (1)"***. He points out that the area of the house is different depending on the area. In the northern area centered on Beijing, the bedroom area was wider than that of the public space (Ting), and in Guangzhou, the area of the public space (Ting) was made larger. This phenomenon is pointed out as the cause of changes in residents' lifestyles depending on the region.

Takakazu Tomokiyo (1994) ***"ON THE ADVANCE OF THE HOUSES WHICH HAVE A TING AND THE FUNCTION OF TING: A study on the urban houses in China"*** categorizes the housing types after opening into three periods. a) Large-scale housing supply period of Soviet standard design, b) China's independent housing supply period (Tao jian: Overlapping Bedroom type), c) Space development distribution period of traditional Qing. In particular, through historical tracking, reappearing public spaces (Ting) that disappeared in the process of modernization in Chinese houses is revealed through historical tracking. Besides, it is presented by classifying the types and examples of Ting in urban dwellings in a morphological perspective and argues that the role of Qing has settled the concept of a modern living room since the 1980s in a buffer space where the role of Cheong divides the early generations through historical data. At the end of the 1970s, the Ting's function changed to the subspace of the public-space. The subspace was used for entrance-hall, living-room, dining-room, guest-room, or sub-bedroom. It is also pointed out that Ting's modern space does not inherit the traditional space of Ting.

The study in the aspect of culture-behavioral focuses on residents' behavior and characteristics responding to physical conditions. The basic ideology is that the occupants' physical movement, the habit of living, and the socio-cultural characteristics form the order inside the building. Moreover, it aims to trace the process of expressing the internal order, thus forming a building. In other words, using a cultural anthropological approach focusing on cultural-social characteristics, it mainly uses empirical methods to track the process of change according to social changes.

In Korea's research case, Yoon (1992) attempted to predict the future by examining the traditional elements expressed in modern apartments from the ideological and physical aspects, and grasping the degree of tradition and the factors that influence it according to the characteristics of residents in ***"Tradition of Consistency and Change. in Contemporary***

Korean Apartment Dwellers." The study has two purposes: a) to investigate changes in the house and social life space form and behaviors in Korean family houses' social life space from Yi-dynasty to the present. b)to develop a housing conceptual framework based on the ecosystem approach by analyzing changes in the Korean family houses. The significant findings were that social life space forms were classified into traditional primary type, Living-Hall type, Living Room type, and Living-Family-Study Room type. Korean family houses' social life space from Yi-dynasty to the present changed a little in the low housing class and a lot in the high housing class. The low housing class's social life space was characterized as Anbang (master bedroom and multi-purpose room)-centered social living space. The social life space in the middle housing class was from Anbang to the living room. The high housing class's social life space has various single-purpose social life spaces, such as living room, family room, drawing room, and study room.

Lee (1991) conducted participatory observations on small apartments, pointing out problems with each space and equipment in *"A Field Study for Housing Design, Suited to the Korean Way of Life."* His research aims to develop a housing form that is suited to the Korean way of life through a field study on small-sized apartments. The primary method is ethnography using participant observation and open-ended questions. After analyzing and synthesizing, the final suggestion is as follow: doing software-oriented design, permitting people's alteration, using people's low technology for problem-solving, adjusting to Korean lifestyle, that is, storing Korean pickle and spice, laundering and drying, and bathroom life, and finally revising Westoriented textbooks. Woo (1991) surveyed the lifestyle of residents of small apartments in *"An ethnographic field study to design housing suited to people's subculture."* Apartments are not a very functional complex of rooms, but they should be treated as vessels containing his life. It should meet the inhabitants' lifestyles as well as their spatial needs to accomplish these goals. Dwellers'life pattern showed as follows:1) Life pattern is different according to family-style.2)Each room has the characteristic of appropriative use, functional complexity, and flexibility in time.3)Each has site little different distribution of family-style. The inner and outer appropriation is various, even on the same site.

Park Yong-Hwan (1992) surveyed residents of remaining Japanese houses in Jinhae, Mokpo, Gunsan, Daegu, and Gwangju in *"A Study on the Succession and Transformation of the Japanese Houses in Korea Through the Survey."* His study is about the spatial evolution of the process in which the Japanese houses, dissociated from Korean culture and tradition, were being superimposed on the traditional Korean houses. From the 1876's Open-Port till now, the flashing alteration in the Korean houses has generated an obscuring circumstance

which can not be named just "Modernization." The study refers to how the foreign lifestyle, separated from our tradition and culture, conformed to and adapted to our Korean houses, and how Korean houses preserve the traditional lifestyle. Based on this analysis, We can see through the remaining existing Japanese style house and understand our house-style. As this study is the first result, it says the arrangement of Japanese houses; the entry process in the road's relation to the site. The entry had changed from direct Approach to the porch from a road into the Korean traditional entry process, created when the entrance moved through MADANG's direction, the front gate Madnag-Maru process.

In the case of Japanese studies, Mineki Hattori (1981) investigates and analyzes the relationship between the scale and ideology of space inside the house, the origin of the Washitsu (Japanese-style room), and the formation of the Tsuzukiai type with the composition of a family in *"A Study on trends in dwelling styles from the viewpoint of housing unit plan."* Makoto Oogida (1979) investigates the justification of the existence of the Tatami space in *"A Study on residential style."* The tatami space is used for reception and is required when accommodating a large number of guests. Besides, residents are pointing out the tendency to require tatami space when there is no reception room. Besides, Tatami space is used as the main bedroom and spare space, and the present situation is pointed out. It is analyzed that the Tatami space has been used in the hospitality space and daily space.

Toru Egami (1990) summarizes critical opinions on Ima and traces the concept and status of "Ima = living room" in *"A study on the planning of A living room as multipurpose space."* Ima is changing from the family's daily activities, such as family gatherings, meals, and housekeeping, to a multipurpose space that includes receptions. Ima's multipurpose space characteristics are as follows; a) It has a spatial area that can use both Floor-seating style and Chair-seating style. b) Has storage space. c) Direct access to the entrance is possible, and the necessity of planning visually separated from the kitchen is presented. Hideki Kobayashi (1995) resiliences with the subject and form that manages the living room. Moreover, it points out that there is a relationship with the characteristics (class, occupation, family structure) of the resident in *"TYPOLOGY OF THE PERSONALIZATION IN MODERN JAPANESE HOUSES: A study on territoriality. in home."* In particular, it is stated that it is necessary to pay attention to residents' characteristics in housing research.
In the case of Chinese studies, Yasufumi Uekita (2003) investigated the furniture arrangement patterns and habits of houses in Beijing and Shanghai in *"RESEARCH ON THE DINING SPACE IN CHINESE APARTMENTS."* As a result of the survey, it was pointed out that in traditional Chinese houses, the dining space changes according to residence

habits, but there is a growing tendency to separate eating and sleeping behaviors in multi-family houses after opening. Since 1960, as Ting (public space) has been spreading to houses in earnest, dining is mainly done in the office, and it is believed that it is changing into a multipurpose space for customer service. Besides, since 1980, canting (dining room) is often divided separately in commodity housing, and it is argued that it has a spatial character similar to that of Japanese LDK. Takakazu Tomokiyo (1993) classifies residential housing in China from 1949 to 1976 from a time-series perspective in ***"ON THE POLICY FOR HOUSING AND THE HOUSING MODEL AFTER THE REVOLUTION: A study on the urban houses in China."*** In particular, it analyzes the flow of Jung-gu apartment complex plans based on historical facts.

Comparative studies on South Korea, China, and Japan are being conducted in various fields. However, very few studies exist comparing three countries simultaneously. In particular, the spatial composition of traditional houses, decorative elements, architectural structures, Etc., and the comparative typological analysis of modern apartment complexes account for the majority.

Kim (2003) analyzes the family system of each country and reveals the differences in traditional living spaces according to it in "A Comparison of Traditional Living Space Based on Family System in Korea, China and Japan." The similarity is that the female space is located inside the house, and the difference between the male and female spaces appears. The difference is that in Korea, there is a strong distinct spatial division according to the role of couples, and in China, spatial separation by generation is specific. Japan points out that the space of the head of household constitutes a concept higher than the space of family living. Shim (2000) Surveyed the plan types of apartment complexes built in the 1990s in Korea, China, and Japan in "A Comparative analysis on Housing Unit Plans of Korea, China, and Japan." As a result of comparing the ratio of the three countries by surveying the area by space of the house, it was pointed out that Korea has a typical square shape and that China and Japan have a variety of spatial composition compared to Korea.In particular, in the LDK configuration, Korea emphasizes the independence of the living room. It plays a central role in life. China goes through the process of dividing the kitchen and dining room, and Japan prioritizes the kitchen's independence and connects the living room and Washitsu to unify it. Moreover, set it as the center of life. In terms of the area of each space, the size of the main room in Korea is larger than that of Japan and China, and the exclusive area and the correlation coefficient are significantly larger. It is described that this is different from China and Japan, which have a certain bedroom area regardless of the residential area.

1.5.2 Discussion and differentiation

As described in the previous section, the study of housing transition is interpreted in terms of housing history, anthropology, or socio-cultural aspects. These characteristics are more clearly seen when the subjects, scope, and methods are classified and observed, centering on research related to the change of housing space in each country (table 1.1 to table 1.2). Focusing on the research method, the proportion of field surveys and questionnaires appears to be high. Besides, many studies observe changes in physical factors by collecting housing floor plan data through literature research. Analysis tools are mainly used to discover trends in basic statistics, and element analysis or correlation analysis are used. Previous studies have dealt with morphological studies and resident behavioral studies separately, and most of the subjective explanations are made by intuitively judging and categorizing changes in urban housing plans. The interpretation of these methods tends to vary according to the researcher's criteria. Previous studies have clear limitations: a) independent interpretation between floor plan analysis and resident behavior survey, b) difficulty in presenting objective indicators for the evolution of different types of floor plans, c) fragmentary time and subject-focused research fields.

The most relevant study for this study is "Spatial Interpretation of Housing" by Seo(2004). He analyzes the evolution of houses built in Seoul from the 1930s to 1990s based on the theory of space syntax. The process of transferring traditional courtyard houses to modern apartments is presented in terms of "floor level distinction." As the traditional courtyard function was relocated to the periphery of the modern apartment space, the topological centrality of the high and low floor level spaces was reversed. Moreover, this is defined as an element leading to the evolution of Korean housing. However, the analysis is conducted by limited to five typical planes of each era. The study's scope is limited to private apartments in the Gangnam area in the 1990s.

This studies are complements and expands Seo's (2004) research method and perspective. From the perspective of "space-behavior," This study analyzes the key elements that lead the evolution of each country's housing from traditional housing, modern detached houses, and public housing in South Korea, China, and Japan through objective indicators.Besides, this study acquires differentiation by analyzing the commonalities and differences of each country by comparing the topological centrality of the living room and kitchen space.

Literature review

keyword : Urban Housing; Modernization; Housing Spatial transition

	South Korea	1965 Joo	1970 Joo	1982 Moon	1984 Lim	1984 Kim	1985 Go	1988 Klm	1988 Song	1989 Kim	1990 Kwak	1992 Jung	1992 Lee	1992 Hyun	1994 Jang	1994 Jung	1995년 Kim	1995 Go	1996 Choi	1997 Ahn	1997 Lee	2000 Seong	2001 Song	2002 Woo	2002 Kim	2003 Kim	2005 Yang	2008년 Lee	2008 Son	2009 Kim	2010 Son
Time range	Previous 1900	●	●	●							●																			
	1900		●	●							●	●	●	●						●									●	●
	1910		●	●							●	●	●	●						●			●					●	●	●
	1920		●	●						●	●	●	●	●						●			●		●		●	●	●	
	1930		●	●					●	●	●	●	●	●						●			●	●	●		●	●	●	
	1940(1945)		●	●		●	●			●	●	●	●	●			●			●	●		●		●			●	●	
	after1950					●	●										●		●		●		●							
	1960					●	●								●	●	●	●	●		●	●	●	●						
	1970				●	●	●								●	●	●	●	●		●	●	●	●						
	1980				●	●	●	●								●	●	●	●		●	●	●	●		●				
	1990																					●				●	●			
	After 2000																													
Type	Tradition	●	●	●							●																			
	Foreign house		●	●		●				●		●	●	●			●			●				●			●	●	●	●
	Improved traditional		●			●			●		●												●	●						
	detached House				●	●	●	●		●						●	●	●			●	●		●	●	●	●		●		●
	Apartment house														●			●	●												
Data	literature	●		●						●					●					●					●			●	●	●
	law clause																													
	Floor/Site Plan	●	●		●	●	●	●	●		●	●	●	●	●	●		●	●			●	●	●	●		●		●	
	Area length	●	●				●	●			●						●			●	●										
	Interview				●	●			●			●	●	●	●	●					●	●	●					●			
①	Dwelling Style			●					●	●		●	●	●		●				●	●				●			●	●	●	●
	Arrangement		●			●		●				●	●	●		●	●				●	●		●				●	●		
	Type classification	●			●		●		●		●		●	●	●				●				●	●	●		●				
	Spatial change																	●	●												
	Policy change			●																		●							●		
②	Documentary record	●		●						●					●					●					●			●	●	●
	Behavior				●				●			●	●	●	●	●						●	●					●			
	Rank of area size		●		●	●		●				●	●	●						●											
	Length and ratio		●																												
	Arrangement of function				●	●		●	●		●	●	●	●	●		●		●	●	●	●	●	●		●	●	●		●	
	Route				●				●			●	●											●				●	●			
	Physical form	●					●				●	●	●			●								●	●						
	Interrelationship of space																		●												
③	Socio-cultural		●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●
	Decorative	●	●								●											●						●			
	Physical morphological	●			●	●	●	●	●			●	●	●	●	●	●				●		●	●	●		●	●			
	Statistical							●										●	●												
	Topological																	●	●												
Tool	Statistics Program										●								●												
	Researcher standards	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	●	●
	Morphological theory	●	●		●	●	●	●	●			●	●	●		●	●			●	●	●	●	●	●	●	●	●	●	●	●
	space syntax theory																														

① Analysis target, ② Analysis object, ③ Interpret results

Table 1.1 Literature review on spatial transformation of urban housing in South Korea

Literature review

keyword : Urban Housing; Modernization; Housing Spatial transition

	Japan	1959 木村	1980 石原	1981 服部	1981 服部	1982 鈴木成文	1984 青山	1984 青山	1986 青山	1988 青山	'989 鈴木	2008 鈴木	2010 宮崎恵行	2013 湯浅 裕樹	2017 真鍋 怜子	2017 井上 美奈枝
Time range	Previous 1900	●	●	●	●		●		●	●						●
	1900	●	●	●	●		●		●	●						●
	1910	●	●	●	●		●	●	●	●					●	●
	1920	●	●	●	●		●	●	●	●		●	●			●
	1930	●	●	●	●			●		●		●				●
	1940(1945)		●	●	●					●	●					●
	after1950			●	●						●					
	1960			●	●	●					●					
	1970					●					●			●		
	1980										●			●		
	1990													●		
	After 2000													●		
Type	Tradition house		●	●												
	Foreign house			●					●		●					
	Middle class housing	●		●			●	●	●			●	●		●	●
	detached House			●						●	●			●		
	Apartment house				●						●			●		
Data	literature	●	●					●	●	●					●	●
	law clause															
	Floor/Site Plan		●	●	●	●	●	●	●	●	●	●	●	●	●	
	Area length				●		●			●		●	●	●		
	Interview			●	●	●								●		
①	Dwelling Style	●				●		●	●		●			●		
	Arrangement		●	●	●	●	●	●				●	●	●	●	
	Type classification			●	●	●	●		●	●					●	
	Spatial change															
	Policy change															
②	Documentary record	●						●	●		●					●
	Behavior					●										
	Rank of area size		●	●	●	●				●		●	●	●	●	
	Length and ratio				●											
	Arrangement of function		●	●		●	●	●	●	●	●	●	●	●	●	
	Route			●			●									
	Physical form		●													
	Interrelationship of space															
③	Socio-cultural	●	●	●	●	●	●	●	●		●	●	●	●		●
	Decorative															
	Physical morphological		●	●		●	●	●	●	●	●	●		●		
	Statistical		●	●	●	●				●				●	●	
	Topological															
Tool	Statistics Program		●	●	●	●				●				●	●	
	Researcher standards	●	●	●		●	●	●	●		●	●	●	●	●	●
	Morphological theory	●	●	●		●	●	●	●	●	●	●			●	●
	space syntax theory															

	China	1998년 HAM	2007 LI	2008 JIN	2012 GAO	2012 DUAN	2013 JIN	2013 LIM	2015 WANG	2017 WANG	2017 RUAN	2017 ZHENG
Time range	Previous 1900				●		●		●		●	
	1900						●					
	1910						●					
	1920	●					●					
	1930						●					
	1940(1945)						●					
	after1950											●
	1960											●
	1970											●
	1980			●								
	1990			●	●							
	After 2000		●	●	●	●		●	●	●	●	
Type	Tradition house				●				●		●	
	Foreign house						●					
	Lilong house						●					
	detached House	●			●		●					
	Apartment house		●	●	●	●	●	●	●	●		●
Data	literature	●			●		●		●			
	law clause											
	Floor/Site Plan	●	●	●	●	●	●	●	●	●	●	●
	Area length					●						
	Interview			●								
①	Dwelling Style		●							●		
	Arrangement		●	●	●	●	●	●	●	●	●	●
	Type classification	●										
	Spatial change											
	Policy change											
②	Documentary record				●				●	●		
	Behavior			●								
	Rank of area size					●						
	Length and ratio	●					●				●	
	Arrangement of function	●	●	●	●	●	●	●	●	●	●	●
	Route							●				
	Physical form											●
	Interrelationship of space											
③	Socio-cultural	●	●	●	●	●	●		●	●	●	●
	Decorative	●					●					
	Physical morphological		●	●		●		●		●	●	●
	Statistical					●						
	Topological											
Tool	Statistics Program											
	Researcher standards											
	Morphological theory	●	●	●		●	●	●		●	●	●
	space syntax theory											

① Analysis target, ② Analysis object, ③ Interpret results

Table 1.2 Literature review on spatial transformation of urban housing in China and Japan

1.6 Theoretical considerations

1.6.1 From the pre-requisites of the study towards a study methodology

In the previous section, this thesis's aim and scope have been more clearly outlined by defining the problems and modulating the research questions. The following question in this section is in what way those questions could be answered. What is needed is a proper theory and methodology that could synthesize all the variables to answer these research questions without conflict. There are several pre-requisites that the research method of this thesis should possess.

First of all, the methodology should have an explanatory power to describe architectural space in an analytical manner. There exist many different types of approaches that have tried to analyze architecture and its space - this includes Altman (1980), Lawrence (1990), and Rapoport (1990). They have suggested their methodological models through which architectural research could be more systematically investigated and analyzed. Their efforts, however, were not practical enough to be applied to architectural research in general. They merely suggested a list of possible factors that might help analyze an architectural environment (Altman and Lawrence) or too abstract to be useful in real research (Rapoport). Hence, what is needed in this thesis is a methodology that is concrete enough for real-life adaptation and persuasive and logical enough for analytical description.

Second, the methodology should demonstrate analytical objectivity in inspecting the culturally heterogeneous settings since this thesis deals with a chronological change in housing space that expands from the traditional type to the modern one. It would be a primary concern if these houses, formulated and lived in during different social systems and environments, required different sets of variables for analysis, as this would spoil the coherence of any subsequent interpretation. What is required in this study is interpreting the old and new houses in a single methodological framework? Some outstanding examples of previous research have successfully tackled the issue of illuminating a transformation in housing. For example, Glassie (1975) displayed a highly analytical way of seeing the housing evolution based on Chomskian generative grammar, and Michael Ann Williams (1991) took an ethnographic approach to reveal the inhabitants' real perspective on architectural space and its change. The methodologies they used, however, are not useful

for this research. In their case studies, sample houses were laid on a continuous line of time where small changes in architectural language and social values were overlapping with the existing ones without any gaps. Therefore, the houses showed, in a broad sense, consistency in style. To explain two heterogeneous sets of houses that are formally and culturally somewhat different as in this thesis. Another methodological approach is needed that is neutral and free from changing social variables in its pure state of analysis.

Third, there should be a convincing connection between morphological analysis and social interpretation. Put differently, the methodology's application should not be restricted to describing the physical and superficial features of the architecture; it should have the capability to be linked to a socio-cultural dimension. In the second requirement described above, it was emphasized that the methodology should possess the analytical objectivity that is free from changing variables in time. However, this does not mean that it should not be connected to the level of cultural interpretation. At the methodological level, the morphological analysis is supposed to be independent without the interference of changing variables. However, at the theoretical level, the analysis should become the groundwork that leads logically without arbitrariness, to subsequent evaluation and interpretation. In sum, what has been described above shows the three prerequisites that any methodology appropriate to this thesis should possess: an analytical description of space, analytical objectivity, and a systematic connection to a social interpretation. As will be discussed in more detail in the next section, only one theory fits these conditions. The space syntax theory exhibits the quality and methodology that is in demand in this thesis. About the rationale of this theory, Hillier and Hanson note:

"First, it must establish for space a devscriptive autonomy, in the sense that spatial patterns must be described and analysed in their own terms prior to any assumption of a determinative subservience to other variables... Second, it must account for wide and fundamental variations in morphological type,... Third, it must account for basic differences in the ways in which space fits into the rest of the social system... This means that we need a theory that within its descriptive basis is able to describe not only systems with fundamental morphological divergencies, but also systems which vary from non-order to order, and from non-meaning to meaning." (Hillier and Hanson 1984, 5)

From their statement, it is evident that the space syntax theory has been originated with aims that closely match the purpose that is almost matching with the methodological prerequisites of this thesis described above. The space syntax method first acquires purely morphological information from architectural space configuration and represents it in a logical way using graphs and mathematical values. Based on these topological indexes, interpretations follow to see what social implications are embedded in the spatial structure.

1.6.2 The problem of domestic space and its association with social meaning

No building could possess as many layers of meaning as the house. As an essential spatial setting for human beings, the house supports all aspects of everyday domestic routines and changing needs at different stages of life. The variety of words that can be associated with it, e.g., home, dwelling, shelter, habitation, may reflect different angles through which it can be seen. In this connection, though being deceptive with its scale and character. When its function and meaning are considered, the house is thought to be the most complex building of all (Hanson 1998, 2). The study of, therefore, becomes a subject that cannot stand alone without theoretically being exposed to other disciplines, and defining a proper research method becomes a critical concern for scholars in the field.

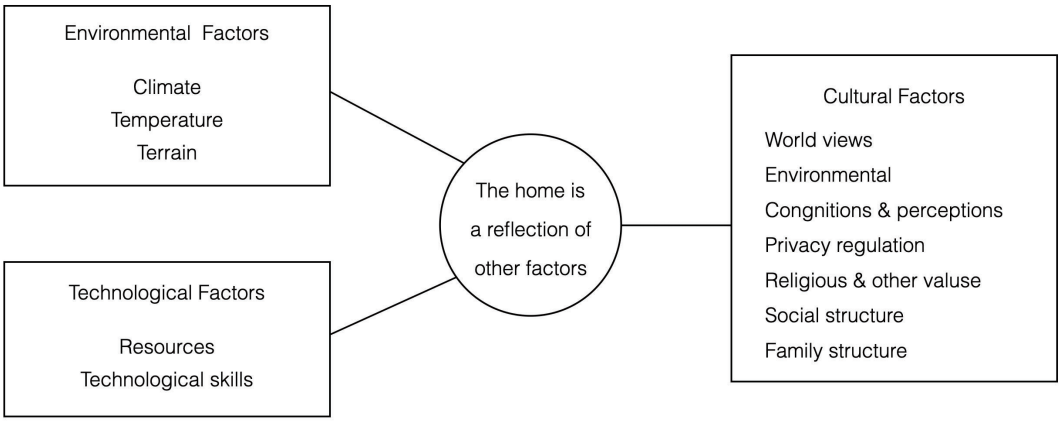


Figure 1.5 The home in relation to other factors

(from : Altman 1980, 156)

The most direct and fundamental approach to the study of housing is the typological interpretation in which the house is seen merely due to environment and technology. The meaning of the house, in this case, is degraded to its explicit day-to-day function. In this approach, houses are defined and classified by their formal types, building materials, techniques, decorations, and so forth, and the emphasis is put on the explanation of geographical variations. Classic examples of this are found in Rudofsky's (1964) works, Brunskill (1981), and many others dealing with contemporary and vernacular houses. In the case of the houses, which comprise this thesis's sample, there is a plethora of research on their typological aspects but a dearth of insightful research on their spatial meaning. Although such an approach is essential as a first step where data is modulated to offer a

good overview, criticism always follows that it ignores the aspect of meaning.

The meaning of architecture is the most intractable issue that escapes clear understanding; it can be interpreted from many different perspectives, and no single perspective can claim to be complete. Therefore, it seems natural that there exist only a few theoretical models that specify the variables or suggest the methods needed to investigate the meaning of housing. Altman (1980, 155-6) suggests, from environmental psychology, three categories of factors that affect the formation of the house, i.e., environmental factors, technological factors, and cultural factors. He points out that it is impossible to identify these factors' exact contributions, and unless those factors are viewed simultaneously, the analysis is incomplete.

His proposal seems more dynamic compared to the typological approach discussed above in that it includes a cultural dimension in addition to the environmental and technological dimensions. However, Admittedly, it is merely suggesting would-be affecting factors divided into three categories; it seems impossible to apply this model to real research directly. Besides, a closer inspection of cultural factors reveals that they overlook the day-to-day human practice, and as a result, the home becomes a static concept. In other words, the model excludes those social factors related to space usage, such as "everyday domestic activities', 'interactions between the residents and visitors,' and so on, which are decisive clues to link material structure to everyday practice. This is a similar type of criticism that can be applied to a structuralist interpretation of housing (Hodder 1982, 1986), and a detailed account of this issue will be introduced in the next section.

The as above criticism indicates, in order to deal with the cultural dimension of housing, it is essential to examine the positive association of human bodies with material culture. Indeed, our bodies' movement within domestic settings enables the learning and practicing of a particular culture imprinted in the spatial configuration. Thus Stea notes:

"Everywhere, people eat, clean their bodies, and launder garments, in culturally ritualized ways. Their activities in the domestic sphere inevitably involve age- and sex-role differentiation, as well. Thus, the domestic environment not only communicates and is communicated with, but it acts as a setting for the transfer of knowledge and cultural values. In this way, the built environment serves as a setting for people-to-people communication, once again" (Stea 1987, p.xiii).

One important characteristic in this 'communication' is that the process is performed without conscious effort; naturally, from the earliest stage of life, one starts to understand the surrounding environment by gradually being acquainted with his home (see Piaget, 1956). It could be understood as an 'act of incorporation, according to the psychologist Lang:

"Inhabiting is an act of incorporation; it is a situation of active, essential acquisition. Incorporation is the initiative of the active body, embracing and assimilating a certain sphere of foreign reality to its own body. In this sense, incorporation is essentially the movement from the strange to the familiar. This commerce of strange and familiar, which forms a central dialectic of human existence, is instituted and embodied in our dwelling... This act of familiarization is performed as if by magic by active body. It is enacted at the most primitive level without the assistance of conscious thought." (Lang 1985, p.202-203)

For the researchers dealing with the meaning of the house, this 'familiarization' means much more than merely getting to know the physical setting. Through this unconscious process, a domestic setting that materializes the cultural norms of a society is experienced and remembered by heart. For the interpretation of a cultural dimension, therefore, the implications of a house as a medium to transfer the spatially imprinted culture should be explained. Across disciplines, this line of thought has affected scholars and provided a basic conceptual framework for the investigation of houses. It has been argued that the house is another type of cultural symbol that should be dealt with as if a text, where the message is encoded by writers and decoded by readers (Geertz 1973; Bourdieu 1977, 90; Moore 1986; Johnson 1993, viii; Blanton 1994). For example, Bourdieu adopts this analogy in his book, *Outline of a Theory of Practice:*

“The house, an opus operandum, lends itself as such to a deciphering, but only to a deciphering which does not forget that the "book” from which the children learn their vision of the world is read with the body, in and through the movements and displacements which make the space within which they are enacted as much as they are made by it." (Bourdieu 1977, p. 90)

In this regard, it has been suggested that since a text contains a cultural message, the interpretation should be analogous to the 'work of literary critics' (Geertz 1973). Further, it has also been indicated that meaning can be reassigned by different groups (Moore 1986) or by different periods (Johnson 1993). Discrepancies in interpreting meaning can arise from different research methods, different perspectives, and changing contexts. Bailey emphasizes this complexity:

"The house therefore exists simultaneously within the dimensions of time, space, possession, wealth, protection, craftsmanship, access, permeability, weather patterns, technological ability, and so forth. Indeed it may prove impossible to exhaust the inventory of levels of perception. Each methodology, each society, and each individual will value the house differently by implementing different standards of measurement. Meanings of houses shift within temporal, spatial, and social parameters." (Bailey 1990, 26)

The above arguments strongly suggest that research on housing cannot be successful by adopting a single approach; all possible approaches should be considered. Johnson (1993, 183) argues that to study houses that are ‘part of a continually reinvented tradition,’ there needs to be ‘more than a detached academic exercise’ to secure interpretation reliability. A question then arises: how is it possible to systematically combine multiple perspectives

in available research? Concerning this question, Lawrence (1990) suggests a rigorous model. He first lists, based on his extensive survey on English and French literature, seven categories repeatedly used for the study of vernacular houses in the previous hundred years:

1. The aesthetic/formalist interpretation: concerned with the formal composition of buildings rather than what they mean and by whom and how they were used.
2. The typological approach: focusing upon the geometrical and compositional rules of extant house plans and the location of doors, windows and chimneys.
3. An evolutionary theory: concerned with the development and change in house plans and elements through time.
4. Social geographical diffusionism: relating the development of vernacular houses to the influence of social or geographical diffusion.
5. Physical explanations, such as materials and technology, site and climate
6. Social explanations, including economics, household structure and defence
7. Cultural factors including collective spatial images and religious practices

He is pointing out the problem that these approaches have not been used in a complementary way by authors in diverse disciplines. He draws on Geertz's (1973) idea of 'cutting the culture concept down to size and suggests that a built environment could be analyzed appropriately and comprehended by defining and relating the context-dependent parameters.

At the end of his argument, Lawrence presents a conceptual reference model where each of three sets of parameters, i.e., physical factors, societal factors, and individual factors, represents one of the three dimensions of a cube. He claims that these three sides should have equal weighting and lengths if not in a specific context.

While Lawrence's research model seems to conform to the previous arguments that housing research should be grounded on multiple approaches, it still lacks a method for how these could be put together. For example, even though he provides his research, 'colonial houses and domestic life in South Australia' (ibid, 227), it is doubtful that he uses all the factors – and that in equal 'weighting'! - and takes into account their 'reciprocal relations' as advocated by himself. His model seems to have strengthened the human or individual factors that are deficient in Altman's, but it still looks more like a suggestion a checklist rather than a well-defined method.

Rapoport (1990) makes another type of suggestion. In his article, 'Systems of activities

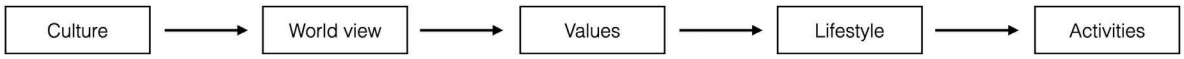


Figure 1.6 Process of dismantling the concept of culture

(reproduced from Rapoport 1976; 1990)

and systems of settings,' he suggests that culture can be related to the built environment more practically than the previous models. In the beginning, he notes that 'culture' and built form' are different in scale, in that the former is a vast domain in which the latter is a subset. The fact that 'culture' is 'too broad and too global' a concept makes research into houses difficult. From this problem definition, he suggests a sequence where 'culture', the highest level of abstraction, is gradually linked to lower-level components to arrive at activities at the end. Through this process, the culture's concept is dismantled and becomes more concrete and manageable (figure 1.6).

According to Rapoport, activities can be seen at four different levels: (1) the activity itself, (2) how it is carried out, (3) how it is associated with other activities and combined into activity systems, and (4) the meaning of the activity. As one goes down from (1) to (4), the level of culture goes up and finally reaches the meaning. To investigate the abstract notion of culture, therefore, one must see not single activities but a sequence of activities, i.e., 'systems of activities', as a whole. Rapoport then points out that activities and settings' are connected by 'meaning':

“The situation, the rules, and the ongoing and appropriate behavior are communicated by cues in the setting. This suggests that activities and settings are linked through meaning, in other words that the principal mechanism that links an activity and a setting is meaning" (Rapoport 1990, 12).

The concept of 'settings' was then further detailed: activities occur not in single buildings but in various spaces, including the outdoor environment. Moreover, at the same time, activities are affected not only by 'fixed-feature elements' (architecture) but also by "semi-fixed-feature elements such as furniture. All these ideas conclude that through the investigation of the mechanism between 'systems of activities' and 'systems of settings,' the cultural meaning, which mediates these two, can be revealed.

In general, the conceptual frame suggested by Rapoport seems more suggestive and inspiring. Whereas those two models suggested by Altman and Lawrence are somewhat static and functionalistic, his model is more dynamic and oriented more specifically towards the link between culture and the built environment. Rather than presenting a list of candidate

factors that might have significance in analyzing an artifact, this model shows how an abstract concept, 'culture,' can be decomposed and more specific.

While his model helps define the relationship between culture and housing and thus can be an excellent conceptual guide for research, some aspects hinder this from being practical. First, it does not provide an actual method to investigate activities; it emphasizes the utility of activities as a vehicle to understand the culture but what it shows is their diversity, which is hardly observable:

"the differential sequencing of activities in time as well as in space, tempos (number of activities per unit time) and rhythms (the periodicity of activities related to different cycles: lifetime, annual, seasonal, profane time/ sacred time, festivals, work-day vs. weekend, day and night, etc.)". (Rapoport 1990, 15)

Second, the model renders the concept, 'settings,' out of control; according to Rapoport's idea, the demarcation of spatial boundaries for research would be impossible since activities happen in a series of settings. In other words, they should not be confined within a single building but stretch out towards the whole cultural landscape' (Rapoport 1990, 12). In sum, although conceptually persuasive, the model is too abstract in terms of methodology to be useful for the investigation of real house samples.

What, then, could be a proper method applicable to housing research? To answer the question, it is necessary to return to see the house as an analogy of text. Many scholars seem to share the notion that the house has multiple meanings and, therefore, through different angles, different interpretations could be formulated. However, only a few could suggest a consistent and systematic theory and methodology that respond to this inherent problem.

A text can be read and interpreted in several ways according to a reader's impression or judgment, but what is unchanging is the text's organization as a syntactic structure. Likewise, careful investigation of what buildings reveal in their pure state can be a real and substantial testimony from which interpretations can be established. This line of thought has affected Hillier and Hanson (1984). Reviewing various types of research on architectural space, they emphasize that the meaning of space can be explained not by simple external causes' but within the 'intrinsic material nature of the artifacts':

“In spite of considerable divergences, these approaches all seem to sidestep the central problem of buildings in the sense that we have described it: they do not first conceptualise buildings as carrying social determination through their very form as objects". (Hillier and Hanson 1984, 8)

This is the core statement that distinguishes their theory, 'space syntax', from others. Given the research questions and the problem definition of this thesis, Hillier and Hanson's approach is considered to be the theory that can give answers to those questions. Before the justification and theoretical account of space syntax theory in section 4, it is necessary to overview other related approaches that put an emphasis on morphology of housing. By critical analysis of these, a more suitable framework for this thesis can be constructed.

1.6.3 Change of housing culture seen through the formal transformation process

Although lacking holistic explanatory power, structural anthropology has opened up the possibility that a house can be more than a physical structure. It brought to academic discussion the issue of built form, which used to be relatively neglected in anthropology (Humphrey 1988, 16). However, a criticism comes that structural anthropologists see architectural space 'as a by-product of something else whose existence is anterior to that of space and determinative of it and construct their theory with a limited number of cases (Hillier and Hanson 1984, 5). Even in those influential structural studies, e.g., Levi-Strauss on the Bororo village (1963), Tambiah on the Thai house (1969), and Bourdieu on the Berber house (1973), houses were thought of as reflecting a 'symbolism or cosmology rather than as a subject in their own right' (Humphrey 1988, 16). More importantly, structuralism ignores the role of individuals who can construct social change within a given context. In other words, individuals are portrayed as' subordinate to the organizing mechanisms of the unconscious' rather than 'competent social actors. There is no effort to understand how structural rules can be changed over time (Hodder 1982, 8).

While the structural way of thinking has greatly influenced many scholars, considering all these drawbacks, it is clear that structuralism as a grand theory is inadequate for research such as this thesis, where the emphasis is placed on morphological changes in housing over time in relation to everyday activities. In what follows, two definitive studies that have a similar research subject to this thesis are introduced. From different perspectives, they deal with the tricky issue of how social narratives can be connected to the formal evolution of housing. In these studies, the house is seen as a mere reflection of an externally predetermined cultural system and a potential generator of social interactions and architectural change. It is expected that the analysis of these studies can provide some

proper viewpoints for this thesis.

Michael Ann Williams (1991) takes an ethnographic approach to the investigation of formal change in the folk dwellings of southwestern North Carolina in the nineteenth and twentieth centuries. Based on interviews with the local people who lived in this period, she portrays how dwelling type change through time was associated with their actual living at home. In North Carolina, the earliest home life in a 'single pen plan' was re-accommodated in a 'double pen plan' and then in a center passage I-house' during the nineteenth and twentieth centuries. With reference to local people's memory, Williams finds out how spatial image and actual use were expressed by verbal language. For example, the term 'big house' indicated a primary living area within a single pen plan rather than a house scale or type, 'front room' and 'backroom', a space for living and space for sleeping, respectively double pen plan. However, they were equally accessible from the front door or doors.

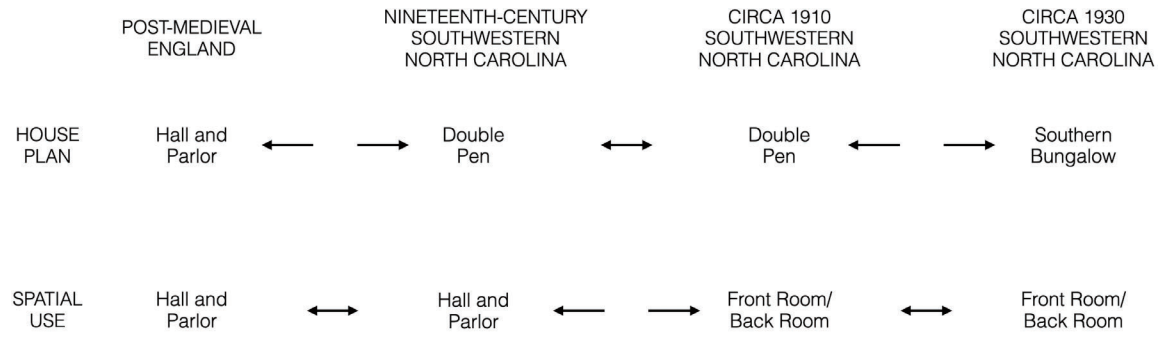


Figure 1.7 Continuities and discontinuities in houses plan spatial use

(from Williaams 1991, 91)

During the period of double pen plans and the time of their replacement by 'modern' bungalows, Williams observes two distinct types of change in housing culture: one related to domestic behavior and the other to the house's physical form (figure1.7). The double pen plan, which inherited the 'hall and parlor style of living in post-medieval England, went through a change in spatial use around 1910 while the house structure remained the same. An intensive living space, the hall absorbed the parlor's formal functions, acquiring the more formal names, 'sitting room and 'front room,' while the other room entirely became a sleeping space with a new label, "backroom.' Thus, profound changes in spatial use occurred without the physical modification of the double pen plan house. In other words, 'spatial change was characterized not by rebuilding or remodeling but by "rethinking" the house (Willams 1991).

A completely different type of change occurred in the 1920s and 1930s, when the new popular bungalow style was introduced; it was built using a new construction method and

materials and now the narrow gable side was facing the front. Although the building looked different, the similar type of two-room arrangement in it enabled the local people to preserve the old way of living; thus the same front room/ back room practice was replicated in it. Hence, the bungalow house, which physically appeared to be a 'major break' in building traditions in the early twentieth century, was perceived as a “slow and incremental change to the local people who maintained the same spatial use (Williams 1991, 90). Synthesising these two observations, Williams noted:

“Overall the history of the double pen house in southwestern North Carolina shows a balance of continuities and discontinuities in house plan and spatial use. Periods of discontinuity in house plan are marked by continuity in spatial use, while the major change in spatial use was countered by a period of stability in house plan. The trend is neither wholly toward conservatism or innovation but a balance of the two. By understanding this balance, rather than focusing only on physical changes, we may better comprehend the nature of tradition and change in folk architecture.” (Michael Ann Williams 1991,91-2)

Another peculiar thing Williams observes is that the central-hall I house, which was not commonly built in the area, imposed a somewhat different social effect on the rural people in southwestern North Carolina. Typically, the advent of the central hall is accepted by scholars as a reflection of the social desire for control, privacy, and egalitarian imagery (see Glassie 1975, 189). Unlike this generally accepted conceptualization of the hall, its meaning and use seem different for the rural people. In many cases, Williams finds that the hall was enclosed within a living space by demolishing its wall, or its width widened for another use other than passage. She even finds cases where some families moved back to an old double pen house from the central hall I house - thus going against the chronological order of housing development. These observations imply another essential issue that the evolution of material culture does not proceed in a straight, one-directional way; depending on each particular context, it can deviate, diverge, and sometimes even regress.

Williams' work seems to successfully reconstruct the home life in southwestern North Carolina in the nineteenth and twentieth centuries. Through interviews with the inhabitants, she discovers what happened inside the private domains. This understanding enables her to see the changing process of the house morphology from the inhabitants' viewpoint. Her research strengthens the point, which was made in the previous section. In essence, it is neither house form nor inhabitants' behavior alone. However, the synthesis of these two makes it possible to understand the transformation process of housing culture truly. The interpretation should be context-dependent since there are always particular cases that do not conform to change's general pattern.

Henry Glassie, in his seminal book, ***Folk Housing in Middle Virginia*** (1975), displays a highly analytical way of seeing the housing evolution. From the influence of Chomskian generative

grammar. He develops a system of compositional rules by which small architectural components are arranged and built to become all the types of folk housing in Middle Virginia. He argues that what controls and generates this grammar is 'the architectural competence' which is active at the unconscious level in a designer's mind. According to him, competence proceeds, with the designer's geometric repertoire, 'from the abstract to the concrete, from useless ideas to livable habitations' (Glassie 1975, 19).

As shown in the diagram, as one proceeds from top to bottom, a ground plan evolves to become various types of three-dimensional house. Using five different diagrams but applying the same rule sets, he shows that all 157 folk houses in the area could be generated.

Glassie expands his idea of competence to explain house form change through time. He cautions against setting up the time phases of change in terms of 'things' for statistical convenience' because the chronological ordering of material manifestations is merely a 'static series that sidesteps change'. Thus, he notes that what changes are not "individual products of the competence, but the rules in the competence." (Glassie 1975, 111).

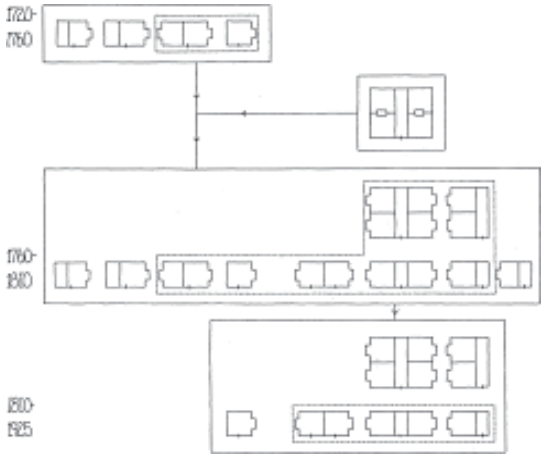


Figure 1.8 Evolution of the architectural competence

(Glassie 1975, 110)

Therefore, as in the figure, Glassie divides the time of traditional houses into three phases based on the change incompetence. The first phase is the time when the houses were English' hall and parlor' plan (1720-60), the second phase when the Georgian central hall type influenced the planned repertoire (1760-1810), and the third phase when the central-hall I house became dominant (1810-1925). In the revolutionary second phase, Glassie notes, some rules had to be added to the competence to cope with the new Georgian

style, while all the existing rules remained in effect. As a result, these expanded rules could create not only old types and new types, but also "the compromises between'. In the last period of evolution, the hall and parlor types were abandoned, and the Georgian type was not commonly built; instead, the central-hall I house, one of the 'compromises,' became dominant.

Glassie conceptualizes this meaningful pattern of cultural change as a dialectic process, i.e., phase I (balance), phase II (disequilibrium-expansion-synthesis), and phase III (contraction-new balance) (ibid. 112), and suggested that this theory could be applied to other cultural changes. Glassie's research suggests a useful model for this thesis, and the conceptual framework of 'competence will be utilized for the analysis of modern urban housing in each country.

A comparison of Glassie and Williams reveals some valuable suggestions for research into changing material culture. While Glassie's research is analytical and systematic in investigating the logic behind the material object, it does not relate to the everyday life of the society that produced that logic; in other words, designers' competence is not connected to inhabitants' spatial use and behavior. By contrast, Williams' research emphasizes the actual use of space, but architecture is seen merely as walls and partitions dividing and blocking human actions. In this case, houses are categorized into a small number of distinct types, i.e., single pen, double pen, and central hall I house. Simultaneously, the formal or geometric variations within each category are highlighted in Glassie's grammar and tend to be ignored.

These two approaches are powerful ones in that they reach far beyond the typological and historical dimensions of research into the American folk house. If the behavioral interpretation of domestic space can be rooted in the house's morphological analysis, and thus the two approaches of Glassie and Williams can be put together, a more insightful investigation is possible.

1.6.4 Floor plan morphology and graph theory

It has been suggested early in this section that housing research, primarily when it is concerned with historical change, should be rooted in the material analysis of the house itself as an object. In the previous sections, two architectural grammars were presented and compared to show how morphological research on housing could be related to the design generation mechanism. In this section, a further review is done on the analytical methodologies to investigate house plans. For the analytical analysis of plan morphology, scholars needed a simple yet powerful representation apart from the conventional way of metric representation. In their pioneering book on this issue, the Geometry of Environment (1971), March and Steadman proclaimed the reason for this approach:

"Perhaps the chief difference between the traditional treatment of geometry in architecture and the one presented here, is that, previously, geometry was employed to measure properties of space such as area, volume, angle, whereas the new mathematical theories of sets, groups and graphs – to name but a few - enable us to describe structural relationships which cannot be expressed in metrical forms, for example, 'adjacent to', 'in the neighbourhood of', 'contained by'." (March and Steadman 1971, 8)

Graph theory was first applied to small architectural plans by Levin (1964) in his article, 'use of graphs to decide the optimum layout of buildings.' Here, Levin used access graphs in which the vertices represent rooms and the edges of the connections between rooms. Some others, including Cousin (1970) and Friedman (1975), have tested the application of graph theory to design. However, March and Steadman (1971) made a significant contribution to utilizing the mathematical concept of graph theory as an instrument for architectural thinking. They emphasized this new approach's importance by showing three house plans designed by Frank Lloyd Wright (figure 1.9). Although these houses have completely different appearances in terms of the 'traditional treatment of geometry', when converted into graphs where points represent functional spaces and lines their connections, strikingly, they begin to appear topologically equivalent. In the same book, March and Steadman also explored many possible ways to adapt graph theory to design problems. For instance, they showed how a rectangular terraced house could be planned following given room-adjacency requirements. Thus, the 'planarity' of the graph is the pre-requisite for realizing candidate solutions (figure 1.10).

Working through this line of thought, some scholars have questioned the relationship between adjacency and access in buildings. Bon (1972) took a sample of seventy North American dwellings and examined the proportion of access against adjacency (Steadman

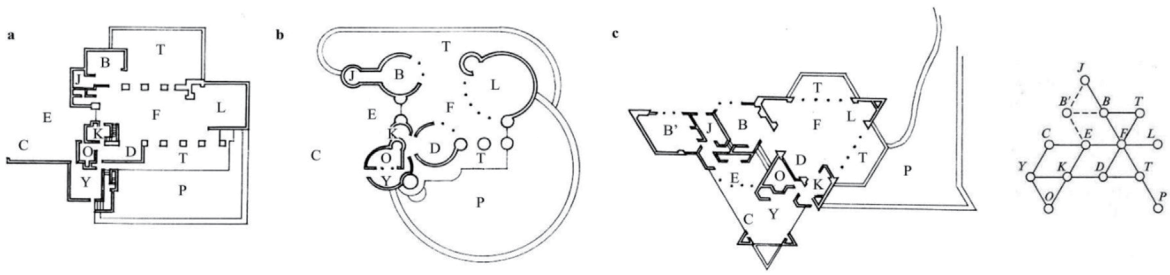


Figure 1.9 Three houses plans by Frank Lloyd Wright and a graph showing their equivalent room connections

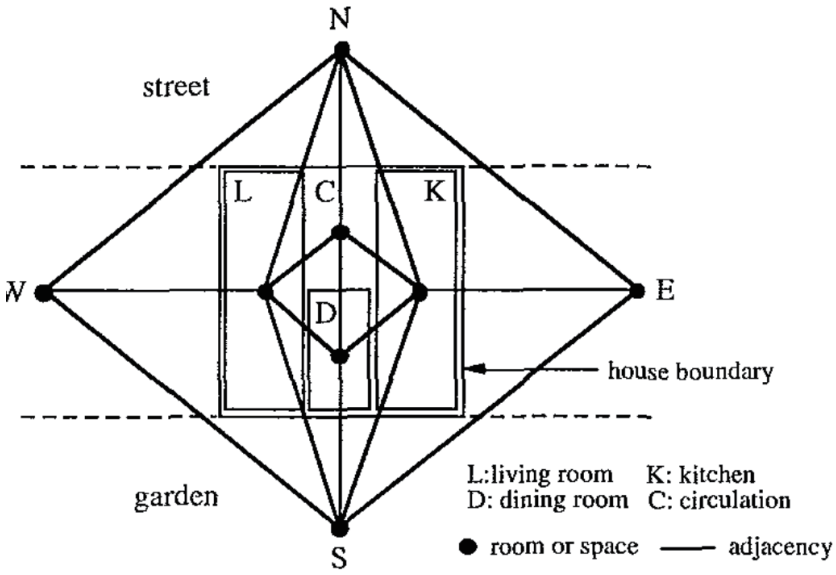


Figure 1.10 Adjacency graph for a hypothetical terrace house

(from March and Steadman 1971)

1983, 185). Since the access graph is a subset of the adjacency graph, the proportion of access against adjacency can show how many adjacency links are used for spatial communication, i.e., doors and other openings. In Bon's sample, it was found that 47% of the adjacencies between rooms were doors. Brown and Steadman (1991) applied this measure to a British housing sample. They found that this 'communication ratio' is higher than Bon's American sample and varies across house types and floor levels.

Some researchers have tried to analyze the historical changes in housing culture using these lines of morphological thought. Dickens (1977) examined a sample of seventy-four small house plans in Cambridgeshire. First, he sought the theoretical possibilities of plan layout using rectangular cells representing significant spaces without circulation space. He compared them with the sample plans to determine that not all the layout patterns were used. He then hypothesized that the reason for this restriction in the number of theoretical alternatives' could be ascribed to the tendency towards compactness in plan and economy

in construction (Dickens 1977, 36).

Next, access graphs for these two-story houses were drawn for the sample with zig-zag lines indicating staircases, and they were sorted according to the layout patterns previously found (figure 1.11). He divided the whole period into 50 years and marked the number of occurrences of these access graphs in each period, and found statistical significance for some graphs in their occurrence.

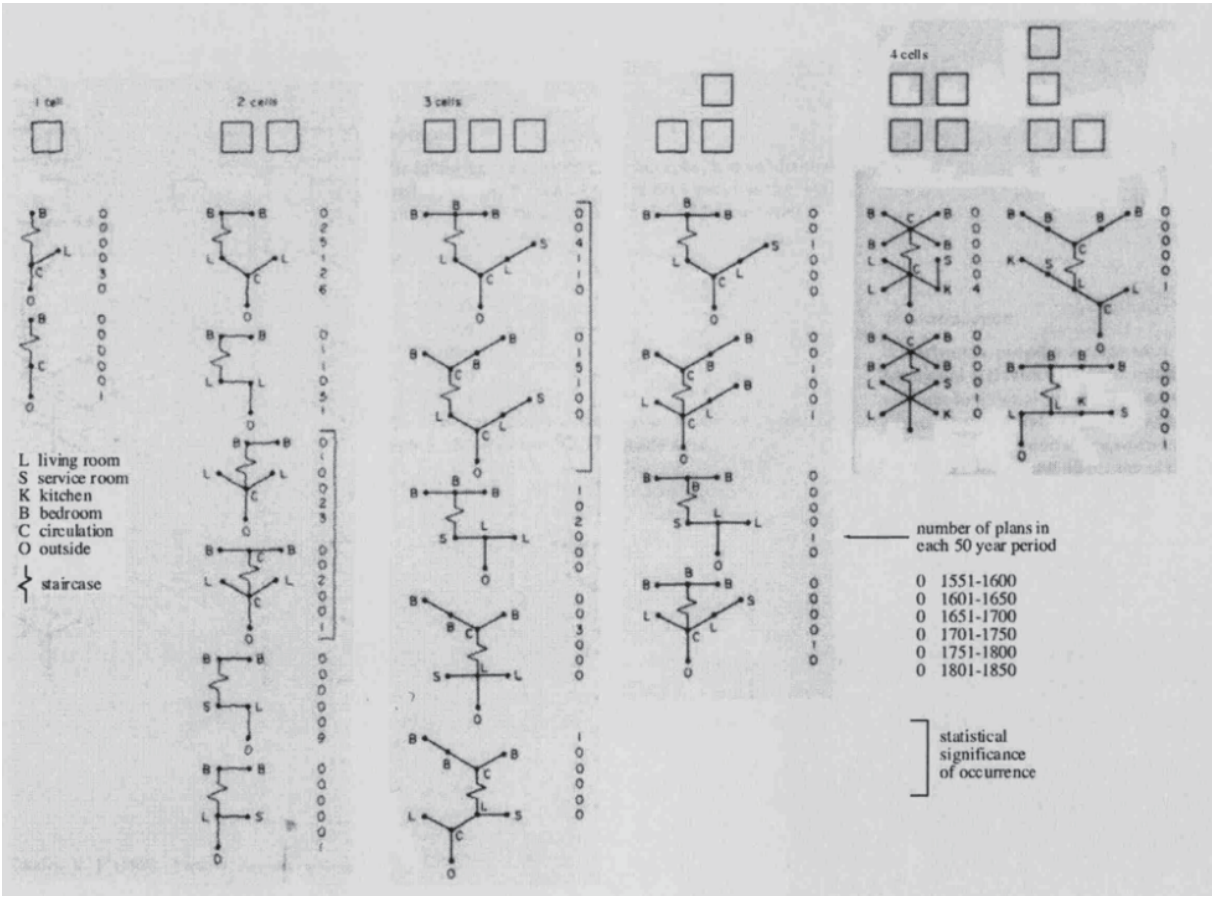


Figure 1.11 List of observed graphs sorted by their plan layout

(from Dickens 1971, 36)

Hillier and Hanson took a further step in using graph theory. They brought its graph technique into their spatial-social theory, space syntax, to measure and evaluate the built environment's properties. Before the detailed account of space syntax theory in the next section, one of their exemplary projects needs to be outlined for the current discussion of graph theory development in architectural research.

Hanson (1998) examined the possibility of how far the typology of residential buildings based on the access graph analysis could be parallel to the social changes in the periods

of their construction. She took the house plans of the Banbury region of Oxfordshire in the seventeenth century assembled by Raymond Wood-Jones. In his original study, Wood-Jones distinguished the house plans into two types. The "through passage' plan and the 'porch' plan, where the former has a through passage running from the front door to the back door separating the kitchen from other living spaces and the later a large back-to-back chimney stack and a porch together separating the parlor from other living spaces – the typical types of these are (a) and (b) in figure 1.12. Despite this clear distinction between the two types, in 'Wood-Jones' sample were many puzzling plans that do not easily fall into these two categories [see plan (c) and (d) in figure1.12].

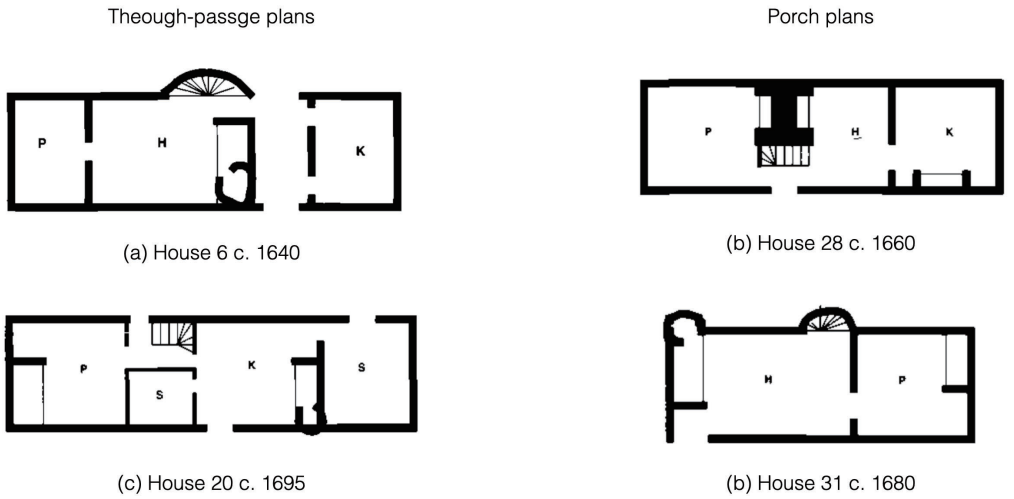


Figure 1.12 Wood-Jones' plan typology for the Banbury region in which plan (a) and (c) are classified as through passage plans and (b) and (d) as porch plans (H=hall, P=parlour, K=kitchen, S=service area)
(from Hanson 1998, 61; 62)

Hanson transcribed these plans into the justified graph' format where their depths from the exterior arrange vertices. Taking into account the configurational pattern of graphs and the position of rooms, they categorized the plans into four categories, i.e. "through passage plans', "single entry plans,' 'multiple-entry plans' and 'sequenced plans' (figure 1.13)

By mirroring the social changes in the seventeenth century to the plan morphology, Hanson related different household structures and lifestyle types to each category of plans. Based on the differentiation of social status by wealth after the middle of the seventeenth century.

She associated the unprecedented multiple-entry plans with rings and shallow configurations to more wealthy Banbury yeoman farmers and the sequenced plans that inherited the through-passage plan's regional style, i.e., the deep sequencing and branching principles, to more impoverished peasants.

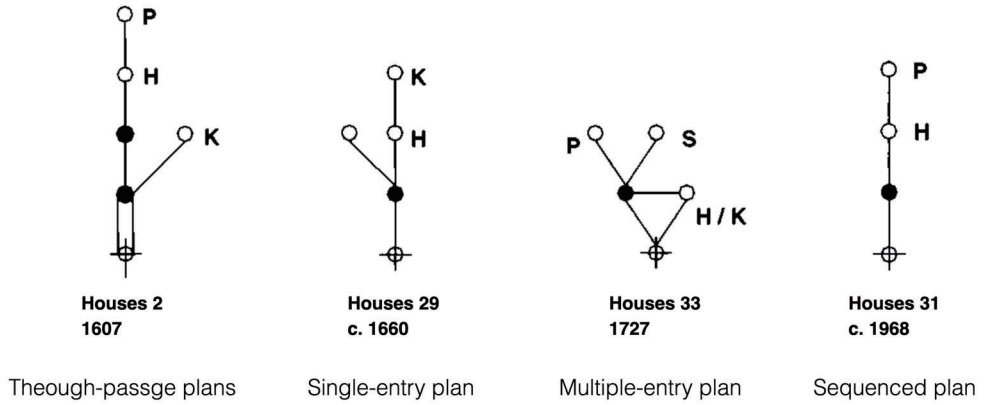


Figure 1.13 Four typical justified graph types by Hanson's configurational typology

(those four plans in figure 2.8 can be re-categorised into these four types; black dots: transitiomal space)

(from Hanson 1998, 66)

Next, concerning Lawrence Stone's book, The Family, Sex, and Marriage in England, 1500-1800, she related the through-passage plans, which put the parlor in the deepest area for the family's head to the open lineage family' in the early seventeenth century. The single-entry plans, which segregate women by putting the kitchen in the deepest place, to the restricted patriarchal nuclear family' around the middle of the seventeenth century. Moreover, the multi-entry plans, which reflect the enhanced women's status, to the 'closed domesticated nuclear family' that appeared from the late seventeenth century. It is not the space to deliver a detailed account of these relations. However, it should be noted that in Hanson's argument, the access graph takes an essential role to shed light on the socio-cultural dimension imprinted in architecture.

Hillier and Hanson's approach of utilizing graph theory to interpret cultural aspects of the built environment has been widely accepted in many different projects across disciplines, including architecture, archaeology, and anthropology. For example, through the access graph's justified format, Brown (1986) illuminated the changing characteristics of the domestic space in seventeenth-century London. Chapman (1990) tackled the problem of the archaeological interpretation of Bulgarian tells; and Blanton (1994), in his comparative study, analyzed house plans from different parts of the world to find out their links to each cultural system from the anthropological perspective. The meaning of Hillier and Hanson's approach is that they found the 'social' within artifacts. By bringing to light the dimension of 'depth' from access graphs, they opened the possibility that pure morphology could be linked to the dimension of the 'social'. In the following section, their theory and method are explained and analyzed.

1.6.5 Space syntax: theoretical statement and critical evaluation

It has been suggested that to reveal the cultural dimension of housing that tends to have multiple meanings, research should be rooted in the very nature of buildings themselves, and following this line of thought, many studies, which emphasized morphology, have been reviewed. In most of the studies reviewed, the analyses of housing morphology could be virtually connected to the architectural level of interpretation, e.g., building typology, design grammars. However, apart from Hanson and Hillier's research, they seemed to have less analytical consistency in linking their analysis to the socio-cultural level of interpretation. How can morphological aspects of housing be connected to the abstract notion of society or culture? The possibility can only arise when the spatial organization of the house is seen as following a particular social order:

"The only possible exception, the only true social theory that could come out of architectural studies would necessarily be closely related to the most important characteristic the built environment possess: its capacity to order space and organise human contact. Such a theory could only be developed from a method of describing and measuring the space of buildings." (Samson 1990, 6)

According to Hillier and Hanson (1984), architectural studies' typical problem can be epitomized as a 'man-environment paradigm' in which the social dimension is separated out from architecture. Confined in this paradigm, the existing architectural studies have moved the problem definition to the wrong position where 'space is desocialized simultaneously as society is spatialized.' Thus the former being reduced to mere inert material, the latter to mere abstraction' (Hillier and Hanson 1984, 9). For Hillier and Hanson, space is seen not as a static reflection of already existing society; rather, it is seen as being created within the process of social change and further as affecting the social change:

The most far-reaching changes in the evolution of societies have usually either involved or led to profound shifts in spatial form, and in the relation of society to its spatial milieu; these shifts appear to be not so much a by-product of the social changes, but an intrinsic part of them and even to some extent causative of them. (Hillier and Hanson 1984, 27)

By detecting the social dimension framed within the pure state of architecture, the space syntax theory, developed by Hillier and Hanson, can bridge the gap between the architectural analysis and the cultural interpretation. The theory is based on the idea that it is through configuration that a cultural pattern of activities is embodied in material culture. Thus Hillier notes:

"One thing is clear. Encountering, congregating, avoiding, interacting, dwelling, conferring are not attributes of individuals, but patterns, or configurations, formed by groups or collections of people. They depend on

an engineered pattern of co-presence, and indeed co-absence. Very few of the purposes for which we build buildings and environments are not 'people configurations' in this sense. We should therefore in principle expect that the relation between people and space, if there is one, will be found at the level of the configuration of space rather than the individual space." (Hillier 1996, 29-31)

In space syntax, to measure and evaluate configuration, first, the access graph's justified format is drawn. The strength of the justified graph lies in the fact that it can reveal the inherent structure of space that is hard to comprehend from a plan's visual investigation (figure 1.14). From the figure, it is recognized that those four buildings with the same geometrics and adjacency graphs are entirely different in terms of access configuration. It is intuitively noticeable among the four graphs that graph (C) is the most integrated from the original space's standpoint at the bottom since all the spaces are tightly linked to it, making the system shallow. In contrast, graph (d) is the least integrated for the opposite reason: the points are in general lining up in a sequence getting farther away from the original space, thus making the system deeper.

The degree of 'integration can be mathematically measured, in three steps, based on the justified graph. First, the mean depth (MD) is calculated by summing up all the depths from the original point to all the others and dividing them by the number of the points less one. Second, relative asymmetry (RA) is calculated from the following formula in which k is the number of points: RA=2(MD-1)/k-2. This is to compare "how deep the system is from a particular point with how deep or shallow it theoretically could be" (Hillier and Hanson 1984, 108).

Third, to deal with different sized systems, real relative asymmetry (RRA) is calculated by dividing the previous RA value by the RA value for the origin of a 'diamond-shaped pattern 3: RRA = RA/Dx. While this calculation for RRA quantifies the original space, when the RRA values for all the points in a system are averaged, the system's degree of integration is acquired; it is called "mean RRA'.

This simple measure of integration has been proved to be a powerful tool to explain the house's social dimension. A space in the house that has the highest degree of integration (thus having the lowest RRA value) can be accessed easily and quickly from the other spaces under normal conditions. It means that space has the potential to have controlling power over the whole domestic space. In contrast, when space has the lowest degree of integration (thus having the highest RRA value), it is less accessible due to its topological distance farther away from the others - thus, most segregated in the house. In this latter case, the movement of going into and out of this space can be more easily controlled.

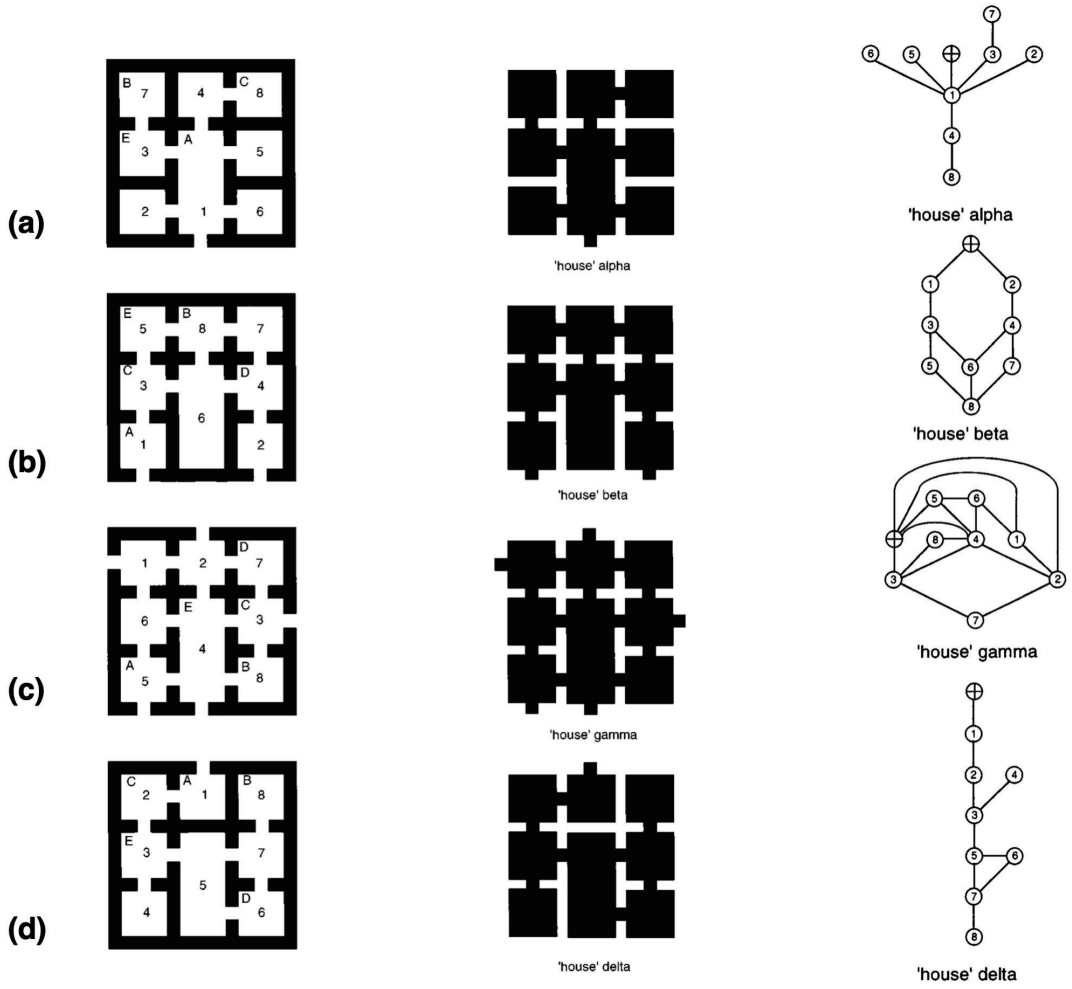


Figure 1.14 Four hypothetical plans their justified graphs form the exterior

(from Hanson 1998, 25; 26)

The assignment of functions to these spaces that are syntactically different tends to follow, to some extent, socio-cultural norms. In many modern apartment houses in Seoul, central halls and living rooms tend to be found in more integrated locations. In contrast, balconies are found in more segregated locations in terms of their syntactic values. When the numerical variation of syntactic values follows a specific order across a sample, then it can be said that the houses share a social logic indigenous to that culture. This 'numerical consistency in spatial patterning' is called 'a housing genotype' (Hanson 1998, 32). As Hanson put it:

"Functional patterning was imprinted into the physical and spatial form of the house. We might best think of this not as a background to behaviour but as a record of behaviour transmitted through the building, perhaps through several generations. Configurational analysis of plans can be conceived of as an 'archaeology of space'. If houses display configurational regularities then the buildings speak directly to us of culturally significant household practices which have been crystallised in the dwelling in the form of an integration inequality genotype." (Hanson 1998, 38)

Through the biological concept of genotype, space syntax distinguishes the spatial pattern in the domestic space from the house's simple form, which is subsequently defined as a

phenotype. Thus the structural distinction between genotype and phenotype is made where the former carries the social meaning of dwellings. Simultaneously, the latter is relegated to an individual variation of the former at the surface level. The fact that configuration is rendered, over the other characteristics, as the single most essential feature of dwellings to find the socially significant genotype, has been the main criticism against space syntax. The criticism can be divided into two categories: the first one is skepticism about its direct connection to social interpretation without considering context, and the second one relates to its geometric reduction to topology, denying the implication of form.

In the first category of criticism, the argument is made at a theoretical level that space syntax is too formalistic in its approach to reveal the social dimension of dwellings (Hodder 1986, Boast 1987, Lawrence 1987, Brown 1991, Johnson 1993). In this criticism, the theory relies exclusively on configuration making spatial patterning and social meaning a one-to-one relationship while ignoring the context and changing meaning over time. For example, Lawrence (1987, 53) argues that space syntax analysis is misleading because dwellings' spatial characteristics are 'interpreted as fixed objects by a static abstraction that overlooks their life history.'

However, this line of criticism seems to have neglected to deal with the basic concept of the theory and the related projects dealing with a variety of socio-cultural contexts. Throughout their book, The social logic of space (1984), Hillier and Hanson show how different social meanings can be assigned to houses and settlements' spatial structure in association with different geographic and historical contexts.

Hanson's study of the seventeenth century English house in the Banbury region, which was reviewed in the previous section, shows another example. In her study, the deepest position in the house is interpreted as having more than a single social meaning: in the through-passage plan, the parlor in the deepest position signifies the status of the household head, while in the single entry plan, the kitchen in the deepest position was to control women. The criticism yields no productive debate on the theory and only brings the issue of context that has been already discussed and established within the theory:
In the second category of the criticism, it is argued that space syntax, confined within the genotype-phenotype paradigm, disregards the formal side of the built environment that is

"The simplest of space configuration can support complex, many-layered and evolving meanings which can be assigned and reinterpreted by different individuals and groups, be they located within the culture or commenting on it from the outside." (Hanson 1998, 78)

inseparable from the understanding of the whole (Boast 1987; Boast and Steadman 1987; Brown 1990; Blanton 1994). In other words, by the action of 'stripping back' of the formal aspects that might affect the spatial configuration, space syntax 'excessively limits the field of exploration' (Boast 1987, 452). The best example of such an argument can be found in several studies dealing with the narrow-frontage British houses (Brown 1986, 570; 1990, 96; Brown and Steadman 1991, 407). In these historical and contemporary house plans, the narrow frontage, which is caused by the local condition of the site geometry or the building form, has affected the spatial organization of the interior and, as a result, entailed a long sequenced access pattern. In particular circumstances like the one above, the building form becomes a vital modifying factor in the design of the internal configuration. It does not, however, indicate the methodological limitation of space syntax. On the contrary, if an interpretation can be linked to background information, a topological analysis still can be the most powerful tool to reveal the social dimension. Even in the above studies, the authors turn to the justified graph representation to effectively show geometric constraints.

Any social research should be rooted in the context of its subject, and space syntax research is no exception, and many variables, including the formal aspects of the house, should be taken into account depending on that context. It is another case where the formal aspects should not be disregarded. In this thesis, therefore, to deal with this issue, formal aspects will be carefully investigated within the theoretical framework of space syntax.

1.6.6 Summary and discussion

It has been noted early in this section that a research framework is needed to investigate the cultural dimension in housing. Several models suggested research methods were introduced and criticized; in Lawrence's research model, even if a well-defined set of variables that affect housing culture is suggested, he did not provide a method for relating these to architecture. In Rapoport's model, he emphasized the importance of activities in architecture as a way to illuminate culture. However, he failed to show how activities and architectural settings could be systematically related. Based on the premise that the house, as if a text, has multiple meanings exposed to reinterpretations. It was suggested that the house should be examined in the first place as a thing in itself because what is unchanging is the very nature of its spatial syntax. In this respect, several studies on housing with an emphasis on morphological aspects have been reviewed. First, Glassie and Williams's

works on the transformation of the American folk houses were found to be suggestive approaches for this thesis in which the change in housing culture through time is the primary concern. Second, while the other morphological research failed to link housing to culture, Hillier and Hanson's space syntax was evaluated as a valid theory and a method for the argument of this thesis.

In chapter I.4, three study questions were asked: first, how is an old spatial organization mapped onto a new setting that is formally and functionally different?; second, how is an old conceptual dimension in space transferred through a transformation process?; third, how is the spatial intuition from the past accommodated within the social-cultural constraints of traditional housing? These questions can be answered through the theoretical and methodological frameworks constructed in this chapter from the review of the existing literature. Space syntax is the leading theory that constructs the fundamental basis for the whole thesis; it is the only theory that fills in the gap between the morphological analysis and social interpretation. For the first question, relying on Rapoport's idea of 'system of settings and system of activities', the new spatial setting of the apartment houses in Seoul is compared with the old courtyard houses in the light of 'space-behaviors' interactions. The second question deals with how the symbolic dimension inherent in each country's domestic space for hundreds of years is transferred through the twentieth century's housing transformation process. The topological analysis of space syntax illuminates this intractable problem. The third question is to investigate the effect of the geometric restriction on traditional houses' design mechanisms in each country that intuitively follows the inherited space configuration.

1.7 Structure of the argument and the layout of the studies

In the previous sections, the research questions that define this thesis's problems were suggested, and the proper methodology appropriate to the problems was chosen. The theoretical framework of the thesis can then be illustrated as in the figure below. The theoretical structure of the thesis is constructed based on the theory and methodology of space syntax. The thesis's whole argument is divided into three categories: a spatial dimension, a symbolic dimension, and a social-cultural dimension. Within the spatial dimension category, the housing evolution in South Korea, China and Japan is examined in terms of spatial configuration. It will answer the first sub-question: how is an old spatial organization mapped onto a new setting that is formally and functionally different? The key concept in this part of the argument is the 'space-behavior interaction.' The second category is characterized as a symbolic dimension. Focusing on the symbolic concept fellow as; level distinction in Korea, separation of household in China, and Mae-Oku distinction in Japan, which underlies housing evolution, the second sub-question is answered: how is an old conceptual dimension in space transferred through a transformation process? Lastly, the third category of the argument is defined as a social-cultural dimension. What is highlighted in this part of the thesis is the inter-relationship between the Traditional family structure of the housing and its space's syntactic configurational structure. This category will answer the third sub-question: how is the spatial intuition from the past accommodated within traditional housing's social-cultural constraints?

Chapter one has described what the whole argument of the thesis is aiming for. In the beginning, it was shown that the changing housing culture in time could be understood as an evolutionary process. This analogy was then adapted to each country's unique case, where the change was fast and intense. Reviewing the brief history of changing housing culture in Seoul, research questions, which would help define the study's direction, were asked, and then based on the pre-requisites of the research, a methodological framework was suggested. And reviews related literature and methodologies that deal with the morphology of housing. Starting from the house's conceptualization as a text that can be encoded and decoded by designers and users, the chapter carefully evaluates the literature to see how the abstract meaning of housing culture can be studied. Through this investigation, a proper research framework is constructed in detail, and at the end, the rationale behind the selection of the leading theory for the thesis, space syntax, is elaborated.

Chapter two, three, four, concentrates on the history and general characteristics of the houses in each country. Each chapter is divided into three sections as follows; first sections provides information on the early origin and evolution of each country's domestic space with its cultural and environmental causes. Next, the historical background and the morphological traits of the urban housing types that existed in the twentieth century are described in detail in chronological order to provide the knowledge required to understand the two following analysis chapters. Second section is designed to answer the first and second sub-questions of this thesis, which have been described in chapter one. Using the space syntax technique, the chronological change of the housing space in the urban is investigated. The findings from the analysis strongly suggest that there is a gradual evolution of old spatial values under the radical formal change on the surface.

Chapter five comprehensively compares the evolution of urban housing in each country, covered independently in previous chapters. In the previous chapter, the spatial composition changes from traditional houses in each country to modern apartment houses were analyzed about each country's traditional elements. Traditional houses in each country have spaces with different characteristics to reflect the social society-cultural structure. However, they have a somewhat standardized space function as they pass through the modernization process. Functionally similar spaces can be found on apartment floor plans in South Korea, China, and Japan, such as: "private space(bedroom)," "public space (living, living-dining, Ting)," "semi-public space(dining-kitchen, kitchen)." The topological centrality of each space is compared according to the passage of time. The two axes, bedroom-public space, bedroom-cooking space, are separated to derive each country's commonalities and differences.

Chapter six synthesizes and concludes the whole argument. Here, those three categories of research in different dimensions illustrated above are put together. By revisiting the analyses in second section, it is discussed how those findings could be connected and understood within the thesis's global perspective to answer the main question: how do old spatial values interact with a new domestic setting? the study's contributions and limitations within the field of architectural research are discussed.

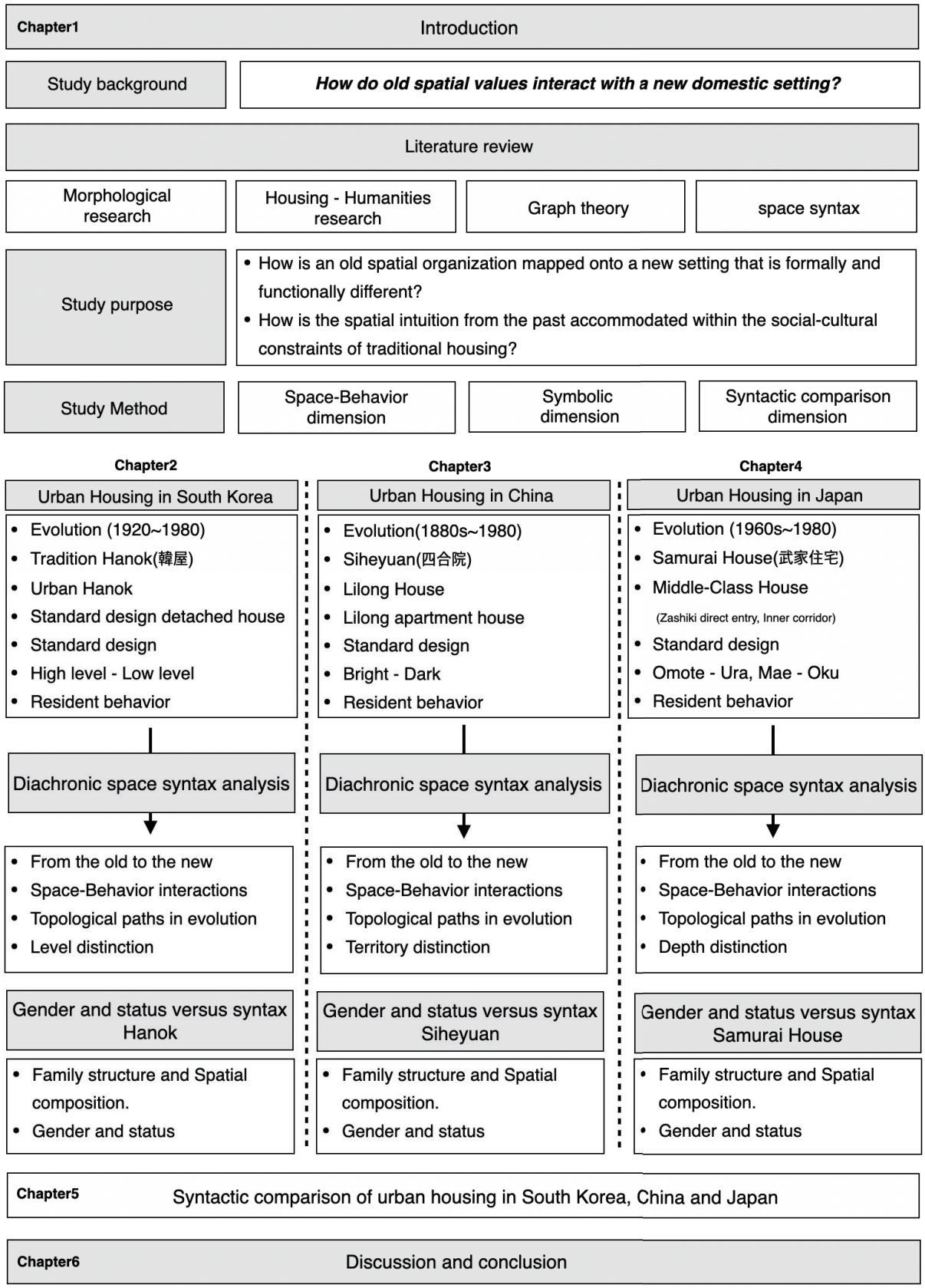


Figure 1.15 Study layout

1.8 Study morphology

This study targets urban housing in South Korea, China, and Japan built in the late 1800s to 1980s. Floor plan data is collected in three periods as follows; a) Early modern period (Joseon Dynasty, Ming/Qing era, Edo era). b) 1900s~1950s, c)1960s~1980s. Based on previous research, urban housing types are divided into three and collected as follows; a) Traditional housing (South Korea: Hanok, China: Siheyuan, Japan: Samurai houses), b) Modern urban detached houses (South Korea: Urban Hanok and standard housing, China: Lilong houses, Japan: Middle-class housing), c) Public Sector apartment standard design. All floor plan data was collected primarily from government publications; South Korea: Korea National Housing Corporation, Cultural Heritage Administration. Japan: Japan Housing Corporation, Urban Renaissance Agency). In China's case, floor plan data from "***Architectural Journa***l" in 1945 to 1989 were collected. Floor plan data was collected from 157 cases in South Korea, 157 cases in China, and 158 cases in Japan. The collected floor plan data contains typical floor plans pointed out in previous studies.

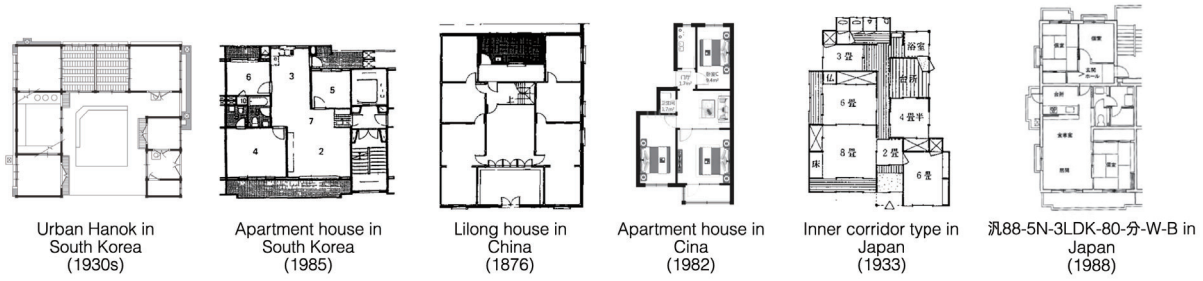


Figure 1.16 Traditional houses and modern apartment houses in each country

It was after the World war ii (1945) that the mass construction of modern-style housing began in each country . In less than a half-century, the house form and culture in the country have been radically transformed. Among the new house types, the apartment housing proved, economically and culturally, to be the fittest in adapting to the middle-class need. It is reported that the first apartment building in Korea was built in 1958, and the first apartment complex developed on a site-planning concept was initiated by KNHC (The Korea National Housing Corporation) in 1963. In 1951, the 51C plan with Japan's modern characteristics was proposed, and the DK type standard design was developed in earnest. After the founding of the People's Republic of China in 1949, many apartments were built to rebuild the city. In the 1990s, after only three decades, it became the most dominant housing type in the city. If it was the traditional detached house that molded each country'

typical domestic life until the 60s, now it is the modern apartment houses that the prime position.

On the surface, morphologically, those each country's two types are entirely different. Figure 1.16 shows that the detached house, which is inward-looking, has now turned into the self-contained modern apartment house outward-looking. What has been changed is not only the overall form. Some spaces in South Korea's case, like the courtyard, have disappeared. Some have emerged; those multi-functional rooms like anbang and Daecheong Maru of old houses have been endowed with new names, main bedrooms, and living rooms due to their more specialized functions in the modern period.

This situation is where the continuity and change cannot be measured simply by the space syntax value of each partitioned space. In other words, for example, the old anbang and modern main bedroom are not equivalent even though they share a considerable amount of characteristics. To deal with this subtle problem, it is needed to focus on the "space-behavior" interactions, how each partition space's behaviors are preserved, migrate, and finally re-group to form new spatial frameworks (figure 1.17).

Figure 1.17 shows a conceptual diagram where spaces are interacting with activities within a domestic space. The three activities in space B in phase 1 are moving towards different positions as time passes and finally are accommodated in three separate spaces. In their paths, space C demises after phase 2, and a new space emerges in phase 4. If the topological traces of activities that underlie the formal change of domestic space.

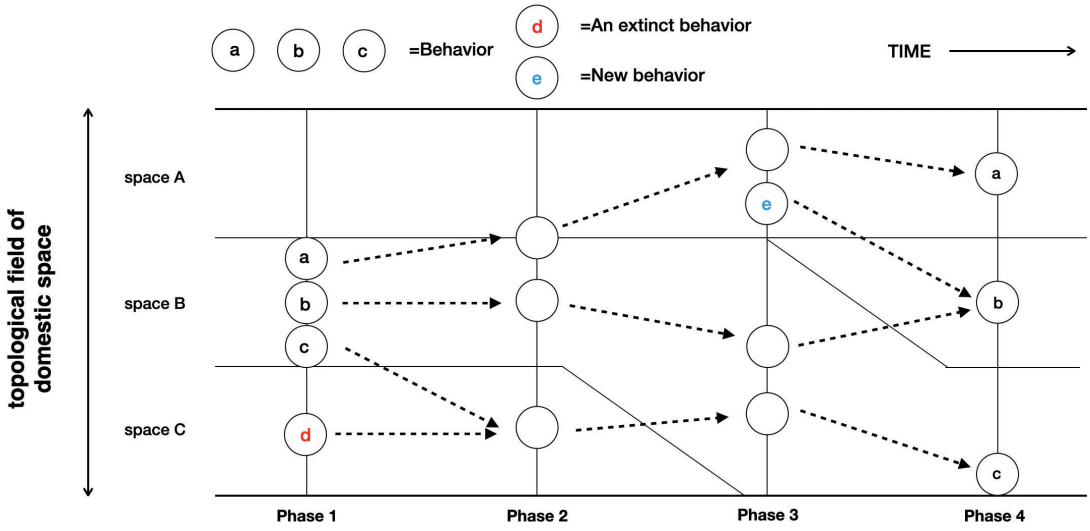


Figure 1.17 Concept diagram of “space-behavior” interactions

It can be illustrated clearly as in the conceptual diagram above; evolution can be more effectively measured. This conceptual framework enables the investigation of 'space-activity interactions, the first sub-question of this thesis – how is an old spatial organization mapped onto a new setting that is formally and functionally different? - will be answered. Besides, this investigation will provide a basis for a further analysis that will bring the issue of 'level-distinction,' and this will answer the second sub-question - how is an old conceptual dimension in space transferred through a transformation process? In the following chapter, the movement of activities is drawn graphically in diagrams and then converted mathematically to space syntax values. They are measured at five important stages of evolution, each of which is characterized by an emergence of a distinct housing pattern.

Space syntax has developed into a theory that can perform spatial analysis with several indicators for analyzing urban streets and building spaces.In particular, concerning the study on urban spaces, space can be quantified and represented by "axis analysis," which analyzes the connection structure of external spaces, and "convex space analysis," which analyzes the internal spaces' connection composition buildings. This study analyzes the changes in urban housing's spatial composition in South Korea, China, and Japan through convex space analysis. As an indicator for analysis, the integration value, which is the reciprocal of the RRA (Real Relative Aysymmertry) value, and the standardized integration value(Z) are used(figure 1.18).

The biggest issue in analyzing traditional housing and modern urban housing is the difficulty of comparing the integration value according to the difference in scale of housing. The method of calculating the integration value includes a correction procedure to minimize the influence of the number of nodes. However, the improved calculation method cannot completely escape the influence of the number of nodes (Kim, 2011). In this study, minimize the effect of the number of nodes with the difference in scale and will use the standardized integration value that does not impair the reliability of the comparative analysis by the scale

Mean Depth $MD(i)=\frac{\sum_{i=1}^{n} d(i,k)}{n-1}$

Relative Symmertry $RA_i=\frac{MD_i-1}{\frac{n}{2}-1}=\frac{2(MD_i-1)}{n-2}$

Real Relative Symmertry $RRA_i=\frac{RA_i}{D_n}$

$D_n=\frac{6.644n\times\log(n+2)-5.17n+2}{(n-1)(n-2)}$

Integration (Centrality) $I(i)=\frac{1}{RRA(i)}$

Standardized Integration $Z=\frac{X-m}{\sigma}$

(m: integration mean, σ : standard deviation of integration)

Figure 1.18 Formula for calculating each indicator

difference. This method is expected to be able to compare and analyze residential spaces of different scales, using standard normal distribution which *Z* value calculation method.

This section explains the process of classifying the actual convex space and grasping the spatial composition. For example, Figure 1.19 shows a simple apartment floor plan converted into a convex map. The corridor, the kitchen, and the living room are not surrounded by walls but can be divided into convex spaces and reproduced in a connected relationship. In other words, must go through the kitchen to enter the living room at Corridor 6. By changing this connection relationship into a justified graph, it is possible to grasp the spatial depth relationship based on the external space. It can be intuitively seen that the utility room (No. 10) attached to the kitchen is most isolated from the house's interior space as external space. It can also be seen that livingroom(No. 2) is the most integrated space(figure 1.19).

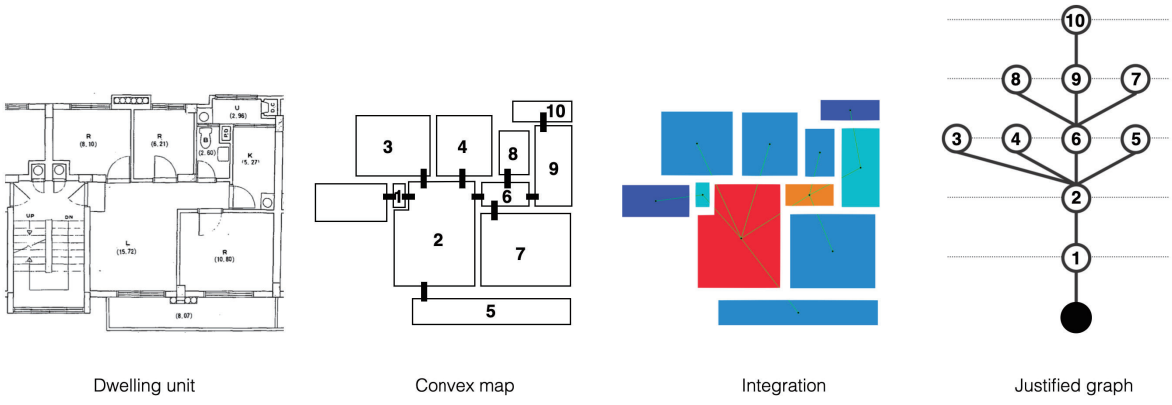


Figure 1.19 Space syntax analysis process

The convex spatial analysis of space syntax has the advantage of showing a topological relationship based on the connection relationship of segmented spaces. Each step from one space to another is defined as depth. In other words, it quantifies and reproduces the spatial depth relationship to reach all other spaces from one arbitrary space. Therefore, there is a characteristic that the integrated value changes by the method of segmenting the space. The method of segmenting space is being studied in various aspects. Basically, the convex space is divided into a unit space based on the access and visual connection between the spaces. Jung and Choi (1996) applied four methods and analyzed RRA value change according to spatial division. In conclusion, it is described that by short-side division method is the most suitable(figure 1.20). Yoon (1981) asserts the possibility of forming a unit space by applying the concept of enclosing balance.

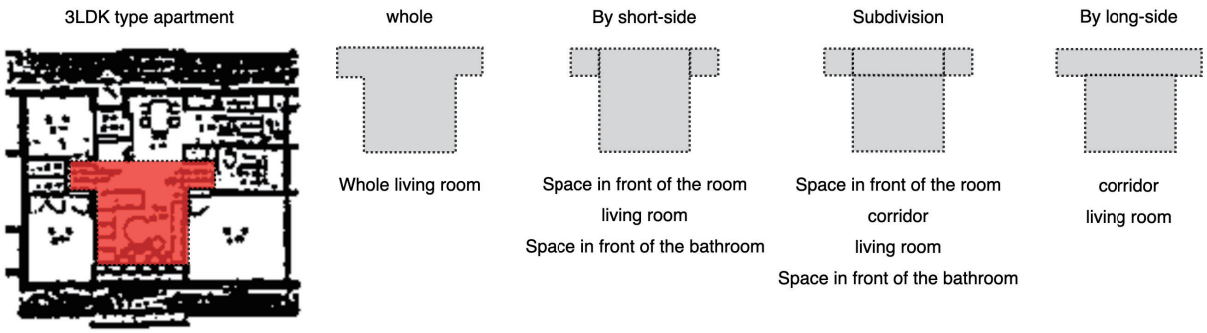


Figure 1.20 Four ways of dividing the convex space

(reproduced from: Jung and Choi, 1996, 47)

Previous studies have limited it to apartment housing types. However, each country's traditional houses and the detached house in the early modernization period maintain a complementary relationship between outer space and the inner space. In particular, Japanese samurai houses and middle-class houses have a spatial composition surrounded by external spaces(figure 1.21). Also, detached houses in the 1950s in South Korea changed from a traditional courtyard house to placing the main building in the front yard and north.

Therefore, in this study, the short-sided division method is applied to the apartment type that is less affected by the external space. In the case of traditional and detached houses, the principle of space division is established as follows: a)fattest, fewest convex spaces. b) In the case of a continuous veranda(Toenmaru, Engawa) in front of the room and the Techoung(main hall), the Convex space is divided based on the column between the Techoung and the Toenmaru, c) In the case of a narrow and long floor, distinguish

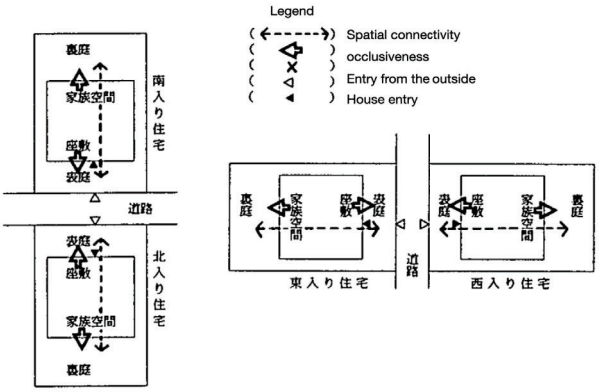


Figure 1.21 Principles of spatial composition of samurai houses

(reproduced from: Ooka, 1999, 102)

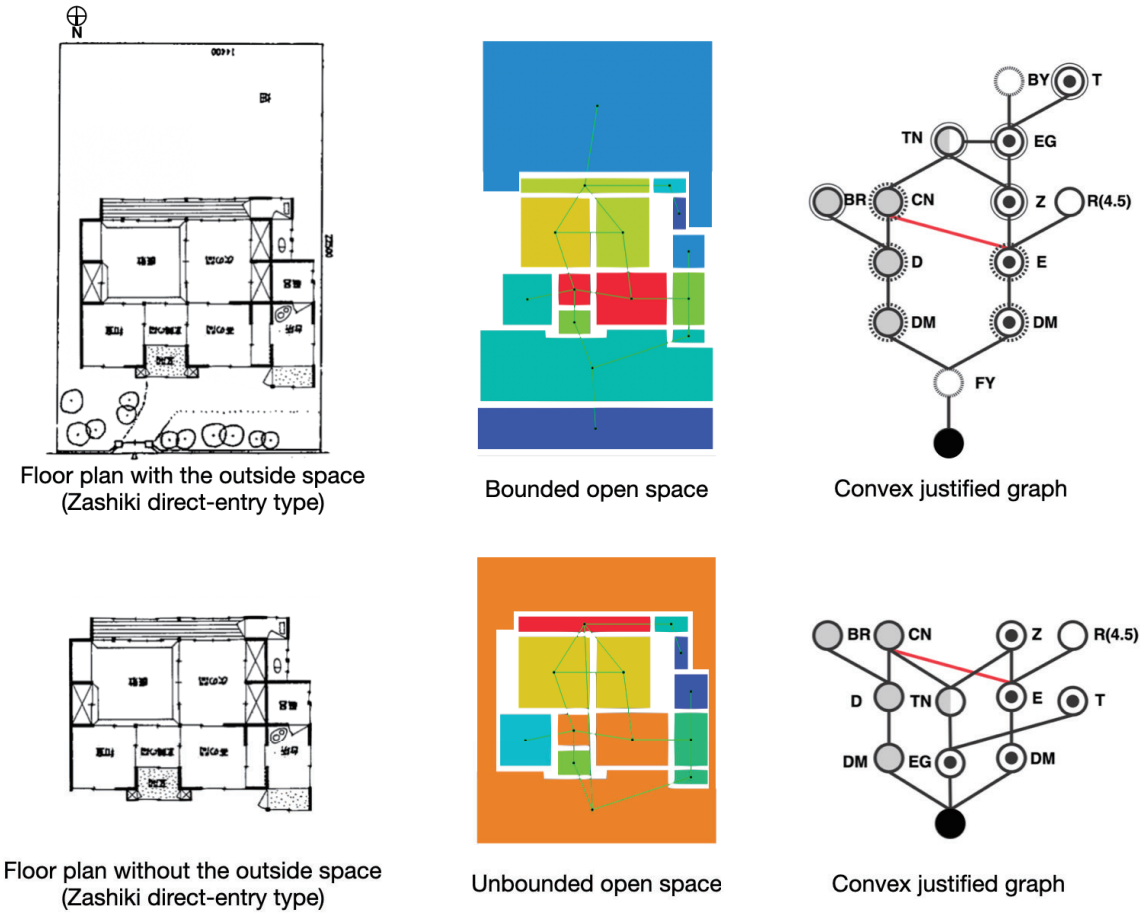


Figure 1.22 Tow ways of dividing the outside open space

according to the wall, d) The veranda(Toenmaru, Engawa) with a width of less than 60 cm is considered not the purpose of the move and excluded from the analysi, e) In the case of the outside space, exclude convex spaces with a minimum width of 1 m or less. However, it is included in the case of the passage connecting the inner space and the outer space.

For example, samurai houses and middle-class houses in Japan divide spatial areas into Omote and Ura areas. The front yard is included in the reception sector, which visually connects directly with Zashiki, and the back yard is included in the family living area that links with Ima or Heya. Figure 1.22 shows the integration value of the Zashiki direct-entry type changing according to the external open space segmentation method. The bounded open space division method is characterized by dividing the front yard and the back yard and linking to each sector. As a result, it shows a high integration value of Genkan and Chanoma that handle each space's circulation. Besides, it can be seen that the back yard is isolated compared to the front yard. It can be interpreted that the backyard comes from the consciousness of forming a private realm as a family living space. It can be judged that the research results of Ooka (1999) are faithfully reflected.

The unbounded open space division method establishes a single space in which the house's outer space is integrated. As a result, the degree of integration of Engawa attached to the backyard increases dramatically. Engawa has an essential meaning as a space that connects the outside and the inside in Japanese houses. From this point of view, it can be judged that this segmentation method is valid. However, there is also a characteristic that the difference between the reception area and the family living area of the samurai house is not clearly revealed. Therefore, in this study, the by short side partitioning method is applied to the inner space, and the bounded open space partitioning method is applied to the outer space.

Chapter 2

Evolution of Domestic Space in South Korea :
diachronic space syntax analysis

2.1 Housing in South Korea

2.1.1 Traditional house
2.1.2 The Urban Hanok(Improved traditional housing : 1930s~1960s)
2.1.3 Colonial houses (1941~1945)
2.1.4 Public sector detached houses (1954~1960s)
2.1.5 Apartment houses (1962~present)
2.1.6 The concept of level distinction

2.2 Evolution of Domestic Space

2.2.1 Introduction : from the old and new
2.2.2 Traditional code and its transfer to the early detached houses
2.2.3 Evolution of apartment house plans: 1960s ~ 1990s
2.2.4 Topological paths in evolution
2.2.5 Level distinction and heating system as an underlying force in evolution

2.3 Respect of Spatial Structure on Gender and status

2.3.1 Introduction
2.3.2 Family structure and housing spatial composition

2.4 Conclusion: genotypical property of space

2.1 Housing in South Korea

2.1.1 Traditional house

Korea has a total area of 220,848km^2 and located at the northeastern rim of the Eurasian continent with its latitude raging from 33˚N ~ 43˚N (735km long) and longitude from 124˚E~131˚E (360km wide). It is a peninsula, a transitional region in which a continental country and an island country coexist. The geographic situation where it is adjacent to neighbors on both sides but at the same time isolated from them has implanted the two tendencies of 'conservation and adaptation' (Jo 1968, 10-29). The Korean peninsula's housing culture also reflects this duality; its housing culture, defined as being in the middle between those of China and Japan, has shown both adaptations to the natural environment and conservation of traditional forms without change until the early 20th century (Joo 1980, 6).

The climate of the country also shows a transitional trait where the continental and ocean climate coexists. The Korean peninsula has marked four seasons; compared to Europe's western coasts at the same latitude, summer temperature is more hotter, and winter is more colder (Oliver 1997, 877). The annual rainfall is 600~1500 mm, and 50-60% is concentrated in the summer season from June to August. Because of the hot and humid summer and cold and dry winter, the Korean houses have developed two contrasted floor structures, namely maru (raised wooden floor) and ondol (floor heating system). A more detailed description will follow in the next section.

The traditional house's exact plan configuration before the Joseon dynasty (1392~1919) is not found from the historical documents; only the remaining paintings and drawings indirectly show the limited information about the house. All the old plans known today were mostly built after the Joseon dynasty's middle period - mostly after the 17th century. The plans in Korea show a morphological variety concerning the geographic regions, while most of them possess the structure of both maru and ondol (figure 2.1).

From figure 2.1, it is recognizable that maru (hatched part) is combined with other rooms and a kitchen to make different plan types. Interestingly this variation of plan type directly reflects the regional climatic influence. The one on the top has no maru since the region is the coldest area where the average temperature is under 5°C. Thus, the architectural con-

sideration for hot summer is not necessary. Going down towards the south, the annual average temperature and rainfall level go up, and, as a reaction, the portion of maru gets bigger. In all cases, the kitchen is a low-level space with an earthen floor, and all the other interior rooms are high-level spaces equipped with maru or ondol. Meanwhile, it should be noted that these plans in the figure are the minimum house blocks where the essential functions are included. In an extreme case, one of these blocks can be the whole building feature of a house, but in a standard case, some subservient spaces like a granary, a pantry, and a toilet are added near this main block. Therefore, a house typically has more than one building block within its compound surrounded by a fence. In this type of multi-building layout, courtyards or yards become necessary spatial devices that link the building blocks and absorb household activities.

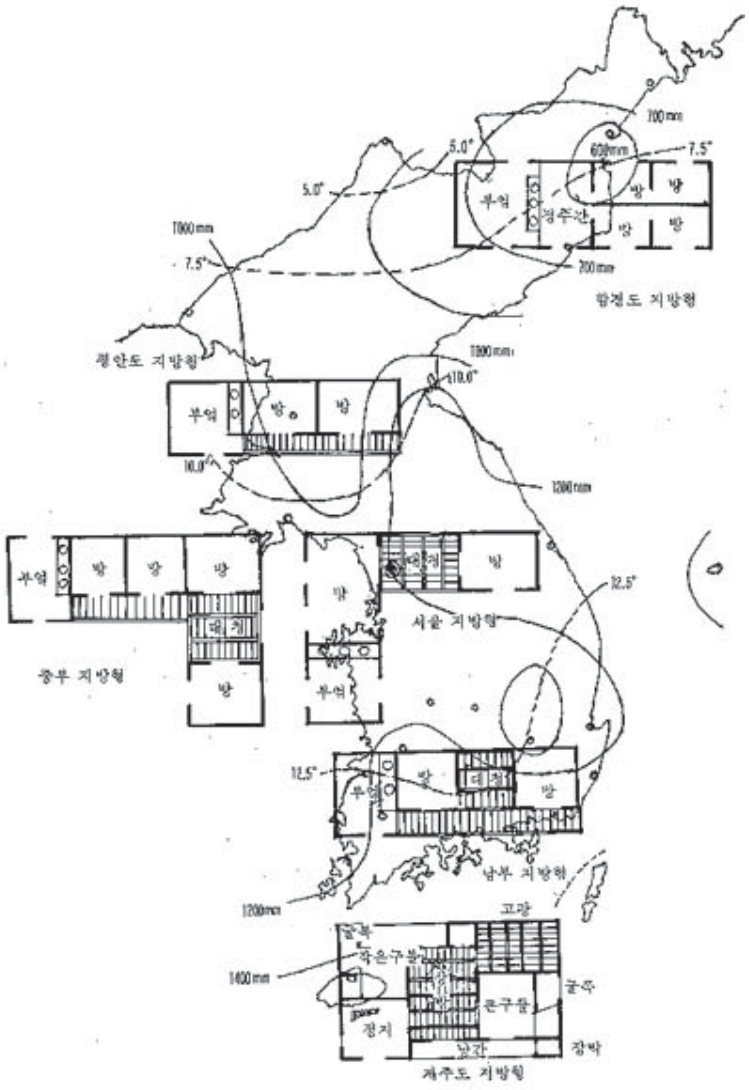


Figure 2.1 Variations of the housing plan in the Korean peninsula (Joo 1980, 74)

(curved lines indicate the annuall average temperature and rainfall)

Seoul has been the capital city of Korea since the beginning of the Joseon dynasty (1392~1919). Therefore, for more than 600 years, it has been the center of Korean culture. It is the reason why this thesis takes the city as a target area for analysis. Geographically, it is located in the middle of the peninsula, so it has a mid-range of temperature and rainfall. Consequently, the houses in Seoul retain the north and the south's characteristics at the same time and hence best represent the country's housing culture. As shown in figure 3.1, the house plan in Seoul has a typical 'L' shaped block. The house's scale varies about the house owner's wealth and status, but the basic structure of this 'L' shaped block appears regardless of its scale(figure 2.2).Figure 2.2 shows a big high-class house built in the 19th century. Although the overall scale is much bigger than the middle-class or lower-class houses, the 'L' shaped block is still used as a basic unit for the planning.

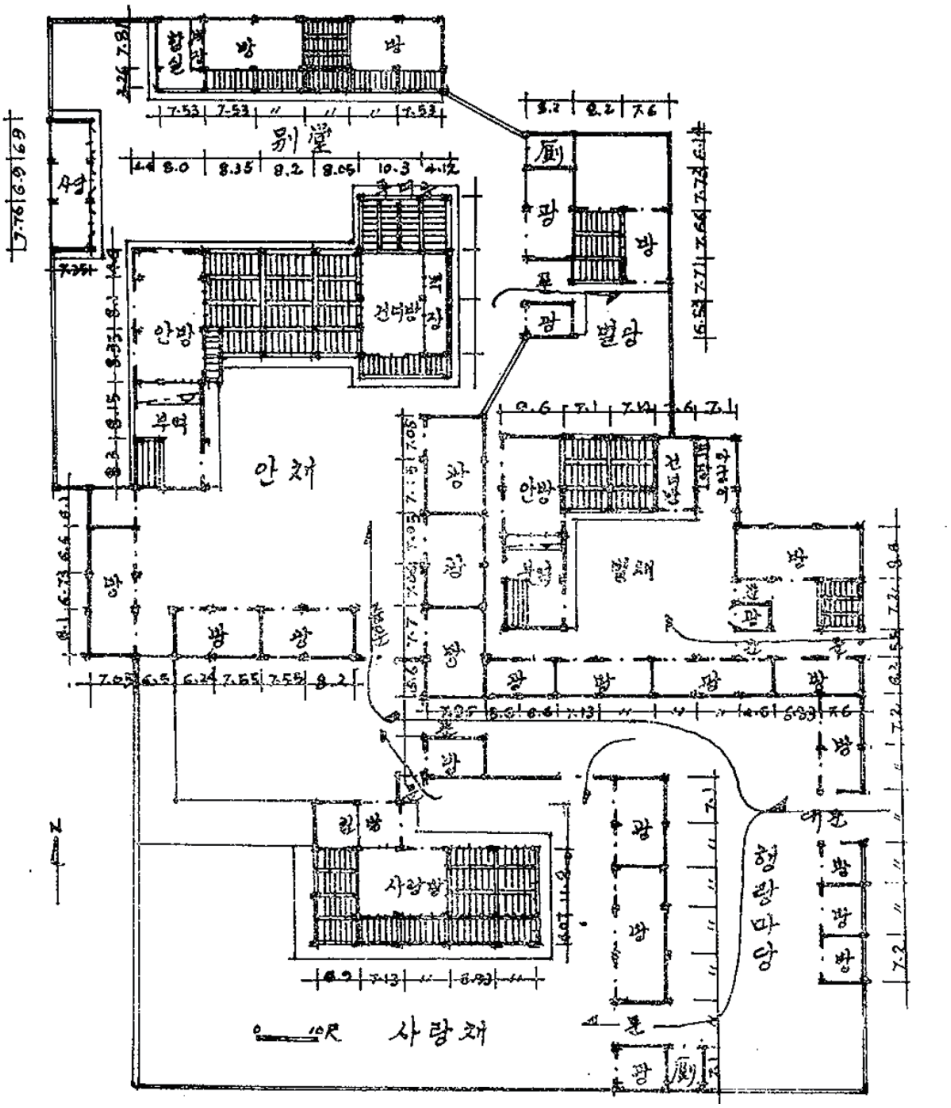


Figure 3.2 A high-class housing in Seoul, 19th century (Joo 1978, 18)

(R : bedroom, R1 : anbang K : kitchen)

Following Confucian philosophy, the 'L' shaped block in the female's quarters should be allocated farther away from the main entrance from the visitor's point of view, as in figure 2.2. In the 'L' shaped block, an anbang (a housewife's room; see R1 in figure 3.2) is located in the pivotal point. Two supporting spaces are attached to this bedroom; a maru on the east (or in some cases on the west) as an alternative space for summer and a kitchen on the south to supply heat to the anbang's floor. In the traditional sense, the anbang is a place for a housewife where everyday living, eating, sleeping, working, and sometimes even body washing is done. Men's entrance to this room is strictly limited due to the Confucian philosophy in Joseon dynasty; instead, a husband can have a room called sarangbang (a husband's room) in a different quarter in this type of big house or, in the case of a smaller house, in a different building in the same quarter. On the opposite side of the anbang, aross the maru, is a geonneonbang(literally, the opposite side room) Where an eldest son's wife lives. The occupiers of the anbag and geonneonbang switch their position when the eldest son's wife succeeds to the status of a housewife(Joo 1978, 18; Kang 1992, 205)

Figure 2.3 shows a middle-class house built in the 19th century. Although the overall scale is similar or small to the high-class house, the 'L' shaped block is still used as a basic unit for the planning. The middle-class housing was for the Jungin class(Interpreter, technician, doctor, etc.) among the Joseon Dynasty's social classes.

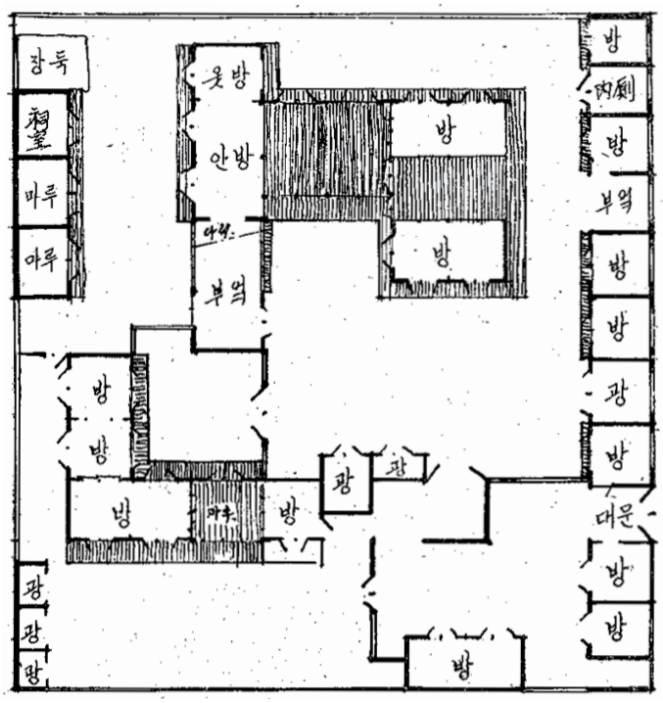


Figure 3.3 A middle-class housing in Seoul, 1859 (Joo 1965, 11)

(R : bedroom, R1 : anbang K : kitchen)

The middle-class houses are largely divided into Anchae(female quarters), Sarangchae(-male's quarters), and Haengrangchae(servant's quarters). The spatial structure of a middle-class house is similar to that of a high-class house, but These houses do not have a sadang(Religious space) or remained in a simplified form.

Figure 2.4 shows a lower-class house built in the 19th century. Lower-class house is for the Joseon Dynasty's general people and is located at the lowest level in all aspects, including economic and social status. Unlike other classes of houses, it has one courtyard. The lower level house is a simplified space, but a distinction between male and female spaces was founded by Confucian ideas expressed in high-class and middle-class houses. The 'L' shaped block is still used as a basic unit for the planning, and the anbang is still located in the pivotal point. It is a space for the eldest woman and the lineal ascendant of the family.

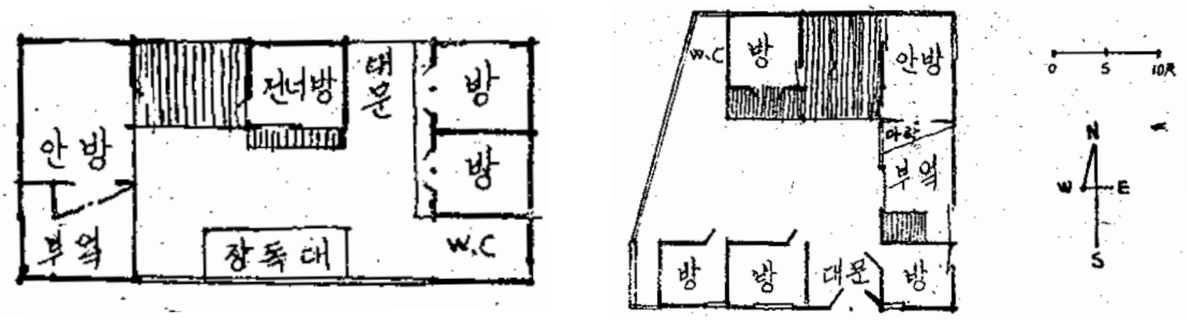


Figure 2.4 A lower-class housing in Seoul, 19th century (Joo 1965, 9)

(left : Insa-dong in 1890s, Right : Malli-dong in 1865, R : bedroom, R1 : anbang K : kitchen)

The Sarangbang(the household's room)is mostly located next to the main gate and is physically separated from the main living space in Anchae. Maru is the space that has been conceptualized as a high and sacred space. It has been reported that the word, maru, was used to describe a government building or a high court, which was thought to be a holy place, and the king of the Silla dynasty (A.D. 4C_7C) was called marupgan because he governed his kingdom at the maru (Kang 1992, 215). Even in modern days, this word is used to indicate a high place or position; for example, a mountain's ridge is still called maru. In the traditional house, it is believed that, amongst many Gods protecting the house, God's head governing the whole house inhabits the maru. For this reason, the maru was thought to be the center of the house, and many ritual ceremonies were held here.

The 'L' shaped block's morphology suggests critical clues in finding the hidden design logic of the modern houses in Korea. The traditional logic in allocating the anbang in the house is that it should be more in-depth. Although it is not topologically deeper than the geonneon-

bang (the opposite side room), it is always geometrically concealed behind the kitchen and the maru and grounded on the site's deeper corner. On the other hand, the maru is affected by the traditional planning logic that it should be in the center. Although it cannot be regarded as central in this 'L' shaped geometry, it is the symmetrical center of the raised space, with one ondol room on each side. This symbolic concept of space allocation has become a strong convention in Korea, especially in Seoul, for hundreds of years and, therefore, is naturally transmitted to the modern house.

2.1.2 The Urban Hanok(Improved traditional housing : 1930s~1960s)

From the 1920s, the population in Seoul started to grow faster; as the industrialization process accelerated, more people moved into the city to find jobs1. As the city workers' demand for housing grew accordingly, an urbanized type of Improved traditional house emerged. It was a compact form of the traditional house within a small plot developed by speculative developers from around the 1930s to the 1960s (figure 2.5). In the middle of the 1930s, under Japanese colonial rule, Seoul underwent a dramatic change. The Chosun Urban Planning Act, considered the beginning of modern urban planning laws in Korea, was enacted in 1934. The existing administrative districts of Seoul were expanded, paving the way for its transformation into a large scale metropolis. As part of the land readjustment process, new residential areas were developed, including the Donam district outside the old city boundaries.

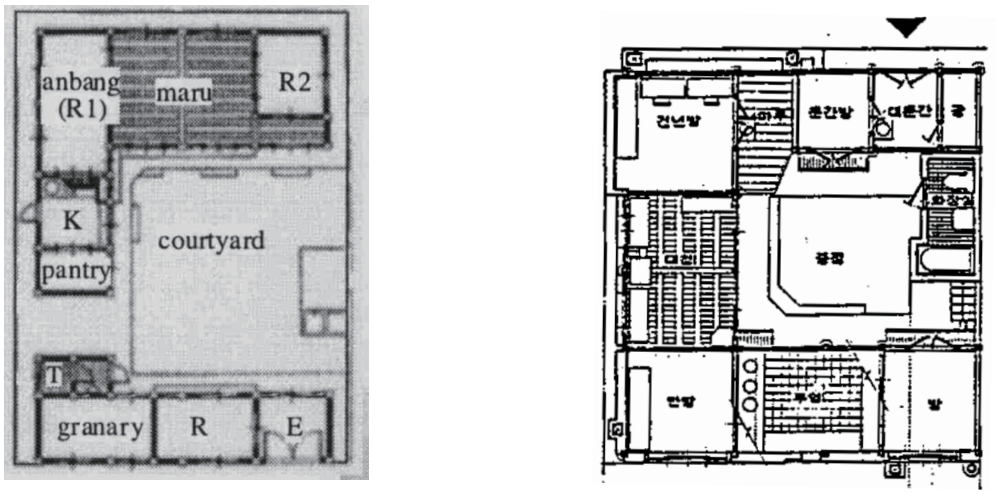


Figure 2..5 The Urban Hanok (left:Lee 1971; right : Song 1988, 67)

Insertional development of existing traditional residential areas was also actively pursued. A case in point is Bukchon, a residential area inhabited by influential families, located east of Gyeongbok Palace. A large number of Hanoks, traditional Korean houses with a wooden structure, were built in reallocated residential areas during this time but were significantly different from the previous ones in terms of spatial composition, layout, and formal shapes. This newly emergent Hanok was referred to as the Urban Hanok in recognition of its status as a new housing type(Song 1988, 67). These Urban Hanoks ceased to be built after the 1960s, however and were replaced by western-style housing.

From the plans in figure 3.5, it is found that the plot fence tightly surrounds the houses. In this compact format, the central courtyard becomes the only outdoor space. The plan on the left, recorded in 1971, seems to be older than the others; this plan has older features like a pantry and a granary. In contrast, the plan on the right, recorded in 1988, has newer features like a modernized bathroom, and it is assumed that the old pantry next to the kitchen has been converted to a bedroom. Interestingly, the time difference between the two document sources - 1971 and 1988 – is naturally reflected in their plans. Apart from these functional and technological changes reflected in the plans, when their spatial configurations are compared, it can be recognized that the 'L' shaped pattern of the critical spaces is embedded in both houses.

As the Urban Hanok tries to transplant the old domestic life into their compact form, it is expected that the old social relationship between inhabitants, which was embodied in a bigger architectural space before, should be compressed and rearranged. Therefore, it seems a natural transition that the anbang, which used to be sleeping space for a housewife and a living space for women, starts to change its function to become a sleeping space for parents and a living space for the whole family. It is probable that this change in social relationships in the domestic space happened in parallel to the disintegration of Confucian principles under the industrialization process's impact, according to which efficiency rather than propriety is more emphasized. The Urban Hanok was a new housing type at the time it was built. However, this house could successfully preserve most of the past's essential spatial characteristics in its simplified format and, therefore, effectively crystallized the spatial genotype that has been formulated for hundreds of years in Korea.

2.1.3 Colonial houses (1941~1945)

The housing deficiency in Seoul became a serious problem by the 1940s as the population continuously increased; the number of households in 1944 grew three times from that of 1925 – from 67,530 to 220,938 (Kang 1992, 100-101). The Japanese colonial government, to deal with this problem, established Joseon Jutaeg Yeoungdan (Housing Institute of Joseon) in 1941. They initially set up a plan to build 5,000 homes every year until 1945 to supply a total of 20,000, but ended up with the construction of 12,184 homes (re-quoted from Kang et al. 1999, 334). To maximize the productivity of construction, they provided five standard types of plans (figure 2.6).

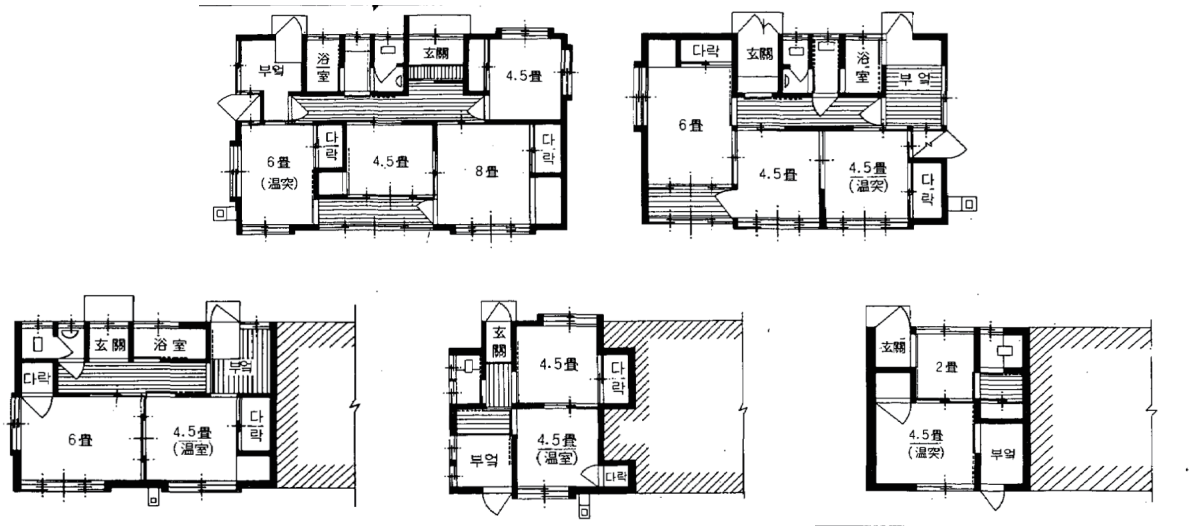


Figure 2.6 Five standard type of colonial housing (Korea Housing Corporation 1979 ,175)

Most of the houses were constructed based on these standard plans. These houses were the first generation of modern housing which are completely different from the traditional type of houses, and moreover, the development was the first mass construction of housing by the government authority. Therefore, it can be expected that these plans made a big impact on subsequent modern housing planning. Indeed, as will be discussed in the next section, the planning logic of 'two-row arrangement with a circulation zone in the middle' in these houses seems to have been transmitted to the next generations of modern houses including the apartment houses.

Investigating these plans, however, it is found that they have many features that originate from the Japanese housing culture. Excluding one ondol room from each plan, all the other bedrooms are finished with a Japanese tatami floor. The sliding doors replacing partition

walls between the bedrooms and the way of using a wooden floor for the central corridor and the outer veranda, not for the maru, also resemble the Japanese plan pattern. The only thing that shows a Korean traditional motif is one ondol room in each plan; for this, it is recognized that a kitchen is planned adjacent to it to provide heat.

In brief, the colonial houses were planned without any intention to inherit Korean housing traditions. Rather, they simply transplanted a modern Japanese housing style with minor modifications. Consequently, this radical experiment was not easily absorbed to the Korean housing culture; in the following periods, most of the Japanese features mentioned above are abandoned, and only the overall layout pattern – the double-row layout with a central circulation zone - is adopted for the planning of the modern detached house.

2.1.4 Public sector detached houses (1954~1960s)

After the Korean War (1950-53), it was urgent to build houses to meet the exploding demand in the city. Two major institutions supported the housing construction. The first is KNHC (Korea National Housing Corporation) which succeeded the former Joseon Jutaek Yeoungdan of the colonial government. The second is ICA (International Cooperation Administration) established after the War with foreign financial assistance. These two institutions not only financially supported the housing construction but also developed several standardized house plans to facilitate it (figure 2.7).

It can be easily assumed that the designers of these plans had no experience and thus no solid idea in designing a new type of domestic space that would successfully accommodate the Korean dwellers' indigenous living style. What is worse, their available references were limited to a few precedents, i.e., the traditional house, the colonial houses, and a small number of western-style houses. Considering these unfavorable conditions, it is understandable that their solutions had no consistent design logic; in terms of plant morphology, the plans generated by these planners encompassed many different types of layout – the plans were experimental rather than exemplary.
Figure 3.7 shows three different types of house plans designed by the ICA planners in the late 50s. The one on the left is a hybrid of the colonial house and a western-style house; it uses the central circulation corridor within the two-row layout just as in the colonial house and provides an integrated living-dining space which is filled with a western-style furniture.

In this plan, more importantly, maru, one of the most representative characteristics of the traditional house, is missing. Put simply, the planners of this plan copied foreign styles and put them together without knowing the consequences. The plan in the middle shows an unusual combination of the colonial style and the traditional style. As in the previous case, it has a central circulation corridor for the left half of the plan, but when the right half is seen together with the bedroom in the middle, it is recognized that the traditional adjacency link in the 'L' shaped block - "kitchen-anbang-maru-geonneonbang" – is alive.

In the third plan, which is on the far right, the original form of the 'L' shape is more effectively adapted as it has the same three bays as in the traditional house. Moreover, now it has the same old access relations of the maru and the two bedrooms. In this modern rectangular format, the maru is expanded towards the north and more subservient rooms are directly attached to it without the intervention of the courtyard. Interestingly, even in this situation where most of the rooms are topologically just one step away from the central maru, the designers tried to distinguish the anbang's status by putting the entrance hall in a geometrically farther position from it.

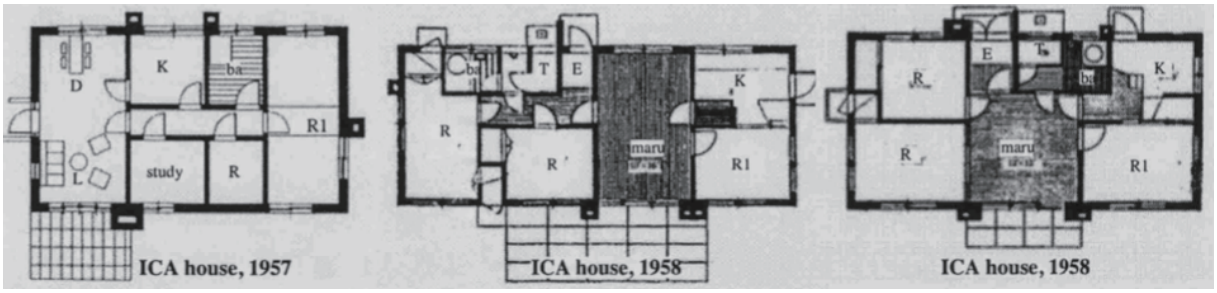


Figure 2.7 ICA houses plans in late 1950s

(R1 : the main bedroom which it the mordern counterpart of the old andbang)

In this way, as in the traditional house, the anbang is felt like the deepest space from the visitors' point of view and this pattern is found in the majority of the public sector houses. In sum, it can be said that, in this plan, the symbolic concept of space allocation in the traditional house, i.e., anbang's deeper position and maru's central position, has been successfully transplanted.

Looking at these various types of early modern detached houses in the public sector, a question arises: amongst these plans developed after the Korean War, which type could be more appealing to the dwellers in Seoul? Is it the plan that preserved the traditional morphological heritage, or the foreign style plan which many designers thought to be suitable for the modern style of living? Since the government's target, public housing type was changed

from detached houses to apartment houses from the 60s, it is only from the private sector that the answer to this question can be derived. In his typological study, Yim (1988) examined 585 modern detached houses in the private sector built-in Seoul from 1964 until 1985.

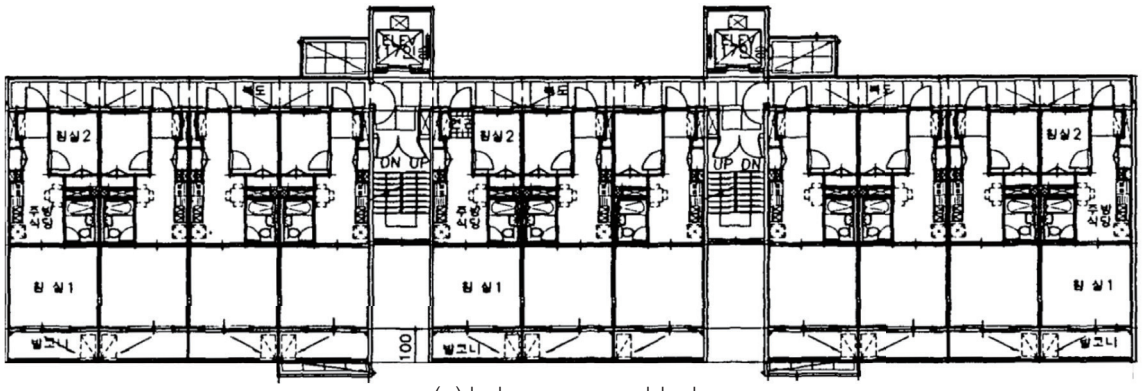
The aim of his study was to “define the characteristics of cultural traditions which might be embedded in urban dwellings” (Yim 1988, 228). Amongst his findings, two design trends he observed can give answers to the above questions. First, he pointed out a tendency where the position of an anbang is decided in the farthest south position from the main gate of the house and also from the entrance hall (Yim 1988, 107). Second, in the modern detached houses, a maru replaces the function of the old courtyard by covering an extended area, and as a result, most of the rooms surround this space (ibid. 107). His observation testifies that the traditional pattern of spatial arrangement has been selected and survived. It can be concluded that, at least within private sector detached houses, the two characteristics of the ‘L’ shaped block, which are the deeper position of the anbang and the central position of the maru, are still manifest.

From what has been described in this section, it can be generalized that during the early period of modern detached house construction (1954-60s), the public sector designers suggested many different types of modern plans, and in the following periods where the private sector dominated the detached house market (1964–85), the suppliers and consumers have reached the conclusion that it is better to embed traditional spatial patterns in the modern layout. Now it is necessary to examine whether the apartment house plans would show a similar tendency or a different design approach. It is believed that the investigation of this dominant type of dwelling in Seoul would lead to a more general and objective conclusion in estimating the morphological transition of the houses in Seoul in the 20th century.

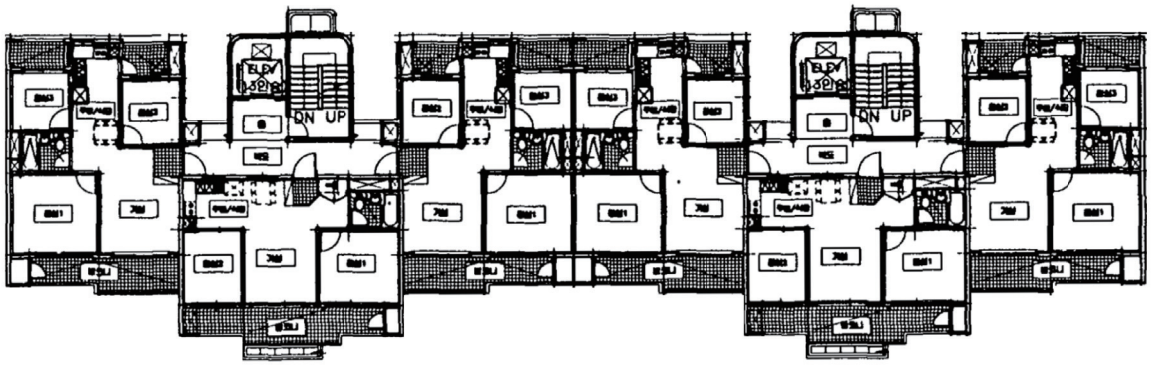
2.1.5 Apartment houses (1962~present)

What has become the most prominent feature in the landscape of Seoul in the second half of the last century is the fast-growing number of apartment houses. In the year 2000, there were already more than one million apartment units in the city, accommodating more than a third of the citizens. The history of apartment housing symbolizes the modernization process of the city that began after the Korean War in 1950. It is reported that the first apartment building in Seoul was built in 1958, and the first apartment housing scheme with a site-plan-

ning concept was initiated by KNHC (the Korea National Housing Corporation) in 1962. From then on, public sector housing construction was dominated solely by this multi-unit housing type. Figure 2.8 shows how the proportion of apartment housing in the new house construction market in metropolitan Seoul increases at an unparalleled speed in each period (see the growing ratio of the black colored area as time passes).



(a) balcony access block



(b) staircase access block

Figure 2.8 Tow dominant apartment block types

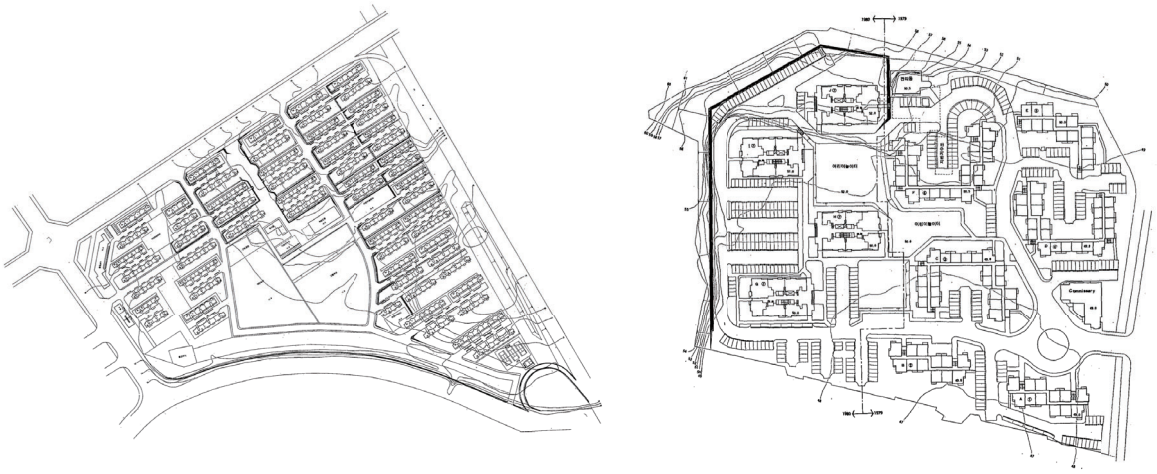
(Korea Housing Corporation 1995 ,133)

Between 1975 and 1979, this housing type began to take the lead in the market by occupying 47% of the new housing construction in Seoul, and the ratio kept growing to reach 90% in 1999. In the year 2000, it occupied 51% of the total housing stock in the city. After only a few decades from its first construction, it became the dominant housing type in the city One peculiar trait of the Korean apartment housing is that only a few prototypes are repeatedly used throughout its design process: the planning of the unit, the block, and the site, all follow a limited number of patterns. As for the unit, most of the units are single-story flats without an internal stairway; the maisonette type is hardly ever found. More interestingly, it is the two dominant access types, i.e., the balcony access type, and the staircase access type that determine not only the building shape but also the basic morphology of each unit (figure 3.9). To access each unit, the typical balcony access type put a long public external

balcony on each floor, and the staircase access type directly relies on staircases. In either case, public staircases are placed internally, inside the building envelope, to avoid prominent projection. Elevators, if needed, tend to be placed internally as well, but in the case of balcony access blocks they are often placed externally as in figure 3.9(a) to make a simple and direct connection with access balconies.

Based on these two access patterns, symmetrical pairs of units are attached side by side to generate a thin and long block plan; a block rarely has a mixture of different unit types in it. This typical way of composition makes every unit in the building necessarily open to the front and back and blocked by walls on both sides. In Sherwood's definition, they are "double-oriented units' – more specifically 'open-ended' plans - and in terms of building circulation, the 'multiple vertical access' type supported by stairs and, in high rises, elevators as in figure 2.9. Amongst the two-block types, it was the balcony access type that was adopted for the earliest apartment housing, i.e., Haengchon apartments (1956), Jongam apartments (1958), and Gemyong apartments (1959) (Kang, et al. 1999, 388). The staircase access type, on the other hand, started to appear relatively later in 1964 in some of the blocks at the Mapo apartment housing scheme. This type, however, has quickly replaced the former and became increasingly prevalent from the late 60s on (ibid. 389). It is the natural result that the balcony access type has lost popularity since this type has restrictions in planning the access balcony side. Meanwhile, when high-rise apartments, which are normally more than ten stories high, became the major construction practice from the 70s, the balcony access type again was widely used for the blocks with smaller size units. This is because the number of elevators, which easily occupies a higher proportion of the price of the smaller units, could be significantly reduced by utilizing the balcony access pattern. After the 80s, however, since the relative cost of the elevators within the total construction cost declined, there exists a clear trend that more smaller-unit blocks are built on the staircase access pattern, suggesting once again that this access pattern can provide better dwelling conditions (ibid. 393).

After decades of repeated construction of these two block types, the thin slab shape became the typical image of apartment housing, and this practice has been severely criticized by many scholars as having created a monotonous built environment throughout the city. Kang et al. argue that this strong bias towards the slab block shape in Korea can be explained by two major reasons (Kang, et al., 1999, p.388). First, in this shape, every unit can equally have the best natural-light condition, which is one of the major concerns for the Korean dwellers who have a long-established preference for the south orientation. Second, the linear building shape can facilitate easy and efficient site planning; using this form, rath-



(a) parallel pattern (b) lattice pattern

Figure 2.9 Typical block layout pattern

er than a curved or twisted one, it is easier to deal with the building code while achieving a higher density. In the earlier schemes, when the blocks are arranged within the site, they are put on the blocks were site in parallel conforming to the site condition with an effort to orient them towards the laid out in south as much as possible [figure 2.9(a)]. When the high-rise blocks became the major landscape after the middle of the 70s, this typical arrangement began to be changed. According to the building regulations, any two parallel buildings should keep a relevant distance which is proportionate to their height. Consequently, now another set of parallel blocks could be easily placed in a vertical direction between the increased span of the two south-facing buildings, thus enabling a more densely packed block arrangement [figure 2.9(b)]. This lattice arrangement for the high-rise blocks became another typical feature of the apartment housing after the 80s. In the earlier period of apartment construction, most of the buildings were less than six stories high, but in the following periods, the number of stories was gradually increased to accommodate more units on limited urban plots. In the case of Gangnam-gu district, the sample area of this research, after 1977, the majority of the new apartment housing schemes were planned as high-rises that were 12 to 15 storey high (Kang et al., 1999, pp.246-247). In general, buildings in one scheme tend to have the same numbers of storey for the efficiency and easiness of the site planning regardless of the unit types they enclose. If there are blocks with different storey, likely, this is deliberately done to provide maximum density by modulating the building heights in relation to the building code. Since the maximum supply of housing has been the main concern for the developers until recently, the efforts to render a more architecturally dynamic and aesthetically pleasing housing scheme was relegated to a secondary issue. Therefore, the mixed development, or other combinatory site development, that aims to offer a variety of dwelling conditions is rarely found in Seoul.

2.1.6 The concept of level distinction

Traditional Korean houses have three types of space depending on the floor material: a) ondol, b) floor, c) earthen floor. Maru can be translated as a raised wooden floor and ondol as a floor heating system. It is believed that Maru and ondol have been developed from the south and the north of the peninsula, respectively. Many historic documents testify that their origin can be traced back to around A.D. 300 (see Joo 1980, 27-39). In the north region, it was recorded that the elevated platform called a changgaeng - meaning a long duct - was installed partially in the living space for heating to endure the cold winter. The heat produced from fire is passed through under the platform, and the inhabitants can stay warm by sitting and sleeping on it. This platform, a primitive form of Korean ondol, can be found in some parts of China.

For example, in the north of China, people make an elevated platform called a kang - meaning a duct with the same function for heating as the one explained above (Knapp 1990, 9-10). On the other hand, Maru originated from the southern part of the peninsula, where enduring the hot and humid summer is the primary concern. It is argued by many scholars that, early in its history, the purpose of raising houses on piles was for the storage of grain, to protect it from insects and humidity of the ground in summer. Then, people gradually adopted this structure for their dwellings. In this process, unlike many south-eastern countries of Asia, the floor's height has been adjusted lower to be positioned a few feet above the ground so that the dwellers can step up quickly to the floor without ladders. Maru is a semi-open space for summer which is open to a yard in the traditional Korean house.

In the beginning, Maru and ondol were not built together in the same house; the former was used only in the south and the latter only in the north. However, it can be recognized from the 12th-century documents that both Maru and ondol were spread over the peninsula and planned together in a house (Joo 1980, 40-44). Another important thing is that the elevated platform, the primitive form of ondol, had evolved to cover the whole floor of a room by this period and became the standard house heating format. Since the stove is placed outside the room in this whole-floor heating structure, it could be maintained cleaner without smoke.

At the time when the practice of constructing ondol and Maru together in a single building was started. It must have been conceived as the best solution that they are raised to the same level to be accessed easily from each other. With this probable reason, it became the

convention that they were equally elevated above the ground, more or less about a human knee's height.

In this study, the determination of this height is crucial in understanding the indigenous level distinction between the clean elevated space and the dirty earthen spaces. It is highly probable that because the elevated space has the height of the sitting and sleeping furniture, i.e., chairs and beds, the whole raised floor is treated like a piece of furniture".' In Korean domestic space, those raised spaces, i.e., Maru and the rooms with the Ondol heating system, are maintained extremely clean. The inhabitants can always sit and lay down their bodies right on the floor without furniture. Therefore, shoes must be removed and placed in the lower earthen spaces before entering this clean zone(figure 2.10).

Figure 2.10 The concept of level distinction

(top plan: reproduced from Joo 1978, 18, bottom plan: reproduced from KNHC 1995, 161)

Many Southeast Asian countries have the raised floor as well. However, since its level is much higher – above the human head in the case of the Thai house (Chongchairuk 2002, 48), dwellers enter the house using ladders and therefore. The raised floor is not regarded as the furniture itself; instead, it is merely a living space on the first floor - equivalent to a second floor in the North American culture. In this sense, the whole raised floor's cleanness is not a critical concern for them as it is in Korea. Moreover, in the traditional Korean house, the floor is finished with oiled paper for Ondol and polished wood for Maru to make them easier to clean.

The Maru and Ondol floor originated from a functional need to endure the hot summer and cold winter. However, gradually a strong conceptual dichotomy has been formulated: "the high-level raised clean internal sacred space" versus "the low-level earthen dirty outside secular space." This concept of level distinction is crucial in understanding the Korean domestic space and will be a subject of analysis in the next section.

2.2 Evolution of domestic space

2.2.1 Introduction : from the old and new

It was after the Korea War (1950) that the mass construction of modern-style housing began. In less than a half-century, the house form and culture in the country have been radically transformed. Among the new house types, the apartment housing proved, economically and culturally, to be the fittest in adapting to the middle-class need. It is reported that the first apartment building in Korea was built in 1958, and the first apartment complex developed on a site-planning concept was initiated by KNHC (The Korea National Housing Corporation) in 1963. In the 1990s, after only three decades, it became the most dominant housing type in the city. If it was the traditional central courtyard house that molded Korea's typical domestic life until the 60s, now it is the modern apartment houses that the prime position (figure 2.11).

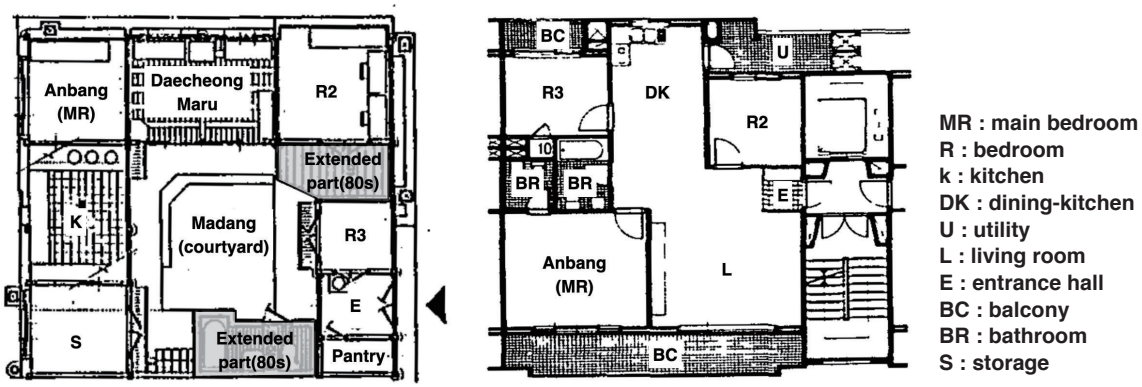


Figure 2.11 Improved traditional house(Urban Hanok) in 1930s and apartment house in 1990s

(left plan: from Song 1988, 67, right plan: from KNHC 1990, 18)

On the surface, morphologically, those two types are entirely different. Figure 2.11 shows that the central courtyard house, which is inward-looking, has now turned into the self-contained modern apartment house outward-looking. What has been changed is not only the overall form. Some spaces, like the courtyard, have disappeared. Some have emerged; those multi-functional rooms like Anbang and Daecheong Maru of old houses have been endowed with new names, main bedrooms, and living rooms due to their more specialized functions in the modern period. This situation is where the continuity and change cannot be measured simply by the space syntax value of each partitioned space. In other words, for

Behavior		Period	Joseon Dynasty							1987 ~ 1920s							
		Type	Traditional houses							Traditional houses & Improved traditional housing							
		Spce	anchae				salang chae			anchae				salang chae			
			AB	DC	K	MD	SB	DC	MD	AB	DC	K	MD	SB	DC	K	MD
1		Sleep	●				●			●				●			
		Rest	●	○			●	○		●	○			●	○		
		study	●	○			●	○		●	○			●	○		
		Meal (alone)	●	○			●			●	○			●	○		
2		Wash up	○				○			○			○	○		○	
		Excretion	○				○			○				○			
		Shower															
3		Family dinning	●				○	○		●				●	●		
		Family gathering	●				○	○		●				●	●		
		Radio / tv															
4	F	Dinning	●	△			●	△						●	○		
		Reception	●	△			●	△						●	●		
	I	Dinning	●	△			●	△		●	○			●	○		
		Reception	●	△			●	△		●	○			●	●		
5		cooking			●							●				●	
		Food preparation		○	●	●						●				●	
		Landry tidy up	○	○						●	○						
		Laundry drying				●							●				
		Needlework	○	○						●							
6		Heating			●							●				●	
		Children play				△							△				
		Take off shoes		●				●			●				●		
		Circulation		○		●			●		○		●		○		●
7		Ancestral rites	○	●			○	○		○							
		Event		●		○			○				○				
		Wedding / funeral	○			●			○	○			●				

Behavior		Period	1930~196				1960s										
		Type	Urban type				Detached house						Apartmant				
		Spce	AB	DC	K	MD	AB	MR	K	T	E	MD	AB	MR	K	E	T
1		Sleep	●				●						●				
		Rest	●	○			●						●				
		study	●	○			●						●				
		Meal (alone)	●	○			●						●				
2		Wash up	○		○	○			○	●							●
		Excretion	○				○			●							●
		Shower															
3		Family dinning	●				●	○					●	○			
		Family gathering	●				●	○					●	○			
		Radio / tv					●	○					●	○			
4	F	Dinning	●	△			●	○					●	○			
		Reception	●	△			●	○					●	○			
	I	Dinning	●	△			●	○					●	○			
		Reception	●	△			●	○					●	○			
5		cooking			●				●						●		
		Food preparation			●	●			●						●		
		Landry tidy up	●	○			●	○					●	○			
		Laundry drying				●				○		●		●			○
		Needlework	●	○			●	○					●	○			
6		Heating			●				●						●		
		Children play				△						△					
		Take off shoes		●							●					●	
		Circulation		○		●		●						●			
7		Ancestral rites	○	○			○	○					○	○			
		Event		○		○		○					○				
		Wedding / funeral	○	○				○									

Behavior		Period	1970s														
		Type	Detached house							Apartmant							
		Spce	AB	L	K	D	BR	E	MD	AB	L	K	D	BR	E	BC	U
1		Sleep	●							●							
		Rest	●	○						●	●						
		study	●	○						●							
		Meal (alone)				●							●				
2		Wash up					●							●			
		Excretion					●							●			
		Shower					●							●			
3		Family dinning	○			●							●				
		Family gathering	●							○	●						
		Radio / tv	●	○						○	●						
4	F	Dinning	○	●						○			●				
		Reception	○	●						○	●						
	I	Dinning				●							●				
		Reception		●						○	●		○				
5		cooking			●							●					
		Food preparation			○	○				○		○	○				
		Landry tidy up	○	○						○							
		Laundry drying		○												●	●
		Needlework	○	○					●	○							
6		Heating	External boiler room														●
		Children play							△								
		Take off shoes						●							●		
		Circulation		●							●						
7		Ancestral rites	○	○							○						
		Event		○							▲						
		Wedding / funeral		○													

Behavior		Period	1980s														
		Type	Detached house							Apartmant							
		Spce	AB	L	DK	ST	BR	E	MD	AB	L	DK	BR	E	U	BC	BO
1		Sleep	●			○				●							
		Rest	●							●	●						
		study	●			○				●							
		Meal (alone)			●							●					
2		Wash up					●						●				
		Excretion					●						●				
		Shower					●						●				
3		Family dinning			●							○					
		Family gathering	○	●							●						
		Radio / tv	○	●						○	●	○					
4	F	Dinning		●							○	○					
		Reception	○	●	○						○						
	I	Dinning										○					
		Reception		●	○	●				○	○	○					
5		cooking			●							●					
		Food preparation			○							○					
		Landry tidy up		○							○						
		Laundry drying					○		○		○						
		Needlework		○							○				●	○	
6		Heating	External boiler room														●
		Children play							△								
		Take off shoes						●						●			
		Circulation		●							●						
7		Ancestral rites		▲							▲						
		Event															
		Wedding / funeral															

1: Personal behavior, 2: Hygiene behavior, 3: Family behavior, 4: Reception, 5: Housework, 6: Service, 7: Non-everyday life behavior, F: Formal, I: Informal.

AB: Anbang, SB: Sarangbang, DC: Sarangbang, MD: Madang, K: Kitchen, T: Toilet, D: Dining room, BR: Bathroom, ST: Study room, U: Utility room, BC: Balcony, BO: Boiler room.

●: Main behavior, ○ : Sub behavior, △ : Seasonal behaviorv, ▲ : Temporary behavior,

Table 2.1 The transition of resident's Behaviours in South Korea

example, the old Anbang and modern main bedroom are not equivalent even though they share a considerable amount of characteristics. To deal with this subtle problem, it is needed to focus on described in the previous chapter the "space-behavior" interactions, how each partition space's behaviors are preserved, migrate, and finally re-group to form new spatial frameworks.

This conceptual framework enables the investigation of 'space-activity interactions, the first sub-question of this thesis – how is an old spatial organization mapped onto a new setting that is formally and functionally different? - will be answered. Besides, this investigation will provide a basis for a further analysis that will bring the issue of 'level-distinction,' and this will answer the second sub-question - how is an old conceptual dimension in space transferred through a transformation process?

In the following sections, the movement of activities is drawn graphically in diagrams and then converted mathematically to space syntax values. They are measured at five important stages of evolution, each of which is characterized by an emergence of a distinct housing pattern, which is: the traditional courtyard house, the early modern detached house, the first 3bed apartment house, the typical 3bed apartment house, and the typical 3bed apartment house with a second bathroom. The apartment plans in the last three stages are taken from the staircase access type rather than the balcony access type for the consistency in analysis.?

Based on previous studies, functional spaces were classified according to residents' behavior, from traditional Korean houses in the Joseon Dynasty to apartments in the public sector in the 1980s. Residents' behaviors were divided into seven categories: personal behavior, hygiene behavior, family behavior, reception, housekeeping, service behavior, and non-daily behavior(table 2.1)..

2.2.2 Traditional code and its transfer to the early detached houses

A Korean vernacular dwelling and its layout developed under the historical and social conditions of Korea. During the Joseon dynasty (1392-1910) of Korea, the basic design and layout of a traditional Korean residence were influenced by the social hierarchy and the cultural environment. When Yangjindang was being built in the 17th century, social status played a more critical role in determining the composition of typical living quarters. The Confucian principles underlying the hierarchical social system had a tremendous influence on a traditional Korean residence's basic design and layout (Figure 2.12).

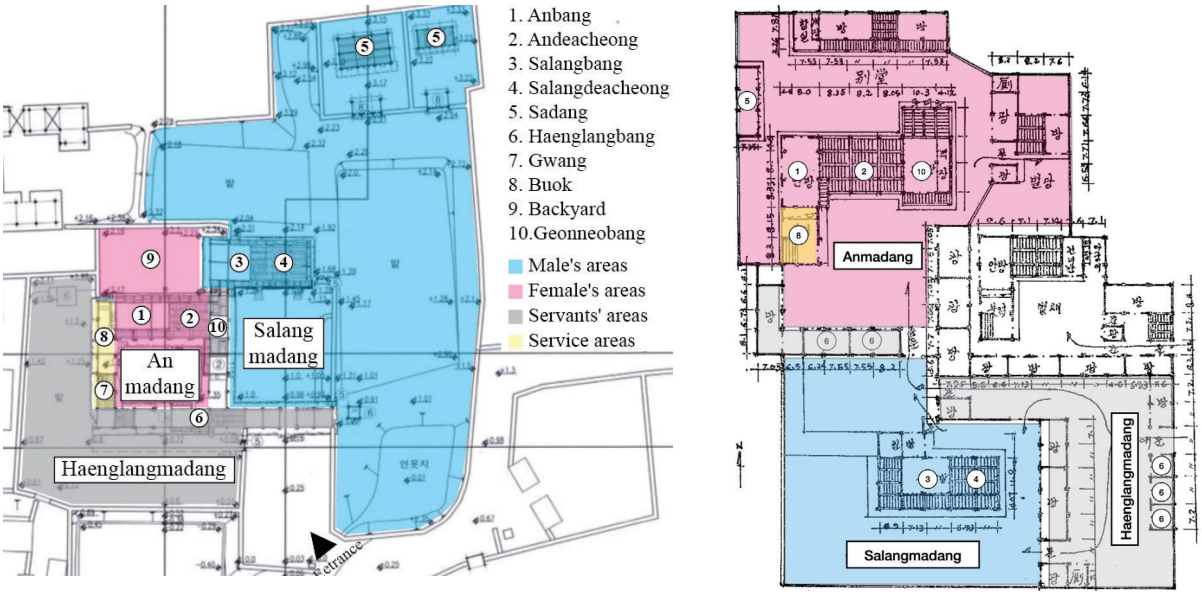


Figure 2.12 High-class house in 17C (Yangjindang) and A high-high-class housing in 19C, Seoul
(left plan: reproduced from Cultural Heritage Administration 1997, 338, right plan: from Joo 1978, 18)

Accordingly, the separation of men from women, separation of superior from inferior classes, and the need for an ancestral shrine became fundamental elements in the composition and layout of residences (Inaji and Virgilio 1998). Yangjindang comprises four distinctive areas: those reserved for the men of the house, areas for women, servants' areas, and service areas. The spatial composition of Yeongyeongdang was prioritized according to social mores, as follows; (a) male's areas: Sarangbang (owner's room), Sarangchae (male's quarter), Sarangmadang (courtyard of the male's quarter), Middle Room, Sarangdeacheong (Owner's reception space), Sadang (Ritual ceremony space); (b) female's areas: Anbang (matron's room), Anchae (female's quarter), Anmadang (courtyard of Anchae), Gonneobang (female's room); (c) servants' areas: Haenglangbang (servants' room), HaenglangChae (servants'

quarter); (d) service areas: Buok (kitchen), Gwang (Storage), Goggan(Storage), Bangasgan, Ect. To intuitively observe the spatial composition of Yangjindang and simplify the functional area, Amorim's(1997) sector analysis method is applied in the conversion to a Justified graph (j-graph). Korean traditional housing space is divided according to gender and social position, and it is connected through the Madang (courtyard) of each part.

Each Madang is connected through doorways, and access is strictly controlled. The women's space is located more in-depth than the men's space, and the entrance differs according to the gender of the guest. As outlined in chapter 3, This spatial composition has a similar pattern in the middle-class or lower-class houses, although the spatial scale is reduced. (Figure 2.13).

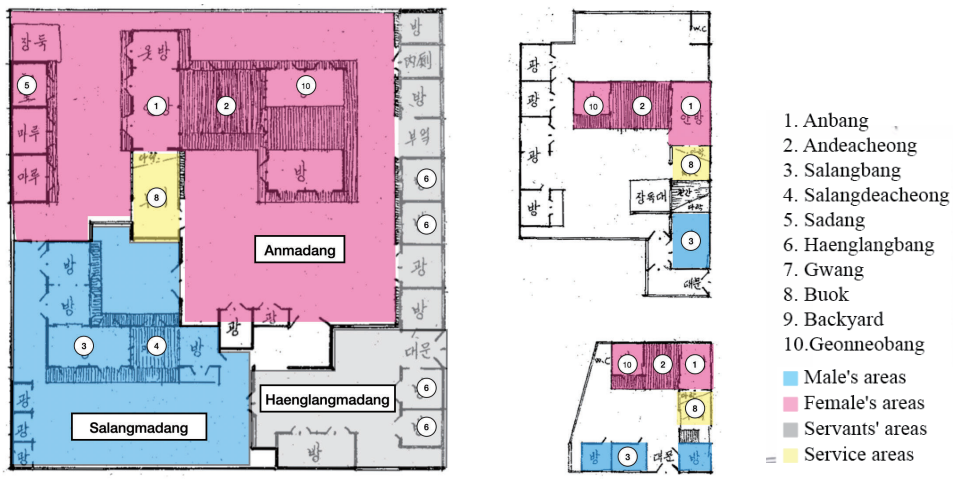


Figure 2.13 left: High-class house (1986), right: middle-lower class house(1865) in Seoul

(soure: reproduced from Joo 1965, 9; 11)

The traditional logic in allocating the Anbang in the house is that it should be deep. The morphology of 'L' shaped block suggests very important clues in finding the hidden design logic of modern houses in Korea. The Anchea should be deep. Although it is not topologically deeper than other sectors, it is always geometrically concealed behind the kitchen and the maru and ground on the site's deeper corner. On the other hand, the maru is affected by traditional planning logic that it should be in the center. Although it cannot be regarded as a center in this 'Anchea('L' shaped geometry), it is the raised space's symmetrical center.

The Salagchea should be shallow than Anchea; It appears to be reduced in size depending on the social class, or reduced to a room next to the entrance that does not include a maru. This symbolic concept of space allocation has become a strong convention in Korea for hundreds of years and therefore, is naturally transmitted to the modern house.

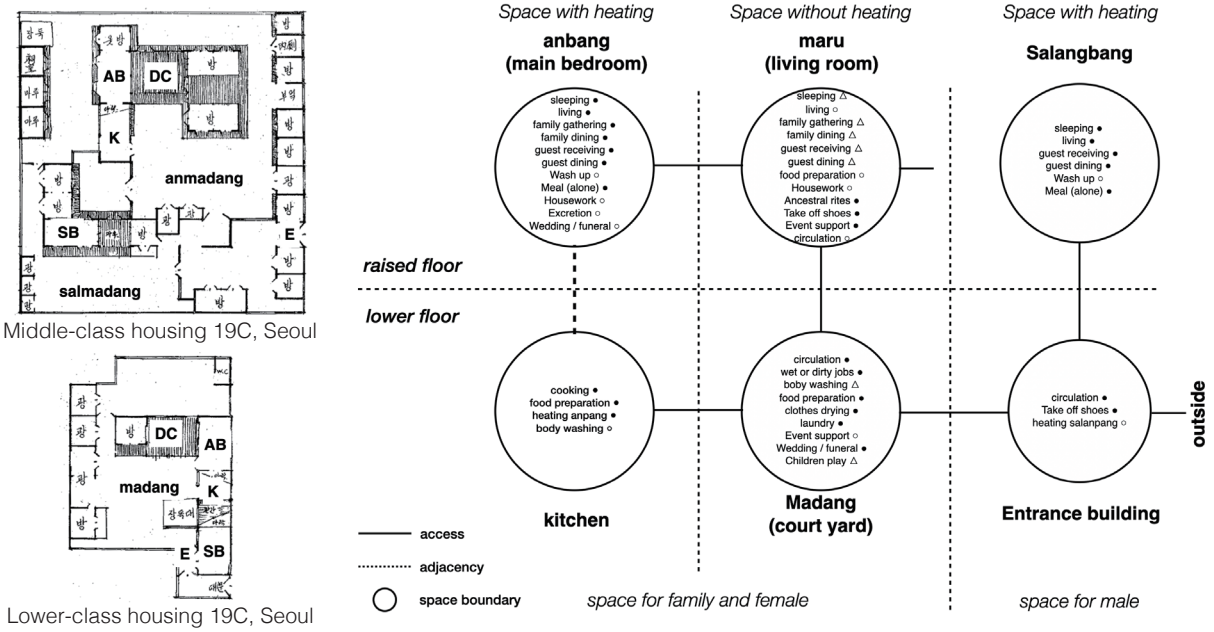


Figure 2.14 The domestic code < 0 > in traditional houses

The diagram linking the four main spaces, Anbang, maru, a kitchen, and Madang(court-yard), can epitomize the spatial characteristics as well as the topology of these spaces. Besides, two sub-spaces be linked to the main space, the entrance building, and Salangbang. Those three living spaces on the top were named after their user's gender (Anbang: wife and lineal descendant, Salangbang: head of household) and construction material and heating system (maru: a raised wooden-floor, bang: a raised ondol-floor) unlike their modern counterparts, main bedroom, and living room, and this may be due to fact that these rooms could not be associated with particular functions. In the diagram, each space's expected behaviors are shown inside the circles (Figure 2.14).

Instead of loosely programmed, these spaces could accommodate various functions, including providing support for space nearby. The Anbang always support each other with family living and dining(formal, informal) behaviors and non-everyday behaviors(ancestral rites, funerals, etc.). The Maru also supported similar behaviors to the Anbang. The kitchen and Madang support wet or dirty jobs with the lower ground, especially, Madang is a multi-purpose space, and it is used when many receptions were needed. The entrance building(Mukan) is a buffer space between the outside and the house. Although it is represented differently depending on the house's size and social class, the spatial structure separating gender is an essential factor in decoding traditional Korean houses. Since these concurrent behaviors tended to be scheduled by season, the Anbang and the kitchen can be categorized "space with heating" and the Maru and the Madang as "space without heating."

The kitchen was directly adjacent to the Anban because the hot air produced from its fire-place, used for cooking, was drawn under the raised floor of the Anbang for heating. The Maru was raised to the level of the Anbang yet with the opposite of passive cooling in summer. These two types of elevated structures were developed solely to control the interior temperature. They encapsulated the conceptual distinction of "raised-clean-living zone" versus "earthen-dirty-subsidiary zone" through long custom.

The Anbang was always physically deeper than the Salangbang from the main gate. Middle-lower class houses tend to have less Confucian ideological expression compared to high-class housing. The "L" shaped block of the anchae remains unchanged, but the male sector tends to shrink preferentially. However, the spatial phase remains, and at a minimum, it is placed next to the entry building to secure its position. They encapsulated the conceptual distinction of "males' zone" versus "female's zone."

This spatial code described above governed the hosing culture for centuries with authority but, when the new housing type was introduced from the early 20th century, changes began to be made. Those traditional behavior-space relations are based on interactions to make different combinations in new domestic settings.

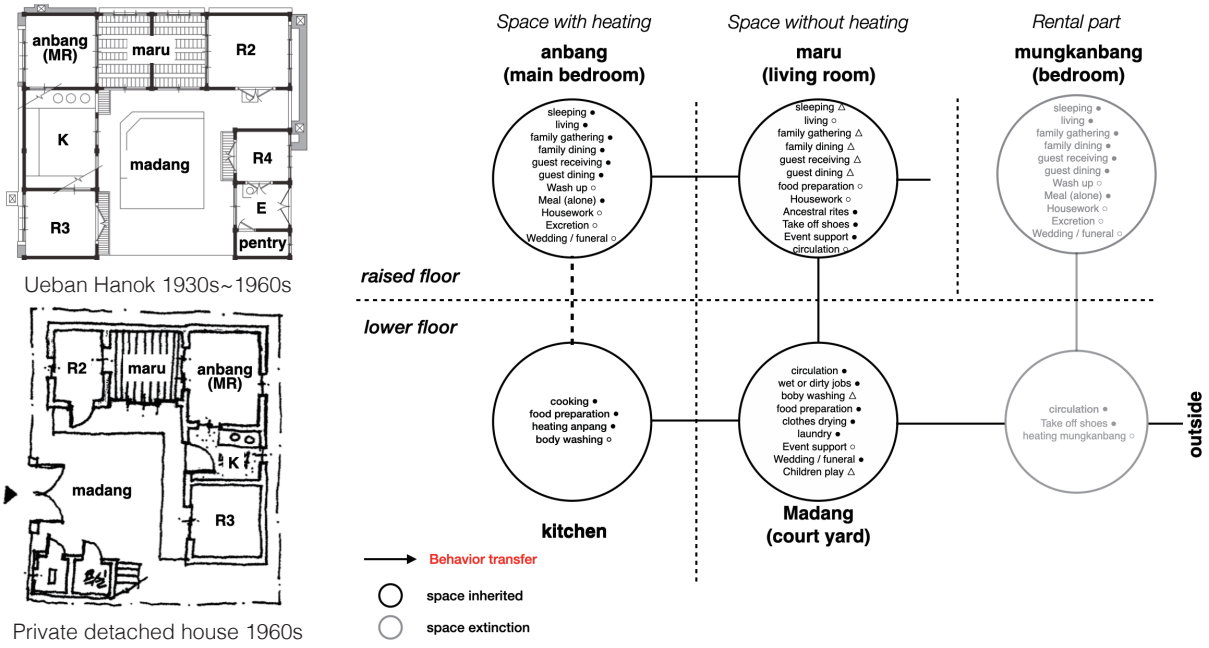


Figure 2.15 The domestic code < 1 > in Improved traditional urban house

(top plan : reproduced Seoul 1986, 29, bottom plan : from ko 1995, 50)

The Improved traditional urban house was developed in Seoul about the 1930s and another city; Daegu, Jeonju, etc. (Song 1988, 62, Sohn. et al. 1999, 30, Ha. et al. 1996, 77). When

there was a growing need for city worker's housing(Song 1980) and the other side, This is because the population of Seoul increased rapidly from the 1920s to the 1930s, and the population of the countryside flowed into Seoul. The new population is mainly urban workers, and it is not easy to judge who can purchase newly built urban Hanok at that time. In the actual newspaper article, a local landowner moved to Seoul to avoid excessive tax payments. Besides, housing developers started leasing businesses for urban workers, civil servants, teachers, etc. Many real estate agents were created, and urban houses were consumed as commodity houses (Park and Jeon 2002, 98).

As outlined in chapter 1, it takes a simplified format of the traditional layout to fit into a small and tight urban plot that borders typically on the street and three other neighbors. While the layout could vary from one site to another, it typically contains a unique structure that encloses the main functional room(Figure 2.15). For hundreds of years, this "L" shaped block has been the distinguishing feature of Seoul's houses (Joo, 1980). On the other hand, in order to improve the marketability of urban Hanok, housing developers used wood produced by factories, and it can be judged that this tendency is also seen in local cities. As described in Chapter 3, traditional Korean houses have different unit plan types depending on the region. However, it can be judged that the regional differences have been reduced by mass production of construction materials in the early modern days and housing construction by developers (Figure 2.16).

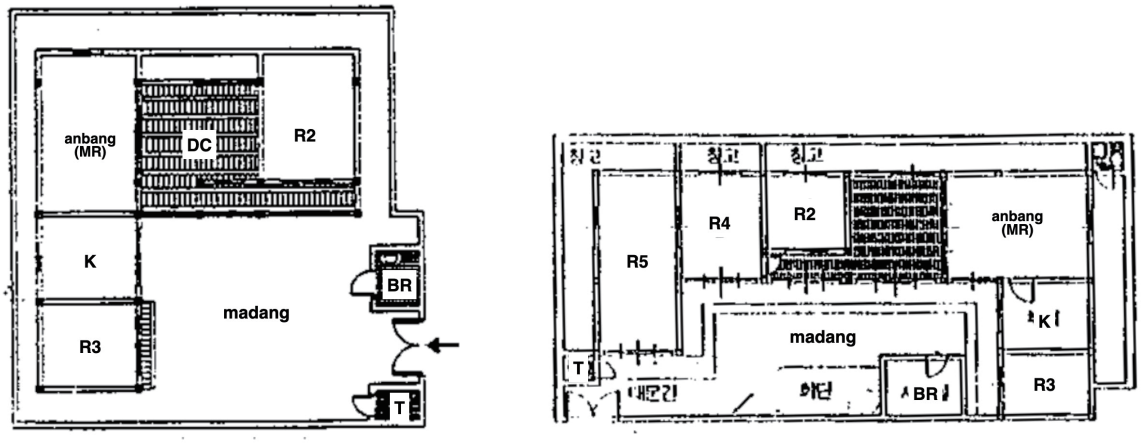


Figure 2.16 Urban Hanok in a Provincial City (left : Daegu City, right : Jeonju City)

(left soure plan : reproduced from Ha ***et. al.,*** 1996, 79, right soure plan : Soha ***et. al.,*** 1996, 36)

Through the repeated production, this structure presumably has been accepted by the people as an ideal arrangement of key spaces; with the compact layout of traditional urban houses, this "L" shaped block has to be placed along the site boundary around the central Madang as in figure 2.15 and 2.16. As a result, it was the direct link between the block and

the Madang that held essential behavior-space interactions, and this can be into a domestic code diagram. The diagram linking the four main spaces, Anbang, Maru, a kitchen, and Madang(courtyard), can epitomize the spatial characteristics and the topology of these spaces. The urban Hanok is Korea's first commodity housing, and the entry building (Munganchae) was rented to improve its merchandise. In other words, economically afforded local landlords and developers own homes and rent existing Salangbang to the city workers or salaried employees. In other words, at this time, the concept of separating gender was integrated into the family, and spatially disappeared.

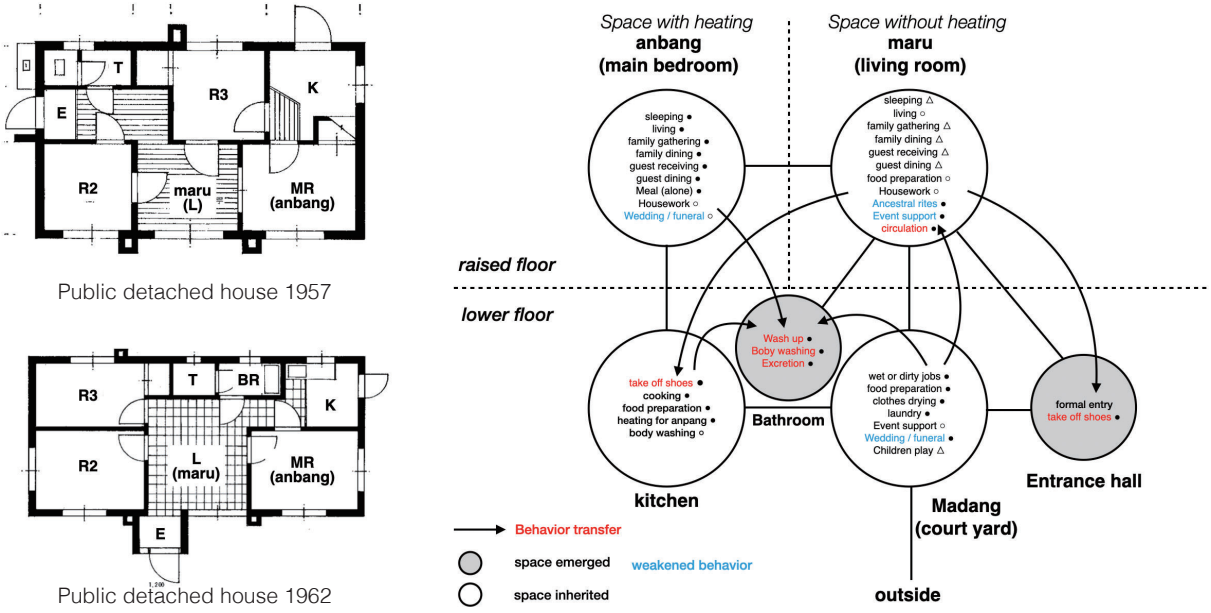


Figure 2.17 Modern public detached house and the domestic code < 2 >

(source : house plans from Korea National Housing Corporation 1975, 192; 245)

Mass construction of economical modern houses began after the Korean War(1950) to meet the growing demand in many cities. The first generation of modern housing development and standard type of detached house plan was designed by ICA(International Corporation Administration) and KNHC(Korea National Housing Corporation). Compared with the traditional urban house, the overall morphology of these plans was significantly different. The courtyard moved out of the central position to surround the houses, mostly double-row structures. On a closer look, however, it is still found that the traditional domestic code is still manifest; the same topological relation of the four virtual spaces has survived to preserve the traditional way of living (figure 2.17).

While the primary spatial links are maintained, some minor changes have been made. The entrance hall was attached to the maru to mediate the inside and outside, thus taking away from the courtyard to remove shoes. It is interesting to note that this “formalistic depth-in-

creasing" in the shallowest part of the house – to emphasize the rites of "going into the house" – is quite contrasted with the "utilitarian depth-decreasing" between the Anbang and the kitchen in the deepest part. Around this time, bathrooms began to be built within some houses, so gradually, the activity of body washing slipped out of yards and kitchens. In this phase of evolution, the maru became the most integrated space taking the function of circulation from the courtyard. Although this central room should allow many through-movements, it could still accommodate many activities, as shown in the diagram owing to the traditional floor-sitting style of living. However, the maru was destined to become a more independent space in the near future to be able to include the growing amount of western style furniture. In this respect, it can be anticipated that circulation would be transferred again to another part of the house. These modern detached houses were the first generation of modernized homes that suggested possible ways of modern configuration that could enclose the indigenous pattern of living; hence they strongly affected the apartment house plans.

2.2.3 Evolution of apartment house plans: 1960s ~ 1990s

After its first mass development in Mapo in 1963, apartment housing became the primary dwelling type in Seoul in only three decades. Now, more than one million apartment units in the city accommodate more than a third of the citizens. One of the conspicuous characteristics of the apartment houses in Seoul is a definite pattern in the plans. In their study, Kim and Park found out, from the analysis of almost all apartment house units built between 1962 and 1990 in metropolitan Seoul, that only a small number of plans are adopted "constantly and ubiquitously" (1992). They identified these dominantly comprehensive plans with the floor area, construction body (pubic or private), and the year they appeared. Amongst them, only three-bedroom plans were chosen for this thesis (figure 2.18). The labels under each plan are from the authors' sorting method. Here it is sufficient to know that the first letters "J" and "P" mean they are from the public sector (KNHC) and the private sector, respectively, and the second letter "S" stands for a staircase type, "C" stands for the corridor.

Following the labels are the years they appeared. A visual inspection reveals that KNHC built most of the houses until the early 70s and tried to develop and test more plans than the private sector. In contrast, the private sector has only five typical plans, PS1-III and PS2-III, PC1-III and PC2-III, PC3-III, which are duplicated within the public sector (see the dotted line box in the figure). Since these four plans were more repeatedly used in both sectors, it

can be inferred that they make up a more significant proportion of the apartment housing stock than any other type. In the range of 60 to 85 m², PC2-III in the private sector and JC1 "-V in the public sector, PS1-III in the private sector and PS2'-V in the public sector have the same pattern, and PC1-III in the private sector and JC1-V in the public sector, PS1'-III in the private sector and PS2"-V in the public sector have the same pattern.

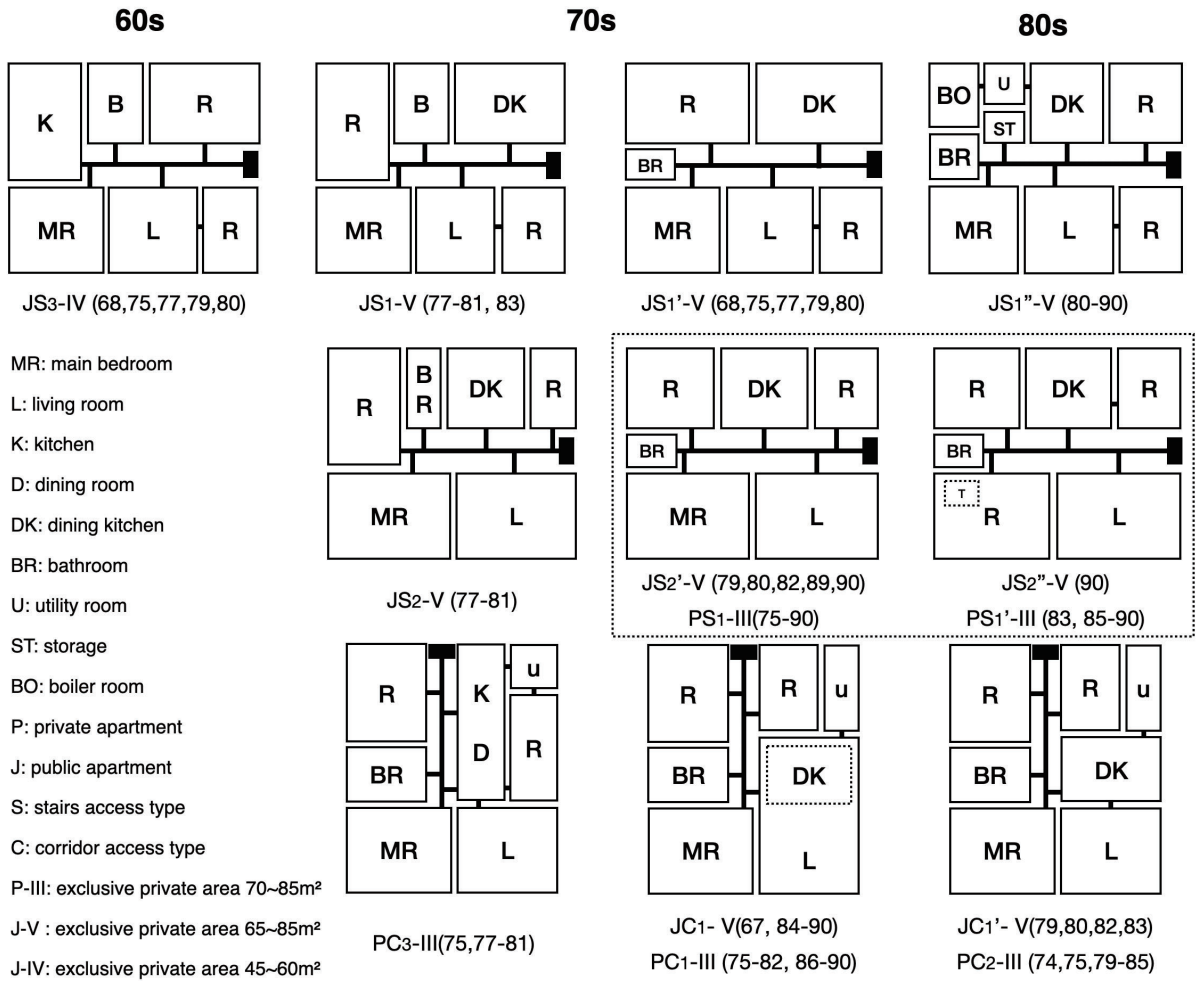


Figure 2.18 Typical 3 bedroom plan in Seoul and 5 new town

(source : reproduced from Kim and Park 1992, 76)

The apartment planning unit has the characteristics and patterns of the private sector and the public sector, but the same general patterns were constructed. In particular, in the range of 40 ~ 85m², apartments' shape and living conditions in public and private areas are set the same, and they are equalized as they influence each other. In terms of spatial composition, it has been fixed to a spatial composition that is constant by the area over time, compared to the initial period when a general pattern is formed. This phenomenon tends to be uniform and fixed regardless of the supplier. (Kim and Park 1992, 83). All the plans in figure 4.9 have the same circulation pattern, which is another vital feature of Korea's apart-

ment type. The stairs access type's entrance hall is always placed at one end of the middle row from which the central circulation area(a part of the living room) is extended across the house, demarcating the upper and lower zones. In real plans, however, it is often difficult to distinguish this central zone because, in most cases, it is fully open to the living room and dinning-kitchen without partitioning; thus, it becomes a part of the fully interconnected public realm. (Figure 2.19, Figure 2.20)

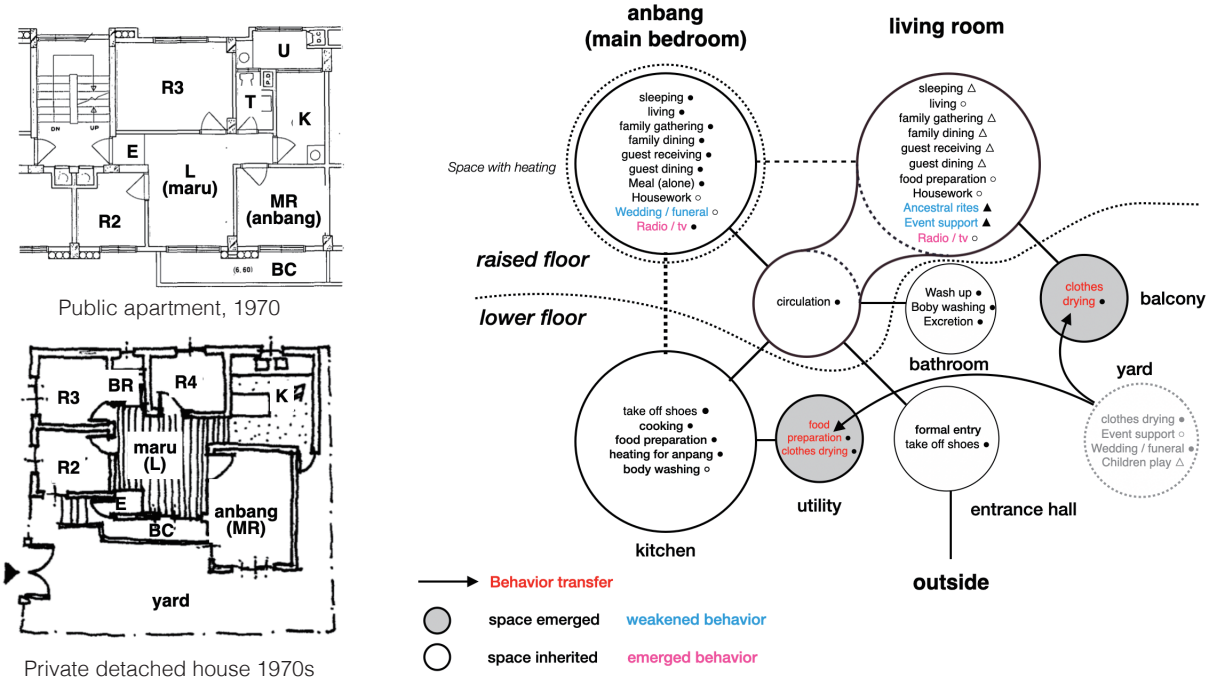


Figure 2.19 Domestic code diagram < 3 >

(top plan : KNHC 1970, 204, bottom plan : from ko 1995, 65)

When the ten plans in figure 2.18 are adapted to the domestic code format, surprisingly, only two types of cold emerge(figure 2.18), code 3 on the reft applies only to the earliest plan(JS3-IV) and all the other plans, despite their configurational variety, converge onto the code 4. Code 3 exists similarly in private detached houses. The most changed part of the detached houses plan in the 1970s shifted from a sedentary lifestyle to a standing lifestyle. It is thought to have been influenced by the trend of the stocking of apartment houses. (Go 1995, 51). As the kitchen floor level became the same as the living room, the kitchen area increased, and it became DK. Besides, to improve the house's product value, the semi-basement part was leased, and the first floor of the house was built up half a floor. As a result, the direct connection to the yard was weakened, and the plane disappeared from the differences from apartment houses. What makes those two codes different lies mainly in the status of the kitchen. In the earliest three-bedroom plan, the kitchen still contained the traditional heating function, and for this, its floor was sunken. The main bedroom, which still carried all

the critical behaviors until this time, was directly adjacent to it to be best heated (code 3). It led to dynamic spatial changes, switching from wood-burning heating systems to hot water boilers using briquettes and oil(Lee and Park 1997,49). Because of its lower level, which is always associated with the word "dirty," the kitchen could not be introduced and placed for dining. This problem was solved when a boiler was introduced and placed in a separate space(code 4). Due to this technological improvement, the kitchen floor could be raised to other living spaces, and this change greatly affected the domestic environment.

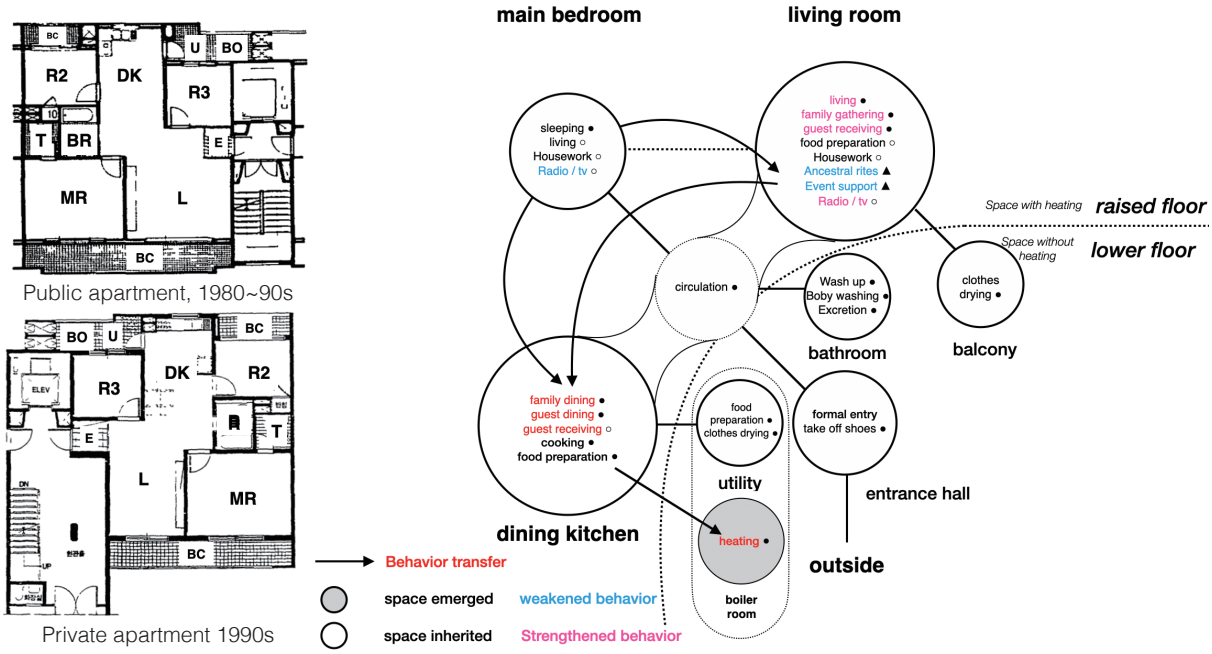


Figure 2.20 Domestic code diagram < 4 >

(top plan : KNHC 1987, bottom plan : from KNHC 1990)

For the main bedroom, this was a critical moment to break free from its centuries-old connection with the kitchen and turn it into a private space mainly for seeling. Owing to this remarkable change in its status, the kitchen becomes the only space that has successfully crossed the conceptual boundary between the "dirty low-level zone" and the "clan high-level zone." Code 4 further reveals that the kitchen absorbs the dining function and becomes a central axis of the public domain. As for the living room, though it has given the kitchen's dining behavior, its public function is much strengthened. Since the main bedroom ceases to be a multifunctional public space, all the living room's similar functions are strengthened. Another striking change was to provide heating for all the "raised spaces." Therefore, according to the season, the living room's behavior was fixed as a public character. It was used as a formal reception and family gathering or as a dining area for many guests. It has shifted from the master bedroom behavior in winter, and it has been an opportunity to confirm the living room's public character. Besides, the DK space raised to the floor level, such

as the living room, was expanded into a visually extended space. The status has shifted to a multifunctional space that incorporates informal reception, family dining, and kitchen functions. In the course of the transition between code 3 and 4, therefore, the Anbang and maru's role as two axes of public behaviors in the past has given way to the living room and the dining-kitchen in the modern apartment houses.

The most significant change at these stages of evolution is the disappearance of the yard(Madang) that is still featured strongly at the earlier detached houses. Of the four virtual spaces, now the main bedroom, the kitchen, and the living room are left with more or less changed functions. What is noteworthy here is that the kitchen and the living room, which used to be supported by the yard, rely on the alternative spaces, the balcony, and utility room, in the apartment houses to preserve the yard's behaviors.

2.2.4 Topological paths in evolution

Over-viewing the whole process, some essential points can be summarized. The four virtual spaces' traditional link was still preserved in the detached houses of the 30s to 60s. However, when it comes to the apartment houses, all relationships are rearranged, and the yard disappears, leaving small fragmented spaces to preserve some of its behaviors. The only indication that suggests the initial code structure is the adjacency between the main bedroom and the living room, which a like a rule, appears in every typical plan. The living room was settled in Korea's apartment house by combining the circulation function to the traditional Madang and the Maru's public character, and it links the three remaining essential spaces. Therefore, the circulation function has been transposed from the Madang to the Maru and the living room.

The next four graphs illustrate the topological paths of the behaviors by means of Standardized Integration(i) values (from figure 2.21 to 2.24). Each graph shows the traces of behaviors that came from one of the four keyspace. Using Standardized Integration(i) values, which show the degree of integration, precisely how these behaviors are assigned their topological position in each phase of the housing evolution can be revealed. First, figure 2.21 shows the diachronic movement of the behaviors that once belonged to the Anbang, the modern main bedroom's counterpart. The nine expected behaviors in the old Anbang change their position in terms of Standardized integration values but remain together in a

single room until the fourth phase of the evolution, i e. the first three-bedroom apartment house of the 1970s. In the fifth phase, as the kitchen develops into a dining-kitchen, the behaviors of dining and guest receiving(informal) move from the Anbang to the dining space. In this phase, the function of family gathering(formal), and guest receiving(formal) and dinning(formal) that used to happen in both the Anbang and the living room are more strictly confined to the living room in order to render the Anbang a move privatized space for parents. Moreover, it provided that the heating system supported the living room, and the function of the living room, which was limited in the summer, become entirely independent from Anbang. Through the six phases of the transition, of nine main behaviors of the Anbang are spread into the three spaces, the main bedroom, the living room, and the dining space.

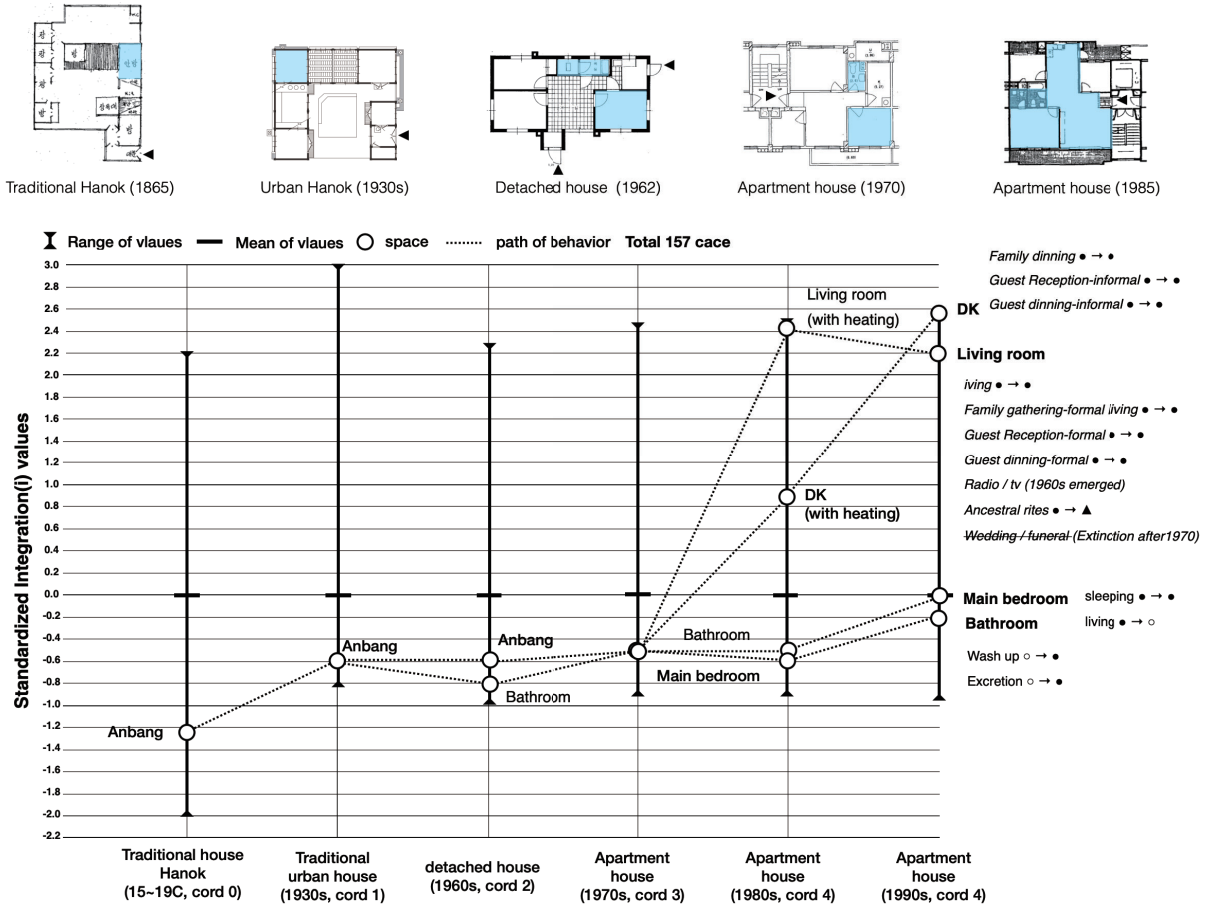


Figure 2.21 Topological of the behaviors of Anbang

Therefore, through the behavior-spaces interactions, the Anbang becomes the most activity-depleted space amongst the four key spaces of domestic code 1 in figure 2.15. This implies that it lost its traditional meaning as the most critical space for the whole family. By looking at the overall transition of Standardized Integration(i) values, it can be said that those nine behaviors have migrated from the more segregated part of the house to the more integrated parts as time passes. Hence in modern apartment houses, they tend to happen

in more open and exposed places than before. The old Maru in the traditional house was the space for a living, family gathering, and dining, depending on the season. All the way through their migration, these behaviors are kept lower than the mean in Standardized Integration(i) values, thus positioned in a more integrated part of the house. The old Maru in the traditional house was the space for a living, family gathering, and dining, depending on the season. Through their migration, these behaviors are kept lower than the mean in Standardized Integration(i) values, thus positioned in a more integrated part of the house.

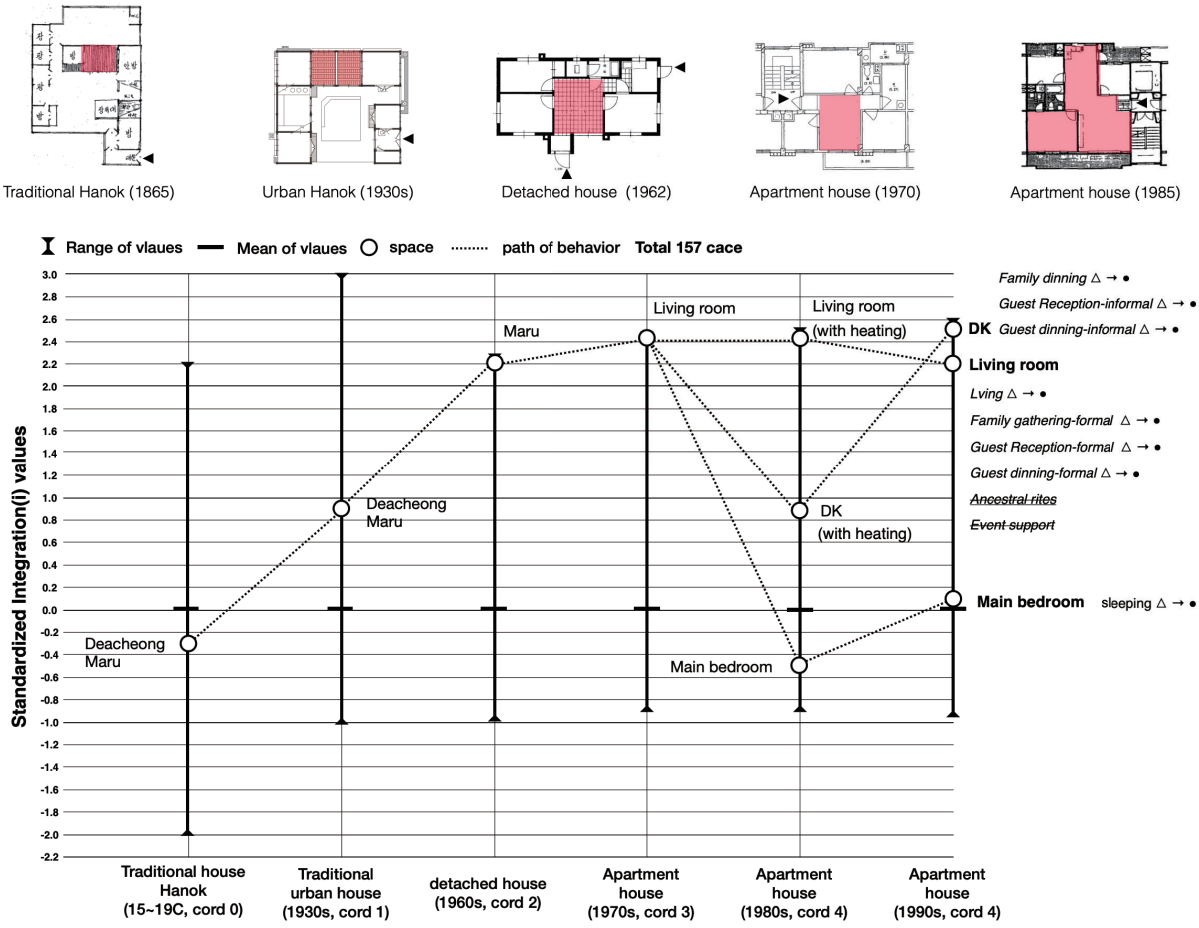


Figure 2.22 Topological of the behaviors of Maru

They move to a higher level in the third phase when the Maru inherits the function of circulation and becomes the most integrated space due to the courtyard's demise. The advent of apartment houses has endowed the Maru with a new name, living room, which implies its status change to a more independent living space furnished with western furniture. Besides, in the fifth phase, the heating was supported in all raised spaces, and the properties of the living room with public characteristics were fixed. The behavior of dining adsorbed to the dining-kitchen from phase fifth when the floor level of the room is raised to become a high-level clan space. In traditional courtyard houses(Hanok), the kitchen was space not

only for cooking and food preparation but also for body washing in winter and bathing in all seasons. As soon as the modern detached house was equipped with a bathroom, the behavior of body washing was separated from the kitchen(figure 2.23). In the last phase of the evolution, the path of this behavior from the high segregated position. Following the modern trend where the kitchen becomes a pleasant living space for the whole family, the behavior of cooking and food preparation moves upwards in the graph to the most integrated area. The most startling change of all is the transformation of the courtyard(Madang).

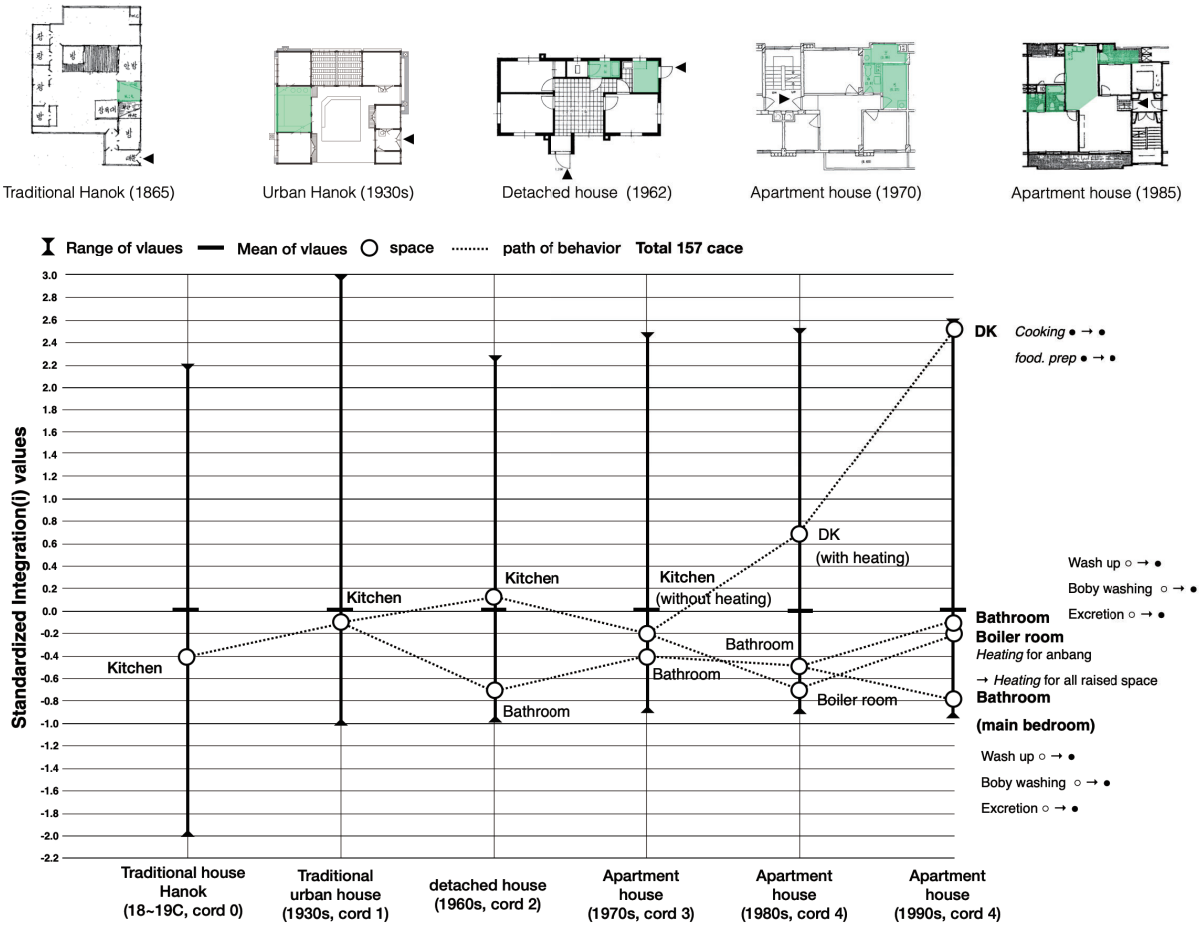


Figure 2.23 Topological of the behaviors of the kitchen

This outdoor space's multiple roles have been successfully re-distributed into the five newly emerged spaces in the modern apartment houses, as previously illustrated in the domestic code diagrams. The utility room, the balcony, and the bathroom have inherited its behaviors, and the living room and dining-kitchen are now supporting its function as a circulation space. Again, this process of "behavior relocation" can be better understood when seen through the topological graph(figure 2.24). The behaviors derived from a single space, the courtyard, migrate through the different routes and spread across the domestic field. It is evident from the graph that the behaviors that once belonged together in the most integrat-

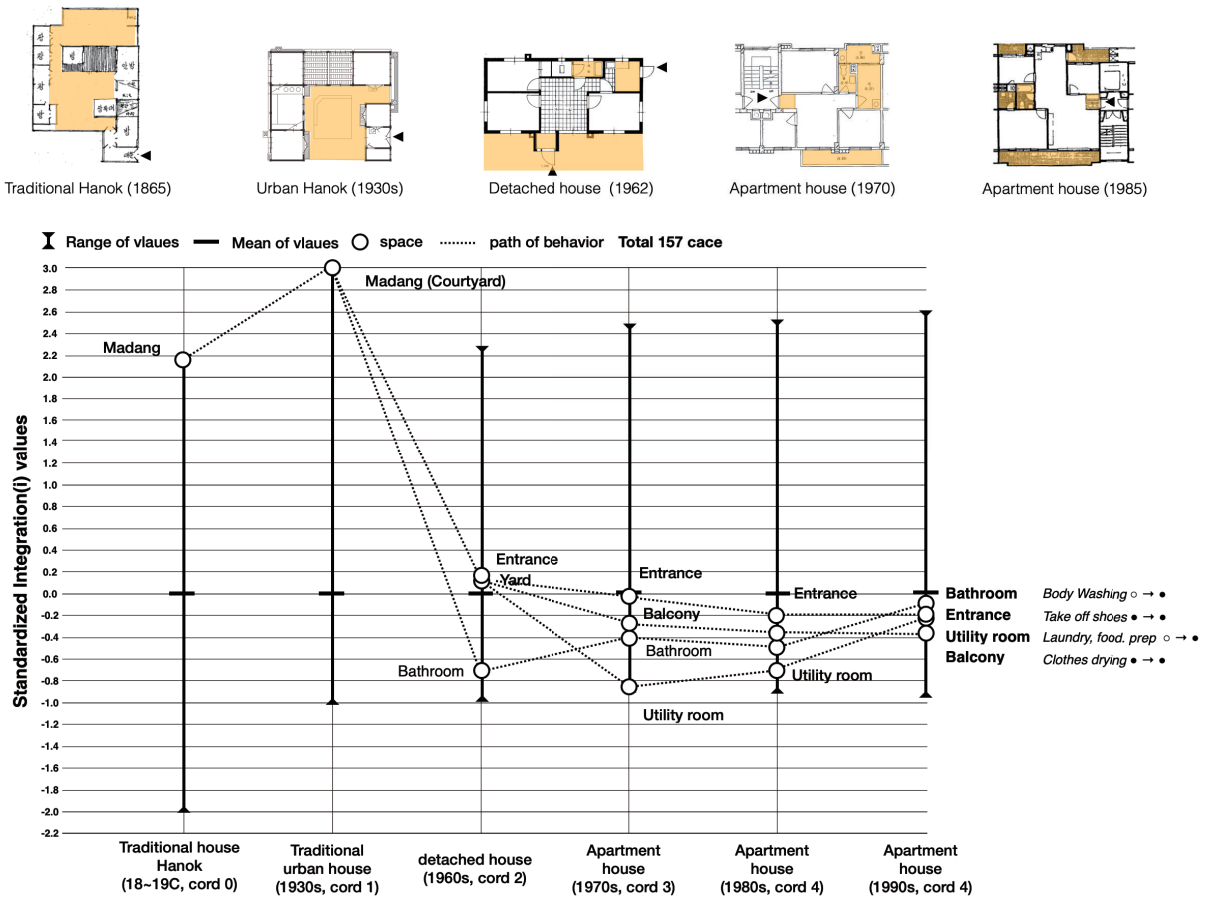


Figure 2.24 Topological of the behaviors of the Madang(courtyard)

ed apace are diverging gradually toward the other end, the most segregated space. It is a natural result caused by the reversed characteristics of the old and new house configurations. The main substitutes for the courtyard, i,e., the balcony, and the utility, are destined to be placed on the perimeter in apartment houses, and this location is likely to have lower Standardized Integration(i) values.

2.2.5 Level distinction and heating system as an underlying force in evolution

Interestingly, what has been transferred from the Madang is not just the behaviors it enclosed but its structural concept, namely "the lower level of the yard." Except for the part of the living room and dining-kitchen that supported the positional role of the Madang as a circulation, those new alternative spaces have all inherited the low-level that has to be separated from the clean living zone of the upper level; though the level difference has been reduced to a few centimeters. Therefore, it is found from the fifth phases of the domestic code

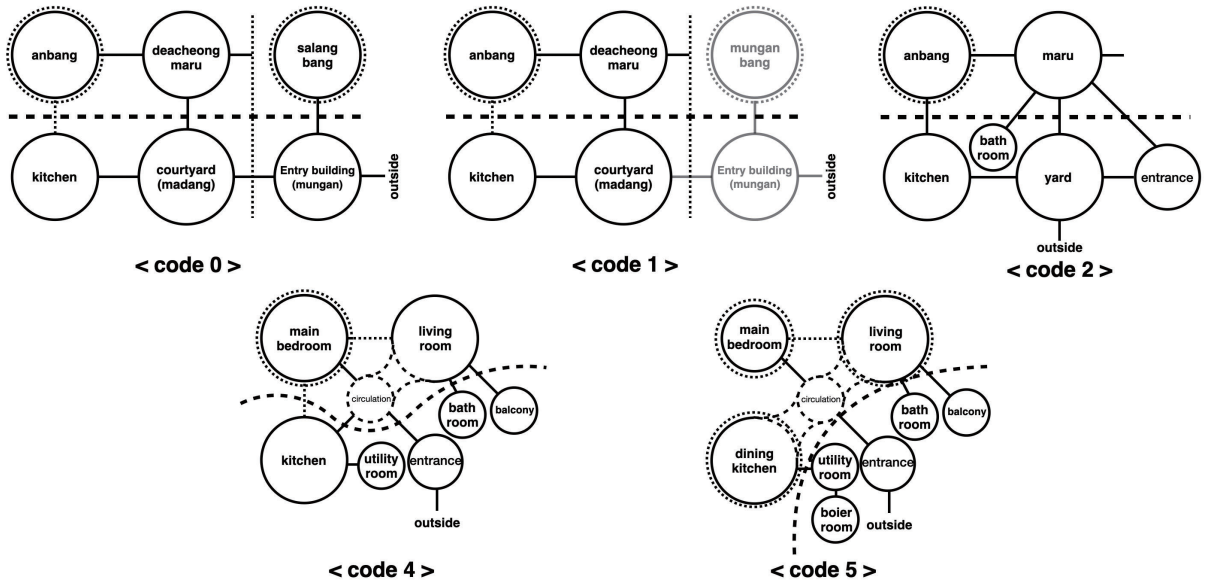


Figure 2.25 Transition of the boundary floor level and heating distinction

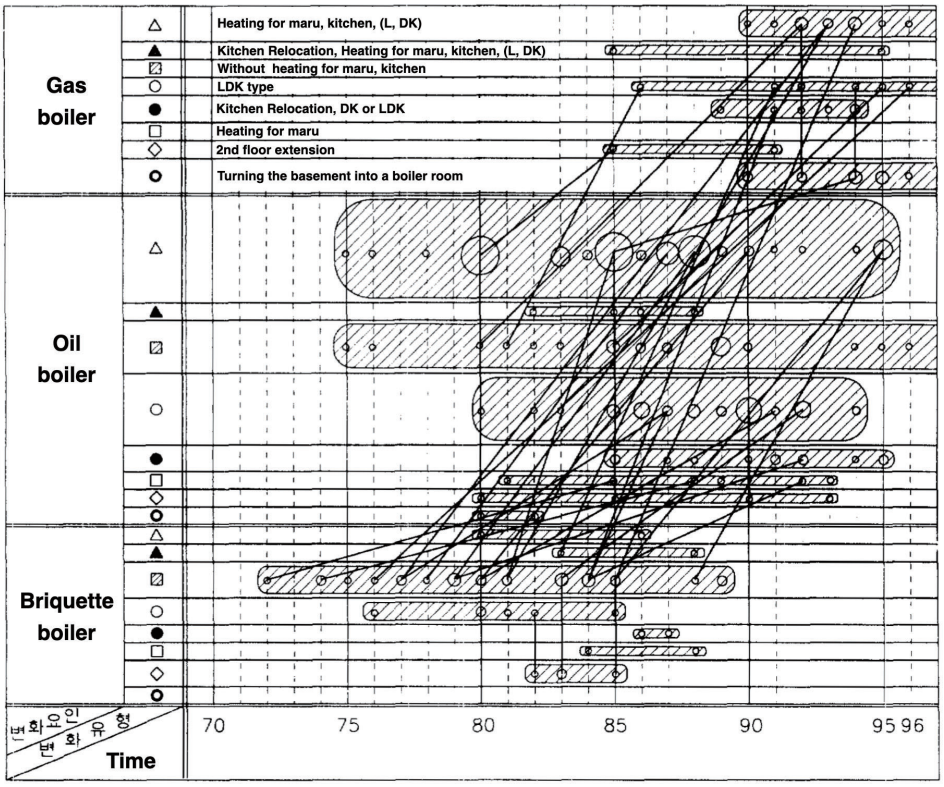


Table 2.2 Change of residential space according to heating system

(soure: reproduced from Lee and Park 1997, 49)

diagrams that the "raised versus lower" distinction keeps operating all the way through (figure 2.25). It is an irony that the lifted floor of the traditional house, which was originally designed for cooling and heating, is still alive in the modern apartment houses. The initial function is now totally lost, but the secondary function, the clean-dirty distinction that was "acquired"

through long practice, has been transferred to the modern homes. Another difference is that the heating system, traditional old maru was limited to summer, and the master bedroom functions were extended. In the period when cooking and heating fuels are combined, personal and public behaviors are concentrated in the Anbang. The heating was supplied to the dining-kitchen and the maru (living room) while separating the fuel according to function. Accordingly, guest receptions and family gatherings were held at the dining-kitchen and maru(living room). In other words, level distinction inherited the characteristics of a traditional courtyard. It acted as the first element of spatial composition rearrangement, and the heating system was the second element that fixed occupant behavior(Table 2.2).

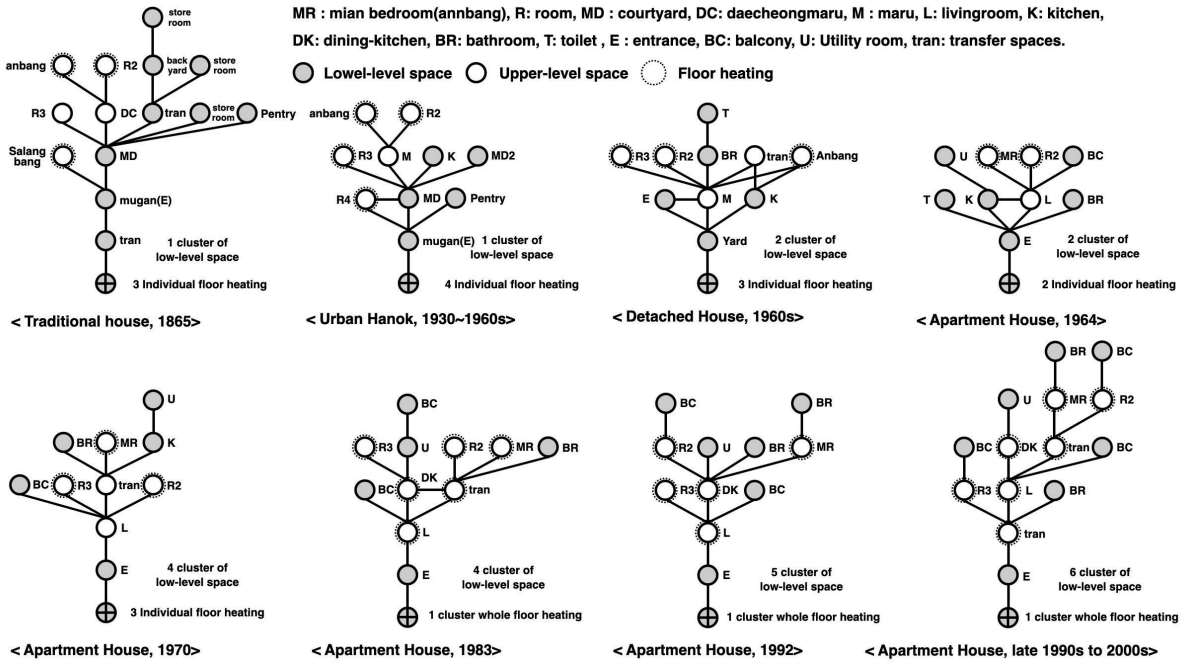


Figure 2.26 Justified graphs of the houses in Korea from late 19c to 1990s

From the fact that the level of distinction has survived the yard's transformation process, a possibility arises that this line of thought can be expanded to the domestic space as a whole. If this conceptual dimension has acted as an underlying force to affect the evolution process, then is it also possible to detect its paths that follow specific directions? This assumption can be investigated first by relying on the most fundamental space syntax method, the justified graph (figure 2.26). Figure 2.26 shows the eight house plan from the previous figures is converted into the justified graph format with the dark dots representing lower-level spaces, and the white dots raised spaces, and a dotted circle representing floor heating space. Two more graphs were added on the far right side of each row; Figure 2.26 represents the earliest staircases unit(Mapo Apartment, 1964) and the late 90's and 2000s new type unit(public and private sector). In the first and second graph of the traditional houses,

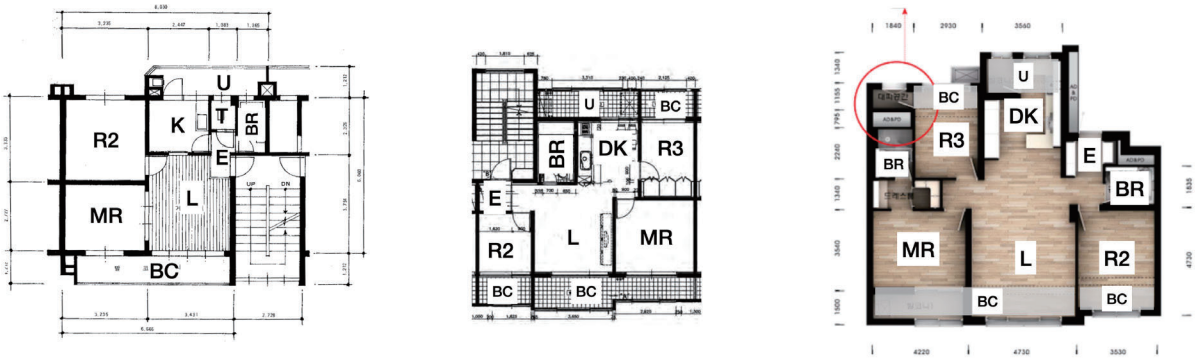


Figure 2.27 Earliest staircase type plan(1964) and 59m^2 -3bay plan(1996), 84A-3bay plan(2008)

(source: KNHC 1979, 267, Land and Housing institute 2012, 63; 121)

the courtyard(MD) is placed in the central and binds all the low-level space together in one cluster, which means that one can move from a lower-level space another without removing shoes. Besides, the heating system supports each bedroom individually, and its location is also different. The next graph represents the detached houses of the 1960s with two clusters of dark dors. In this self-contained house, the bathroom and the toilet from an isolated cluster where extra pairs of slippers exclusively for this separate lower dirty zone are worn. At this time, the existing wood-burning heating system was converted to a hot water boiler using briquettes. The location of distributed heating has been integrated into the kitchen. The first staircase type plan of 1964 also maintains, with a different arrangement, two clusters. Considering the configurational restrictions in apartment unit design, however, this earliest attempt to grow the six low-level spaces in one cluster seems entirely intentional, and therefore could be interpreted as a conscious effort to separate the two zones. The two graphs for the 1970 and 1983 apartment houses have four clusters of dark dors. The difference between them lies in the kitchen's changing status to an upper-level space in the latter plan, as has already been noted. As a result, after the 1970 graph, no more multi-space clusters appear, and the single-cell of sunken rooms are scattered across the houses. Moreover, from this time on, all upper-floors were supported by heating. What should be pointed in the last three graphs, from the 1983 plan to the late 1990s and 2000s plan? The on-going trend of cluster-increasing; has resulted from the extra bathroom in the 1992 plan and the two more balconies after the plan. It precisely reflects the general trend of unit planning in Korea, which has been point out by many researchers; two-bathroom plan PS1'-III becomes dominant in the 1990s, and the number of balconies is continually growing from the 1970s on to cover the whole perimeter zone in the late 90s(Choi, 1996). Looking at those graphs, some transitional patterns can be easily recognized. The number of clusters is increasing while the number of spaces in each cluster is decreasing. In the traditional urban house, the low-level spaces are connected from the shallowest part to the deepest part of the graph.

However, those spaces in the deepest part from the detached house begin to be separated, making another cluster. The number of isolated clusters on the top edge of the trees is getting bigger through time, and finally, all of the end spaces in the last graph are occupied by the low-level spaces. In a sense, the two different spaces are moving in two opposite directions. Suppose the first and last house plans are directly compared again (see figure 2.1). In that case, it can be realized that this is the necessary procedure for the traditional housing to arrive at the reversed form of the modern apartment configuration. It is possible to convert these justified graphs to Standardized Integration(i) values (figure 2.28). In the graph, the dark dots represent the mean Standardized Integration(i) values of low-level spaces and the white dots of high-level spaces.

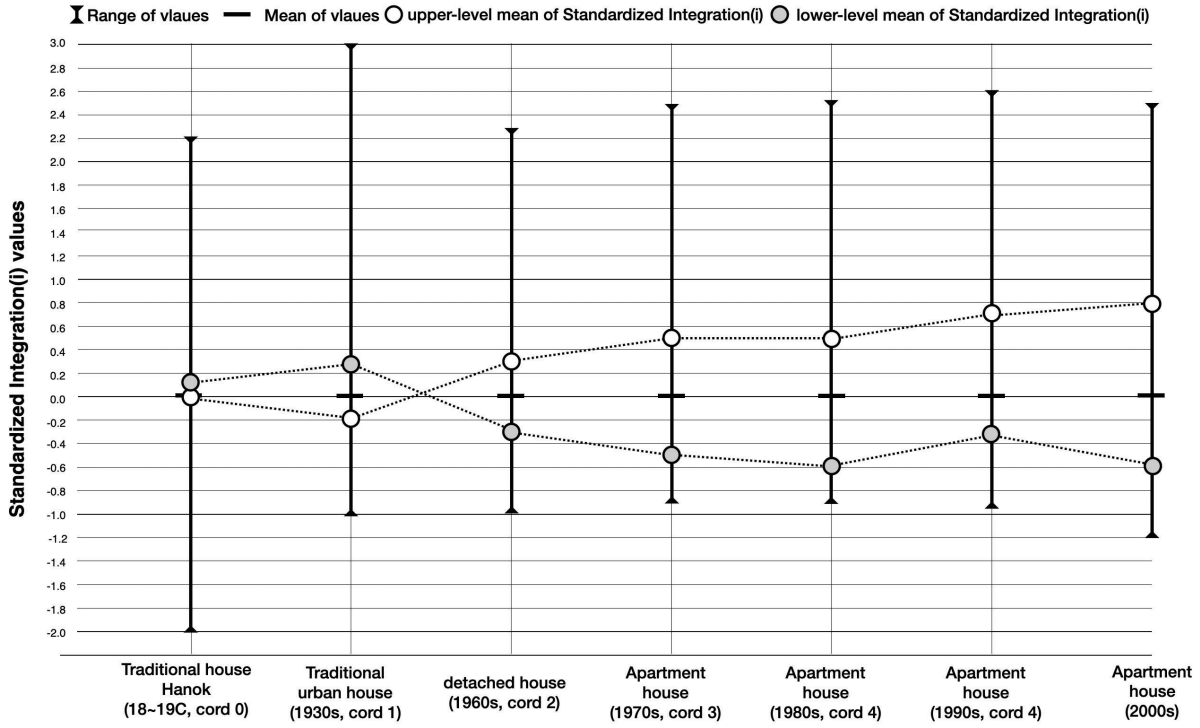


Figure 2.28 Transition of the mean Standardized Integration(i) values of lower and upper level spaces

As expected from the justified graph, the mean Standardized Integration(i) values of low-level spaces in the traditional urban house are lower than those of high-level spaces. In the detached house, this order is reversed as the maru replaces the courtyard by becoming the most integrated space. Starting from the first apartment house in 1964, the two heterogeneous Standardized Integration(i) values are gradually diverging from each other while the mean Standardized Integration(i) values are maintained with small changes. This polarisation precisely reflects what has been observed from the justified graphs. The high-level living spaces are centralized around the livingroom or dining-kitchen, and more low-level subsidiary spaces are placed on the outer edge to surround the unit.

2.3 Respect of Spatial Structure on Gender and status

2.3.1 Introduction

A house is not a simple physical structure containing a family's life, but a cultural space that reflects various aspects of the culture. Aamose Rapopot (1969) emphasizes the relationship between housing form and culture according to human behavior and social institutions. Traditional housing is a space that reflects the unique social structure, institution, and natural environment of each culture. The form and spatial composition of the dwelling are not caused by accidental requirements but is formed by the family relations, social structure, and values of a specific range of groups that share culture and values. Besides, the process of occurrence - extinction - repeat according to the changes and demands of life trends.

Family groups, according to all social structures and cultures, have characteristic practices in spatial use. The house's spatial composition and the behavior of the residents change according to the age, gender, position, and role of each family member. The order in which we live is divided into living spaces according to families' and individuals' positions and roles. Exploring how to recognize the spatial structure and give meaning provides the basis for understanding the time-series transition of houses more quickly. In this chapter, we start from the premise that there will be differences in the concept of traditional residential spaces depending on the characteristics of family relationships (gender) and status (age, class, visitors).

As described in the previous section, cultural cause of Korea develops unique characteristics during development, and its social characteristics are strongly reflected in traditional housing. Besides, throughout modernization, the introduction of Western-style housing, lifestyle changes, improvement of women's human rights, changes in family structure, and urbanization weakened traditional notions and influenced houses' perception. However, the Korean concept of floor level highlight the differences as they inherit it into modern houses.

Research on South Korean traditional housing can be found easily, and through various approaches, differences and commonalities are expressed. However, there are many approaches to analyzing cultural characteristics from psychology, anthropology, history, and social science. Although attempts can be found from a topological and spatial point of view,

the validity is judged to be low due to errors in the analysis sample or errors arising from a lack of understanding of traditional houses in a specific country. Previous studies have a limitation of grasping each space of traditional housing individually and fragmentarily. Therefore, in this chapter, the spatial topological properties and structure of the overall house and the overall residence behavior are interpreted in connection with each space's meaning.

This section aims to understand the traditional houses' spatial composition in Korea and the family structure. There is a sub-purpose to interpret the typical traditional housing of each country. The study's subject is set from the 17th to 18th centuries, which established the cultural value. The study's scope is to Select traditional houses from the Joseon Dynasty in Korea. The research data collection is based on official publication date, and the typical type is selected by referring to the papers published by the AIK(Architectural Institute of Korea), Cultural Heritage Administration.

The analysis method of the spatial composition of a house uses spatial syntax to derive the topological centrality of a specific space quantitatively. Classifying the spaces according to gender and status and using the T-test analysis method, one of the statistical verification methods, each space is judged for the difference in the integration value (i).

2.3.1 2.3.2 Family structure and housing spatial composition

Each society gives a different meaning to the residential area according to its social structure. This meaning combines with each society's sense of belonging and expresses the idea as space. Duncan (1982) found that the attitude toward housing varies according to social structural characteristics, and in particular, argued that the spatial difference occupied by gender differences expresses the properties of housing.

The social structural characteristics were classified into the collectivist social structure and individualistic social structure according to which of the groups and individuals the weight was placed on. Heu (1971) describes that the Father-son relationship in Korea, China, and Japan is the dominant society and has the property of maintaining the family structure and authority that persists around male blood-related relationships. The social system of Korean culture starts with one's family priority and familyism. The realization of a Confucian society that includes Confucian elements respecting ancestors is an essential social system. The

principle of “one’s family first” is the core thoughts and values that support the Joseon Dynasty’s society. The one’s family is a structure in which families of paternal lines are bound and expanded, centered on parent-child blood relations.' This social institution is characterized by establishing a Neo-Confucianism culture since the middle of the Joseon Dynasty. The upper class forms a Lineage Village centered on the rural areas. After transforming into The Lineage Village system, the eldest son inherited one’s family and plays an essential role in ancestor worship. Therefore, the family order centered on the paternal line was institutionalized, and a system in which the eldest son inherited all the property was established. When the second son gets married, it is a rule to move out of houses and not live in the same house as the eldest son.

A patriarch’s rights are a fundamental right to perform rituals and inherited by the eldest son. A brother’s family separated into a collateral family can participate in the rite but cannot directly administer it. Korea seeks to achieve the survival of the family through ceremonies rather than inheriting property rights. Therefore, Korea’s family system has a structure in which all authority and interests are concentrated on the eldest son. (table 2.3). During the Joseon Dynasty, the Yangban house, the middle-high class, consists of several buildings, including Haengrangchae, Anchae, and Sadang.

Space		Behavior (daily)	Behavior (non-daily)	Primary user	Secondary user	gender	Floor type	Floor level
Sarangchae	Sarangbang(L)	sleeping , reception, meal, body wash, excretion	-	head of the household	visitor	male	Ondol	Up
	Sarangbang(S)	sleeping , reception, meal, body wash, excretion	-	the oldest son	visitor	male	Ondol	Up
	Deacheong	reception(seasonal), circulation	ritual ceremony	head of the household	visitor	male	wood floor	Up
	Sarangmadang	circulation	-	head of the household	visitor	male	earthen floor	Down
Anchae	Anbang	sleeping , reception, meal, body wash, excretion	funeral	mother-in-law	relative, servant	female	Ondol	Up
	Geonneobang	sleeping , reception, body wash, excretion	-	Daughter-in-law	-	female	Ondol	Up
	Deacheong	reception(seasonal), circulation	funeral, wedding	mother-in-law Daughter-in-law	relative	female	wood floor	Up
	Anmadang	circulation, laundry, drying (clothes, grain), food preparation	funeral, wedding	mother-in-law Daughter-in-law	relative, servant	female	earthen floor	Up
	Kitchen	cooking, meal, body wash, food preparation	-	mother-in-law Daughter-in-law	servant	female	earthen floor	Down
	Chanbang	food preparation	-	mother-in-law Daughter-in-law	servant	female	wood floor	Up
Haenglangcha	Haenglang bang	sleeping, excretion	-	servant	-	male	Ondol	Up
	Haenglang madang	circulation, drying (grain), food preparation	-	head of the household	servant, visitor	both	earthen floor	Down
Sadanghae		-	ritual ceremony	owner’s family	blood relative	male	Wood floor	Up
Gwang		storage	-	owner’s family	servant	both	earthen floor	Down

Table 2.3 Family structure and spatial composition in Korea

Each building is constructed around a courtyard surrounded by a fence and separated spatially. It is to accommodate large families and maintain Confucian family relationships. It differentiates into many buildings and spaces to comply with the Neo-Confucianism norms such as the hierarchy of interior and exterior, and the hierarchy of living and reception. Each building is generally in the form of ㄱ, ㄷ, ㅁ, ㄹ, and the buildings are combined to form ㅁ, 月, 用, 品. Each building is arranged according to Confucian principles. Social space and decorative elements are placed in the front of the house, and a family and private space are placed in the rear.

Therefore, in the front, a Haengrang-chae that functions as a servant's lodging and a warehouse are placed, the owner's building is placed in the back, and the shrine is located in the deepest part of the house. The owner's space is clearly divided according to the main house's role and the love house. Sarangchae is placed closer to the outside than Anchae and serves as a social function as a space for men in charge of receiving guests. The rear of the house is a space for ancestral rituals, separated from the living space. This concept is also expressed on the floor level, and the ground level increases in the order of Haengrang chae - Sarangchae - Anchae - Sadang.

The vertical structure of blood ties influences the Korean family. The parent-child relationship influences the marital relationship, and the wife is given status and authority within the family. In Korea, a wife gives birth to a child, earning her mother's qualifications, and has the same status as her husband.In other words, the wife is guaranteed independent influence and territory, supports the head of the household, and acts as a force that holds a patriarch's rights in check.

Korea's parent-child relationship is an absolute parent-child relationship, and the son is subordinate to the patriarch as the successor to the head of the household. Based on filial Piety, the eldest son inherits the ritual's rights following the father's generation. Accordingly, the firstborn child acquires a successor's status, receives external guests, and engages in exchanges with other groups. Besides, the successors learn to strengthen Confucian ideologies, rituals, family history, and how to manage groups through rituals. The father educates the son, and the son forms a complementary and interdependent relationship that fulfills the successor's responsibility. The eldest son maintains a subordinate relationship to the elder by making differences in language and behavior between other male brothers.

However, the upper and lower relations due to blood ties are weakened, and equal cooperative relations are formed. The characteristic of paternal society is the status of married

women. The mother-to-child relationship transfers to a mother-in-law and daughter-in-law relationship after the son's marriage. The daughter-in-law is not related to blood and is transferred to the husband's family, and is forced to obey. The tension is high as she maintains a competitive relationship with her mother-in-law in the economic sphere.

The head of the household represents the family and has the role of contacting the outside, and the housewife is in charge of housekeeping. In religion, men are in charge of Confucian ceremonies to promote family prosperity, while women have polytheistic tendencies and wish for family peace. According to males' and females' role structure and consciousness, traditional housing separates men and women's entire living area.

The gender space differentiation divides the area into Sarangchae and Main Chae and separates the boundaries with separate buildings and external spaces with walls and doors. The Anchae is the female owner's space, the center of the residence, and is located inside and away from the outside. It has a closed characteristic that can be reached through several levels of space. According to the Confucian principle, it is a spatial classification method where males live outside, and females live inside. It intentionally implies a planning intention to lower connectivity with the outside world. It is also ideal that the Anchea is prohibited from entering the main house except for males with direct descendants, and upper-class females do not go outside the main house (figure 2.29).

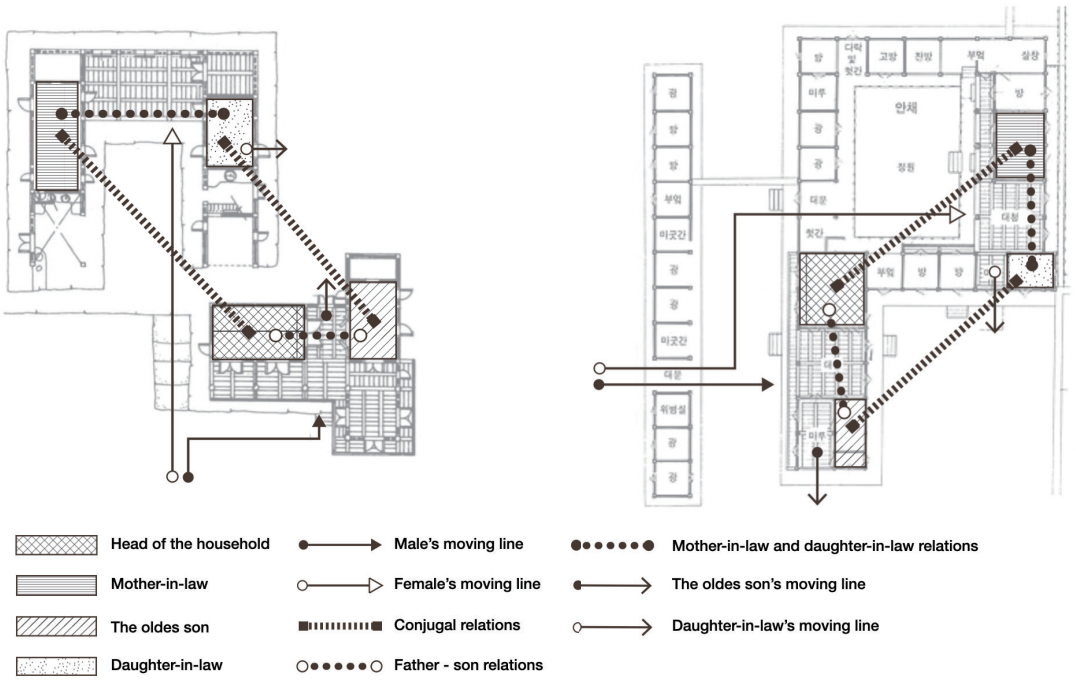


Figure 2.29 Family structure and spatial arrangement of traditional housing in Korea

Sarangchae is located in front of the main house to protect the main house, watch the servants' movements, and increase accessibility to the outside. Sarangchae is a space where the symbolism of the patriarch is well expressed. It is a space that symbolizes the authority of the family and learns for family succession. Not only does it lead the owner's daily life, but it also has a function for a reception.

The Sarangbang is the central space of Sarangchae and functions as a study and bedroom. Sarangchae, the living space of the father and son, designates the room's hierarchy according to the state of inheritance. The large sarangbang is dedicated to the household's head, and the small sarangbang is for the eldest son. Females mainly live in Anchae. Therefore, the relationship between mother-in-law and daughter-in-law also appears around Anchae. Anchae consists of Anbang, Andaecheong, Geonneobang, and the kitchen. The kitchen is located adjacent to Anbang, and Andaecheong is located between Anbang and Geonneobang. Anbang is the central space of Anchae, a space that stores family property and essential household items, and is a space where actual family events are held.

In particular, in the absence of a separate shrine, ceremonies were held in Andaecheong. In other words, it has an essential meaning for the housewife to occupy Anbang. A powerful mother-in-law occupies Anbang, and a daughter-in-law occupies Geonneobang. When the eldest son completes the inheritance, the mother-in-law moves to Geonneobang, and the daughter-in-law moves to Anbang. Andaecheong is a multifunctional space that functions as a front room for entering and exiting the room, becoming a central space when important family events are held and a reception space for female owners. Andaecheong is also used as a device to relieve the tension between Anbang and Geonneobang(table 2.3).

In Geonneobang, there are many cases with small doors in the opposite direction to Andaecheong. This door is not ventilation or decorative element but a device to secure the daughter-in-law's privacy. These devices intend to secure the daughter-in-law's territory and enhance the eldest son's accessibility (figure 2.29).

This section examines the socio-cultural system of family and the spatial composition of houses in the Joseon Dynasty. In the previous section, it was confirmed that there was a clear spatial difference between males and females in the Joseon Dynasty family structure. Besides, the living spaces of the parent and child generations are separated.

The high phase degree of a specific space in any spatial configuration means that space is at the topological center of the overall spatial configuration. It means that access from that

space to all other spaces is easy. As seen in the previous section, in the Joseon Dynasty housing (Figures 2.21 to 2.24), the male space shows a relatively high integration value than the female space. It means that the male space is more accessible from all spaces than the female space and has a lower spatial depth.

To verify these results in detail, the average (T-test) is compared by extracting the male and female spaces. As a result, it was confirmed that the male space's average was higher than that of the female ($p<0.00$). The head of the household had a higher mean of the integration of the mother-in-law ($p<0.01$). This difference in space between men and women appears similarly in children's generation ($p<0.03$). The results in terms of social status are very interesting. In the previous section, in the Joseon Dynasty, Confucian thoughts had a significant influence, and there was a difference in social status between the parent and child generations. However, from a topological point of view, there was no topological difference between the head of the household and the eldest son ($p<0.28$), and no difference was found between the mother-in-law and daughter-in-law ($p<0.17$).

Comparing the male's space and female's space					
Gender -1					
Variable		Males (n=86)	Females (n=94)	*t*-value	prob
Integration value	M SD	0.8566987 (0.019)	0.7701286 (0.020)	2.17	0.004
Gender -2					
Variable		Father (n=41)	Mother (n=47)	*t*-value	prob
Integration value	M SD	0.8861254 (0.018)	0.7710276 (0.020)	2.55	0.013
Gender -3					
Variable		Eldest son (n=34)	Daughter-in-law (n=28)	*t*-value	prob
Integration value	M SD	0.8174631 (0.020)	0.7124232 (0.006)	2.31	0.030
Comparing the space according to status					
Status -1					
Variable		Father (n=41)	Eldest son (n=34)	*t*-value	prob
Integration value	M SD	0.8566987 (0.038)	0.7701286 (0.020)	1.08	0.285
Status -2					
Variable		Mother (n=47)	Daughter-in-law (n=28)	*t*-value	prob
Integration value	M SD	0.8861254 (0.020)	0.7710276 (0.006)	-0.41	0.174
Status -3					
Variable		Owner (n=136)	servant (n=44)	*t*-value	prob
Integration value	M SD	0.80753542 (0.021)	0.935775 (0.027)	-4.42	0.000

Table 2.4 Family structure and spatial arrangement of traditional housing in Korea

However, there was a difference between the owner's family (yangban) and servant space ($p>0.00$)(table 5.3). In other words, it means that the servant's space is located at the shallowest depth in the overall spatial composition of the house, and all the spaces are most accessible. It should be interpreted differently from the meaning arising from the spatial differences occurring in gender. The servant's space is arranged in the most open space so that the owner's family monitors the servants' movement and is a spatial structure to respond to the requests of the owner's family promptly. If the spatial hierarchy is organized based on the results above, the order of servant space - male space - female space appears.

2.4 Conclusion : genotypical property of space

In this chapter, we have considered the transition process of South Korea's domestic space. The conclusion from the spatial-Behavior dimension is as follows; a) The behavior in Anbang is expanding into modern apartment houses' overall space. After the 1990s, the integration value of Anbang increases, and it can be interpreted as the intention to maintain the multifunctional character inherent in the old Anbang. b) The kitchen's integration value has increased significantly since 1980, and there is a tendency to place the kitchen in the spatial center with the conversion of heating fuel and the rise of the floor level. c) The behavior in Maru, which was used temporarily according to the seasons, has taken on a modern living room status with the support of heating since the 1980s. However, it is not easy to interpret that the old floor's behavior is inherited into the modern living room. Instead, it can be interpreted as inheriting the behavior in the bedroom. d) Madang is a space that has undergone the most significant change, and it can be interpreted that some of the old Madang behaviors are inherited from the balcony, bathroom, and entrance.

In symbolic dimension, the floor level distinction was leading the evolution of domestic space in South Korean. From the beginning of the 60s, the aim of the new apartment housing development in Seoul was to modernize and enhance the people’s living. For some planners, the old domestic culture was regarded as outmoded and unhealthy, thus not suitable for modern living. They thought the apartment house that came from the West should enclose the western style of living. In some of the earlier apartment plans, they raised the bathroom floor up to the level of the living room and provided radiators, instead of the floor heating, in the bedroom. How- ever, when the residents moved in, they resisted the planners’ intention; they had the floor level of the bathroom re-lowered in Hangang apartment

housing in 1970 and installed hot pipes under the floor to restore the floor heating in AID apartment housing in 1974.

In Joseon Dynasty, it was found that the hierarchical division between the owner (yangban) and the servant and male and female was reflected in the spatial composition.In particular, the male space is located at the topological center, and there was no spatial division by social status within the family. Choi (2003) compared and analyzed the space of houses in the Joseon Dynasty and apartments in the 1970s~1990s and argued the correlation between the rise of the center value of the kitchen space and women's social status change. The results of this study support Choi's an argument.

The transformation process of the domestic code described in this chapter is to show that it is not merely the changing arrangement of rooms. However, the interaction between the space and its activities within the domestic field can precisely define the new space, and there is an indigenous concept of level-distinction that was actively involved in this process. Guided by these underlying forces, the housing evolution in Korea has followed specific topological paths to adapt the old genotypical properties to the new physical environment. The user’s reaction described above shows that these values do persist through the formal changes.

Chapter 3

Evolution of Domestic Space in China
: diachronic space syntax analysis

3.1 Housing in China

3.1.1 Traditional house(~1870)
3.1.2 Lilong house (1870s~1930s)
3.1.3 Early apartment house(1930s~1940s)
3.1.4 Following the Soviet Model (1949~1957)
3.1.5 Hosing standards and the evolution of different apartment (1958~1978)
3.1.6 The concept of territory distinction

3.2 Evolution of Domestic Space

3.2.1 Introduction : from the old and new
3.2.2 Traditional code and its transfer to the early houses
3.2.3 Evolution of apartment house plans: 1949 ~ 1980s
3.2.4 Topological paths in evolution
3.2.5 “one bright, two dark” as underlying force in evolution

3.3 Respect of Spatial Structure on Gender and status

3.3.1 Introduce
3.3.2 Family structure and housing spatial composition

3.4 Conclusion : genotypical property of space

3.1 Housing in China

3.1.1 Traditional house(~1870)

China has totel aera of 9,600,000km^2 and it is the world's third-largest country by area. Governed by the Communist Party of China, the state exercises jurisdiction over 22 provinces, five autonomous regions, four direct-controlled municipalities (Beijing, Tianjin, Shanghai, and Chongqing), and the special administrative regions of Hong Kong and Macau.China emerged as one of the world's first civilizations, in the fertile basin of the Yellow River in the North China Plain. For millennia, China's political system was based on hereditary monarchies, or dynasties, beginning with the semi-mythical Xia dynasty in 21st century BCE. Since then, China has expanded, fractured, and re-unified numerous times. In the 3rd century BCE, the Qin reunited core China and established the first Chinese empire. The succeeding Han dynasty, which ruled from 206 BCE until 220 CE, saw some of the most advanced technology at that time, including papermaking and the compass, along with agricultural and medical improvements. The invention of gunpowder and movable type in the Tang dynasty (618–907) and Northern Song (960–1127) completed the Four Great Inventions. Tang culture spread widely in Asia, as the new Silk Route brought traders to as far as Mesopotamia and the Horn of Africa. Dynastic rule ended in 1912 with the Xinhai Revolution, when the Republic of China (ROC) replaced the Qing dynasty. China, as a whole, was ravaged by feudal warlordism and Japan during World War II. The subsequent Chinese Civil War resulted in a division of territory in 1949 when the Communist Party of China led by Mao Zedong established the People's Republic of China on mainland China while the Kuomintang-led nationalist government retreated to the island of Taiwan where it governed until 1996 when Taiwan transitioned to democracy.

Chinese home design was originally more heterogeneous than it is today. In addition to the orthodox square shape, evidence of round dwellings are common in early archaeological sites(Needham, Joseph 1971, 204). Over the span of several millennia, architecture was influenced by the development of Chinese thought, narrowing the range of acceptable layouts closer to the mature ***Siheyuan*** style. Traditional Chinese house architecture refers to a historical series of architecture styles and design elements that were commonly utilised in the building of civilian homes during the imperial era of ancient China. Throughout this two-thousand year long period, significant innovations and variations of homes existed, but

house design generally incorporated a set of qualities that made Chinese home architecture distinct from that of other cultures and regions. As highlighted by the classic siheyuan style, this included an emphasis on extended family units in a single dwelling, distinct separation of various elements of the household, alignment with the cardinal directions and wooden construction; all in line with Confucian hierarchy and Feng Shui. (Kohrman, Matthew 1998, 65, 88). As Han Chinese culture spread from out from the Yellow River Valley, dwellings in the outlying regions retained influence from the dwellings of the native cultures.For instance, Yue homes in southern China were traditionally built on wooden piles due to the humid climate.

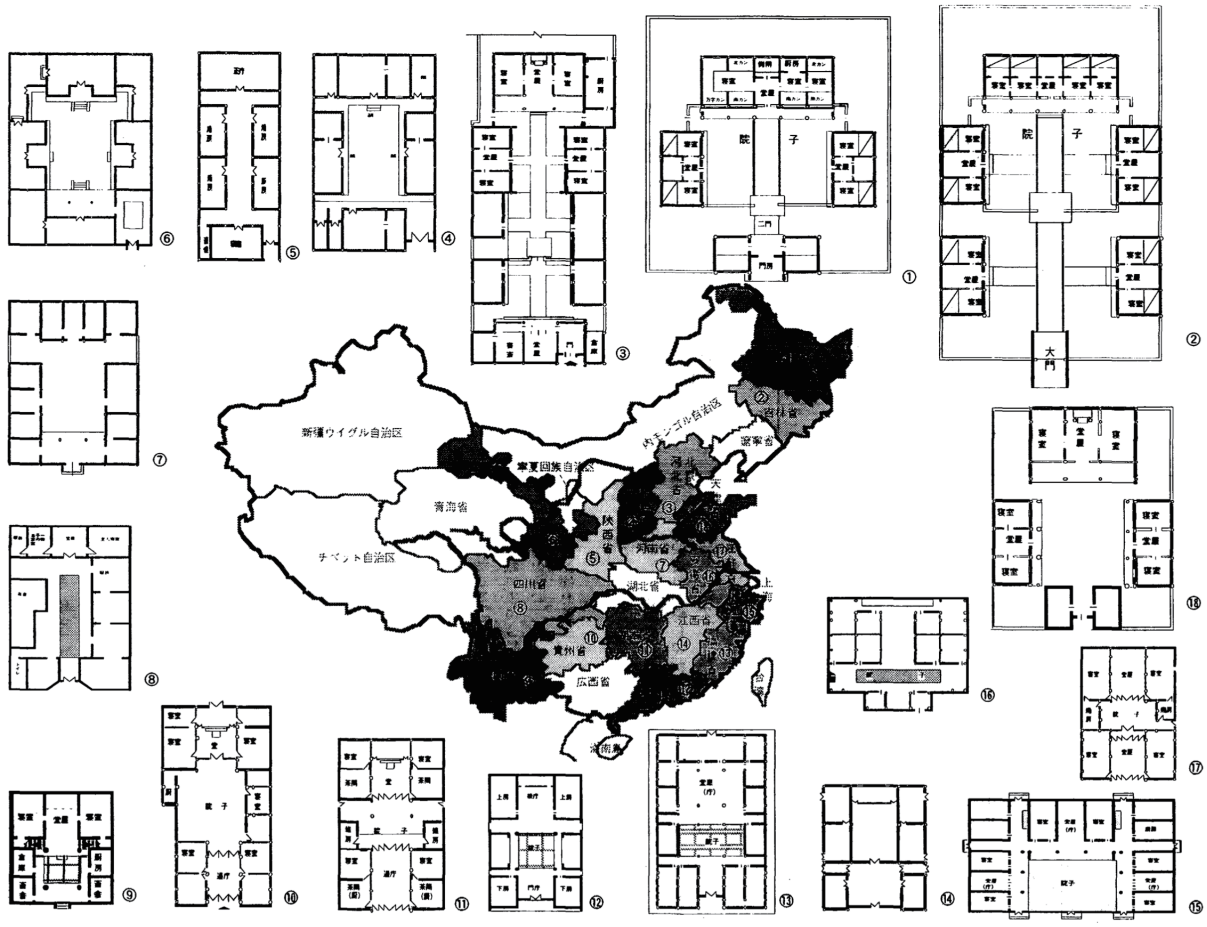


Figure 3.1 China's various Siheyuan (from Nan ZHOU 1999, 184)

When Han migrants moved to the region, they initially adapted this style before the standard Han practice of raised earth foundations eventually re-asserted itself(Liu, Dunzhen 1980). After the form of the traditional chinese household had settled, this basic layout changed very little, especially for commoner's dwellings(figure 3.1). Although the basic floor plans of sanheyuan vary little throughout China, the names applied to them do, as several earlier references suggest. Typically, there are three structural divisions-three 'rooms' or bays-in

the horizontal main building; thus, the unit is termed a 'three-jian building' [*sanjianwu*(三间屋)]. In many re- spects this is quite similar to the *yiming liangan* [one bright, two dark or one opened, two closed(一明两暗)] three-jian form described earlier for northern Chinese dwellings.(Ronald G. Knapp 2000, 46). In southern China, however, each jian is typically narrower across its face than it is deep. The central room is a hall serving ceremonial purposes, and it is bounded on each side by a bedroom.

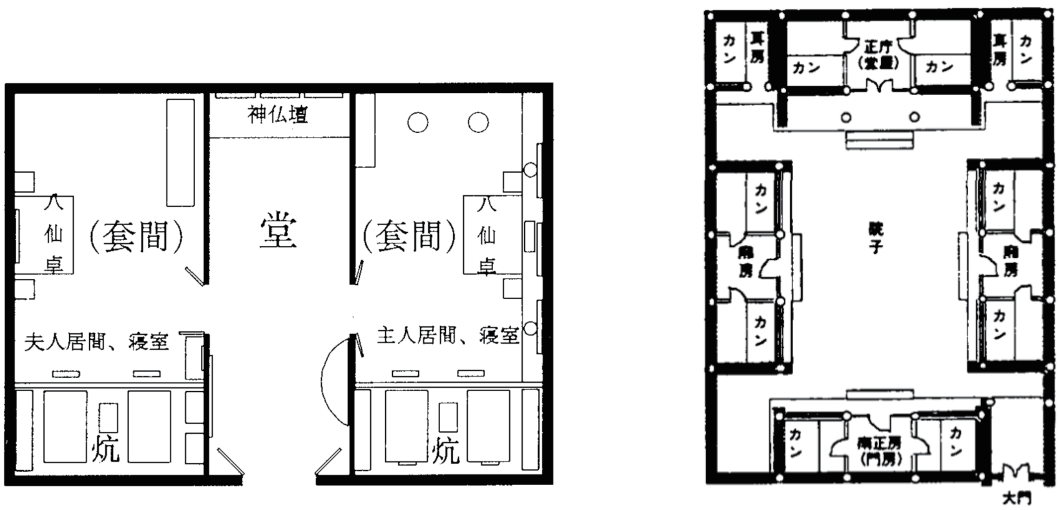


Figure 3.2 Typical Tangwa and siheyuan (Form left: Uekita 1995, 61; right: Zhou 1999, 182)

The pair of wings thatjuts out from the main building may be short or long, a condition that varies widely ac- cording to need. These wings provide room for kitchens, toilets, storage, and additional bedrooms. The 'bright' is commonly called [*Tangwu* (堂屋)]in the northern region and the southern region is called [*Ting* (厅)]. The characteristic of these things is the composition that must pass through this space to enter the bedroom from the outside. n most of southern China, the central jian is symbolic of unity and continuity-a significance heightened by the traditional placement of a long ta- ble facing the door upon which are placed ancestral tablets, images of gods and goddesses, family me- mentos, and ceremonial paraphernalia.(Figure 3.2). The diversity of Yiming liangan type is divided into 3 and 5 bays depending on the size of the building, and there is a small difference in a form in the north and south of China. The siheyuan with a Yiming liangan type is the most distributed in China, *Xiangfang*(廂房) also had many Yiming liangan type. Although there's a difference between northern and southern courtyards, their essential characteristics are almost the same.

In a courtyard compound there will be an open yard, or more than one, surrounded by single-story rooms. Siheyuan construction is always symmetrical. The main house is on the central north-south axis, and the less-important structures are positioned on the west and

east sides. Normally, a siheyuan will contain three courtyards, while smaller versions might have only one courtyard and larger versions might have as many as five courtyards. Tang-wu is the main house of the siheyuan is normally positioned along the north-south and west-east axes. The house faces south and is regarded as the best house in a siheyuan complex, since it has shelter from the wind and also has good lighting. It usually served as elders' accommodation. Xiangfang are also called side houses. The Chinese traditionally thought that the eastern xiangfang were better than the western xiangfang in respect of fengshui (invisible forces). The eastern xiangfang are usually used as married sons' accommodation. Western xiangfang are usually unmarried daughters' rooms or kitchens. *Daozuofang*(倒座房) is a reverse-facing room, beside the front gate. Since the reverse-facing rooms faced north, with poor lighting, they usually served as servants' rooms. Though siheyuan have undergone various developments with time, they all have much in common.

3.1.2 Lilong house (1870s~1930s)

The Chinese economy developed slowly at the later stage of the long feudal period. In the mid-nineteenth century, most Chinese cities remained traditional, as the conceited Qing government adopted a closed-door policy and banned all kinds of foreign trade. Compared with the Industrial Revolution in Western countries, the Qing Dynasty was extraordinarily feeble and, following the Opium War in 1840-1842, Western imperialist powers quite literally forced open its door with their ships and advanced cannons. Subsequently, under the joint action of both internal and external causes, substantial changes took place in China's urban society and economy. However, different from Western cities, this germination of modernization reflected China's characteristics as a semifeudal and semi-colonial society. Predominantly, change first took place in two kinds of places. They were the "concessions" in coastal open cities tract of land supposedly on lease too, but actually seized by, imperialist power and put under its colonial rule. In northeast China, they were also invaded by foreign powers.

Housing Conditions of Urban Residents at Different Social Levels In a traditional Chinese city, there lived landlords, government officials, merchants, and the townspeople serving them U ally the residents resided in different parts of the city wealth, social status, and occupation. The houses differed depending on the area, but basically, they were built in a traditional manner suitable for a large feudal family. After China entered the semifeudal and

semi-colonial period, significant changes took place in the urban social and economic structure, mainly due to the development of new industries and the influx of people looking for work. Further differentiation occurred in people's social and economic conditions. Besides the traditional scholars, farmers, artisans, and merchants, new social classes appeared, including foreign residents, capitalists, compradors, functionaries, industrial workers, and vagrants. Naturally enough, families of different classes and incomes had different living standards and varying demands for housing, further complicating its provision. Generally, a shortage of housing and the polarization of living conditions were common phenomena, roughly dividing into three levels of provision: High, middle, and lower. Clustered urban housing, born out of the Chinese tradition and built by real estate developers, first emerged in Shanghai's concessions. The sale and lease of these properties were primarily targeted for Chinese residents who were able to settle with above-average incomes. Over time, these clustered buildings ushered in a new era of urban housing in China.

Owing to the sharp discrepancy between limited land availability and explosive population growth, property, as mentioned before, was expensive in the concessions. It was impossible for the Chinese landlords and wealthy merchants to copy their country mansions,
Lilong, the small courtyard housing, is named after through the principles of circulation in their urban organization: "Li" means neighborhood, "Long" means small lanes. Their origin lies in the spatial concept and construction in traditional Southeast Chinese dwellings. Their interior plans evolved as lifestyles became Westernized. They were the earliest type of mass commodity housing in Chinese history (Wang 1989, 4). Their density increased under the extreme circumstances of the growing metropolis of Shanghai from 1870 onwards. Since then, they were built on a large scale in the center of this city and accounted for 60% of the total dwelling areas by 1949 (Wagn 1989, 6).

The single units of clustered residential buildings, including their floor plans, architectural structure, and exterior, were based on traditional local houses. This category of residential buildings can be called the clustered urban residential buildings in a traditional Chinese style, with the most typical of them located in Shanghai's Shikumen neighborhood. It was virtually architecture born out of the houses in the southern parts of the Yangtze River (Figure 3.3).

Most of the houses were two-story, post-and-panel structures, with a horizontal courtyard in both front and back. Because the house entrance was a typical shikumen gate, similar to the traditional gateway of vernacular houses in the south featuring a stone doorframe and wooden plank door, the buildings were duly named the shikumen houses (figure 3.4).

Figure 3.3 Floor plan of a two-storey Ming Dynasty house in Jingde town
(from Lu Junhun 2001, 42)

Figure 3.4 Xingren Li, a five-room traditional shikumen houses, built in 1872
(from Wang 1987, 7)

Clustered shikumen houses were often named li, while the common corridors between the rows of housing blocks were called nong, meaning "alley." Residential buildings constructed in this fashion thus became called shikumen linong houses, which continued until 1930, despite changes.

Moreover, because the shikumen linong houses built in the early days used traditional building materials and followed the traditional structure with the interior divided in the trade. Traditional manner, they were called the old-style shikumen linong houses. Compared with the simple log cabins before 1870, their rent was higher, but their maintenance costs were low. It was easy to lease them and the cost could be recovered in less than ten years. Consequently, tens of thousands of these houses were built in Shanghai each year (Zhu Jiancheng 1990, 13).

In Shanghai, the shikumen residential quarters gradually became centers of urban activity. Due to their convenient locations and spacious and flexible internal arrangements, productive activities were often commingled in the same buildings with family life. Many commercial firms, entertainment services, newspapers, and guildhalls had li in their address. Simultaneously, some family hotels and private clinics also emerged in these areas, and businesses gave a commercial flavor to the neighborhoods (Luo Suwen 1991, 45.)

However, in the early 1900s, other Lilong were also built; Tenjin, Wuhan. The vigorous development of residential houses in Tianjin Lilong mainly began in the early twentieth century. Tianjin demarcated the British and French concessions in 1860, and Tianjin has since devel-

oped in modern times. However, there are really large-scale constructions in the concession area that will have to wait until the Yihetuan incident at the beginning of the twentieth century. At the same time, at the beginning of the twentieth century, the New Deal was vigorously implemented in Tianjin. Against this background, in 1903, the Hebei New District, located in the northeast of the old city of Tianjin, received development approval and began construction.

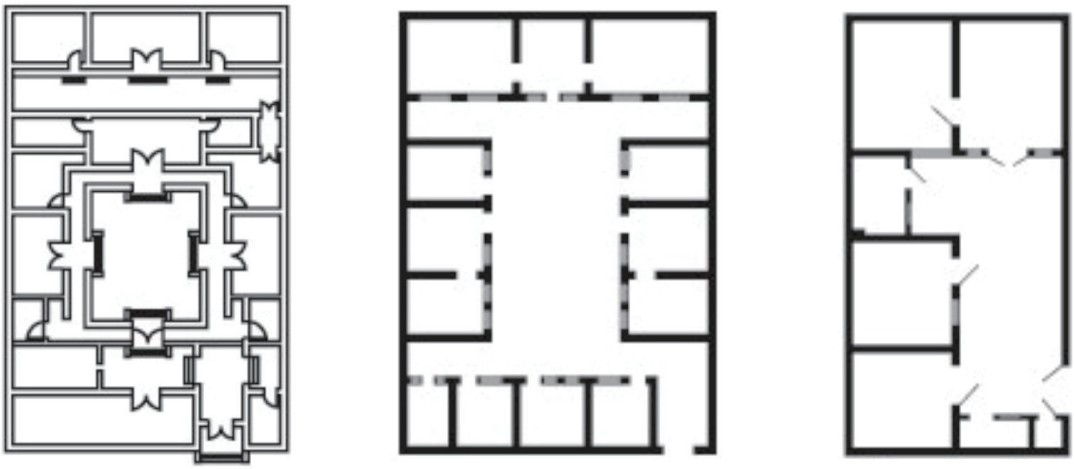


Figure 3.5 Tenji traditional Siheyuan(left) and Heyuan-style Lilong house(Middle and right)

(from Liu 2016,100; Wang 1987, 63)

With the support of policies and financial resources, the Beiyang government intends to develop the Hebei New District into a central urban area in Tianjin that can compete with the concession area and is also a political center.

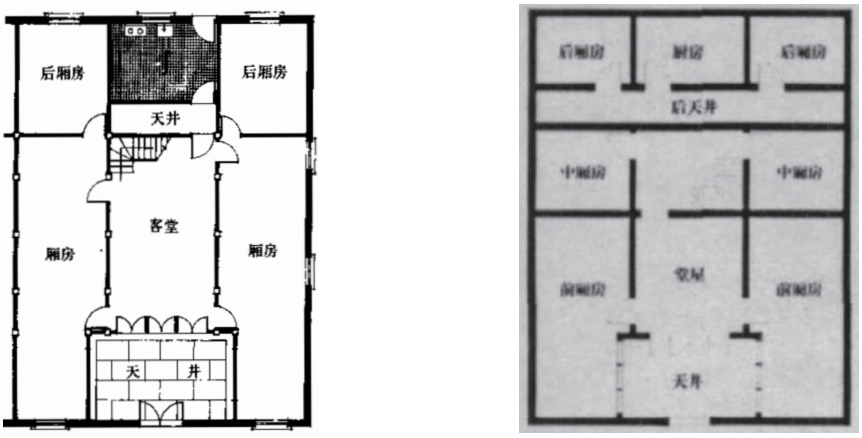


Figure 3.6 Typical Lilong house in shanghai(left) and typical Lilong house in Tenji(right)

(from Wang 1987, 74 (left); Feng 2016, 28 (right)

After the 1911 Revolution, the Beiyang government increased its dominance over Tianjin, which promoted the Hebei New District's further development. Besides, the railway transportation of Tianjin North Railway Station played a leading role in this area, and the population living in the Hebei New District gradually increased. These residents are mainly government staff and railway commercial workers. To meet the needs of these people, a large number of residential buildings in the courtyard of the courtyard have begun to be built in Hebei New District. (Liu 2016, 45).

Unlike the concession area, the developers of these housing complexes are mainly Chinese real estate agents-most of them are warlord bureaucrats. From 1900 to 1930, the courtyard houses were built in a large number of Chinese settlements outside the concession area. In addition to the Hebei New District, there is also the Nanshi area near the old city and Tianjin old city. Besides, there are some small-scale courtyard houses in the fringe of the concession. It originates in the northern Siheyuan (figure 3.5).

Finally, the old-style shikumen linong houses later spread to other open cities such as Tianjin and Hankou. People in Tianjin called similar buildings in the city's Nanshi District tapered end-style houses. At the end of the nineteenth century and the beginning of the twentieth century, similar shikumen houses emerged in Hankou's old city and on the outskirts of its concessions(Lu Junhun, 2001, 46; Liu 2016, 31) (figure 3.6).

Trading port cities, economic development, and population growth caused a continuous rise in land and dwellings prices. In the concessions in particular, increases in housing costs outstripped population growth.

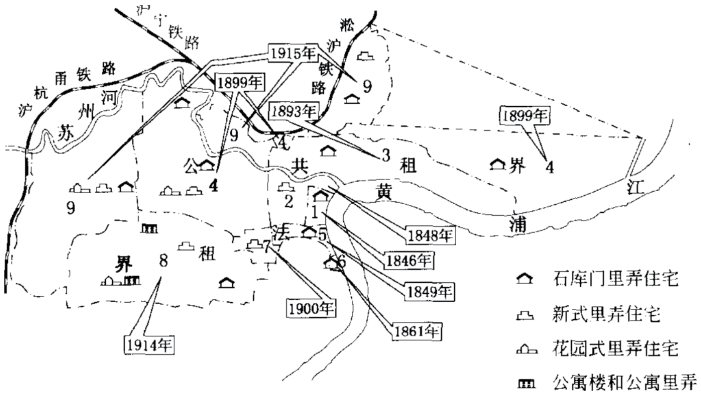


Figure 3.7 The distribution of different type housing in Shanghai 1984 to 1949 (from Lu Junhun 2001, 62)

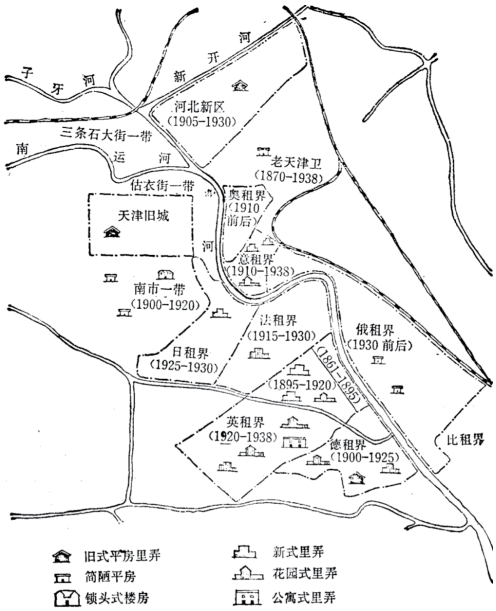


Figure 3.8 The distribution of different type in Tianjin 1984 to 1949 (from Wang 1989, 26)

In Shanghai, for example, the population in the public concessions in 1930 was nearly three times that of 1901, but the number of houses was only 1.8 times greater. The concessions' population density was 15 times that of the areas inhabited earlier by the Chinese, and the rent in the public concessions in 1930 was eight times higher than in 1901. Indeed, written documents indicated that in the thirty years from 1903 to 1933, land prices in the public concessions of Shanghai increased ten times (Wang Shaozhou, 1987, 568).After the 1920s, large tracts of urban housing of different kinds gradually a leading position in the housing constructions of Shanghai(Figure 3.7), Tianjin(Figure 3.8), Whan, and other cities, as well as in the emerging cities of northern China. As mentioned, housing was mainly developed in two directions, roughly simultaneously. The first was housing developed based on China's traditional houses, and the second was housing imported directly from abroad(Lu Junhun 2001, 61). During this period, diversified housing demands, investments, and operations, plus regional differences, resulted in a wide variety of housing.

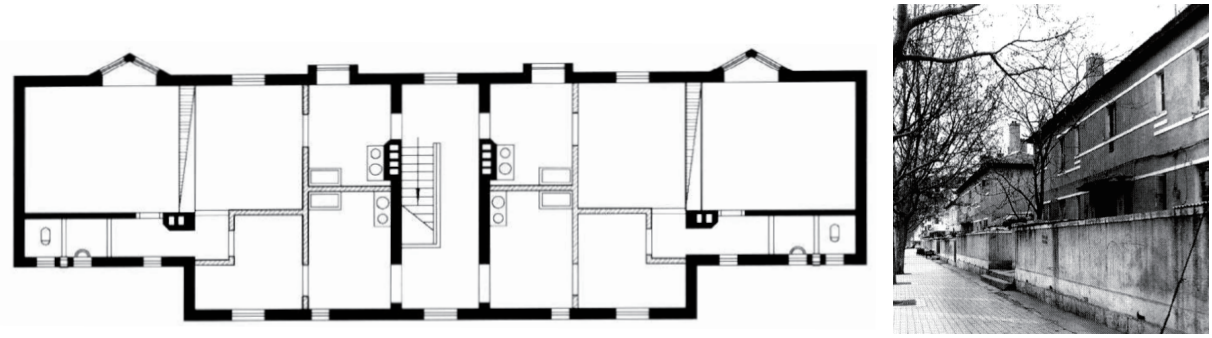


Figure 3.9 Apartment housing for Manchurian Railway, standard unit floor plan

(from China architecture standardization design institute, 1984, 54)

Generally, housing had the following characteristics: a varied appearance of small houses, together with apartments, sophisticated indoor facilities; improvement of the external environment; the use of new materials and new technologies; and the employment of various kinds of unit design. The changes and development of traditional Chinese courtyard-type houses, terrace houses, apartments, open-corridor housing, and high-rise apartments based on foreign countries' models were introduced. The trend toward smaller family size and increased land prices and rents made the design of small dwellings more and more popular. A large number of houses in the shikumen linongs of south China, for instance, were turned from an original five-room or three-room configuration into one-room or one-and-a-half-room dwelling. Besides, apart from many buildings and other more compact housing types, small floor-space allowances for each household appeared (figure 3.9).

3.1.3 Early apartment house(1930s~1940s)

Many foreign railway staff and workers came to live in the emerging cities of northeast China. Their houses were constructed by the railway companies in a unified way, with characteristics that reflected different users and standards of living. However, each type of house had a standard design. Among them, the China Eastern Railway houses developed by the Russians in Harbin, and the Manchurian Railway residential areas developed by the Japanese South Manchuria Railway Co., Ltd., in Dalian and Shenyang, were most representative of this new type of modern urban housing. The China Eastern Railway residential areas in Harbin were also high standards, with a commodious environment and furnished apartments for rent. All employees working on the railways, ranging from high-ranking officials to ordinary workers, lived in the apartments, distinguished only by different space standards. In Harbin, two-story high-grade apartment buildings appeared early on because they were economical and easy to keep warm (Liu Songfu 1991, 82). The buildings were designed with standard units, each accommodating from two to four households sharing one staircase (Figure 3.9). There was an entrance hall within each apartment, a living room, bedrooms, a children's room, a kitchen, and a bathroom. Large apartments had a study and a sunroom, as well as a stairway to the kitchen. Overall, apartments ranged in size from two to five bedrooms and, in layout, attention was paid to the excellent division of rooms. On average, each family possessed a floor area of 50 to 100 square meters, and these dwellings were occupied primarily by forging staff who had come to China earlier.

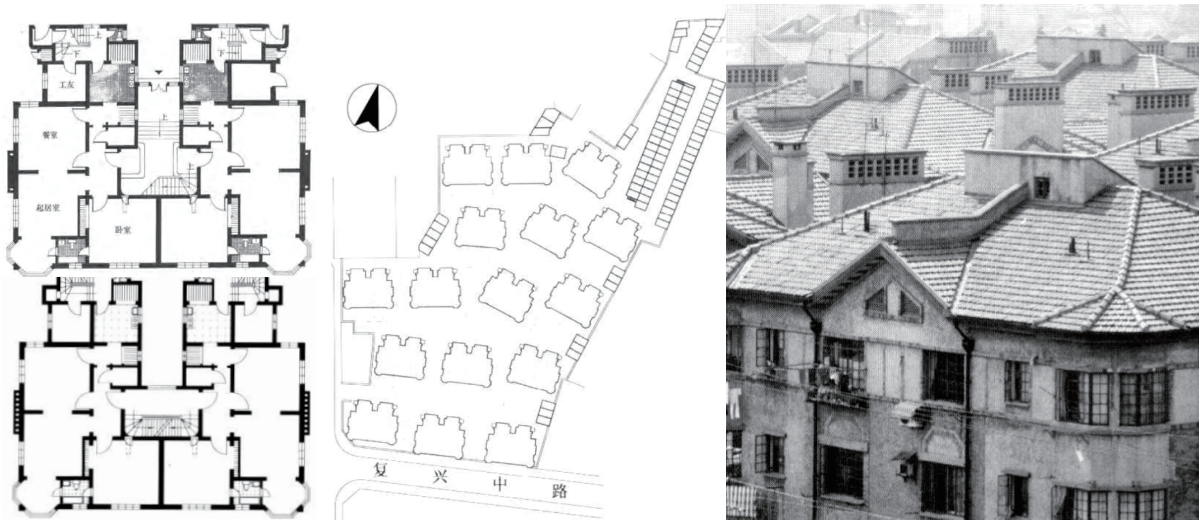


Figure 3.10 Shanghai Shannan village, a house estate consisting of multi-story apartment building (from Chen hua 1993, 173)

Figure 3.11 Shanghai garden apartments, located on 1173 west Nanjing road

(from Chen hua 1993, 178)

Figure 3.12 Individual multi-story apartment buildings in different cities

(from Lu Junhun 2001, 92)

In the trading cities, apartment buildings' development resulted from increased urban population, land shortage, and the concentration of Shanghai and Tianjin in the 1930s; for instance, a pressing problem was rising population and scarce land, therefore. Multi-story apartment buildings were built to accommodate these exigencies. Most were middle-grade or high-standard apartments for people to rent. Some stood alone in crowded neighborhoods,

while others were developed together as a more massive complex. Although they were well designed, each apartment's floor space was comparatively small, and the building area of each household ranged from 40 to 150 square meters. Whether large or small, every apartment had its kitchen and bathroom. Most had separate living rooms and bedrooms, with more expensive apartments having a separate dining room, a servant's room, and a garage. The main bedroom had its bathroom, and some units even had back doors and special staircases for servants. Although none of these houses was huge, the layout of rooms on the same floor made them look spacious and convenient to use.

In areas where many apartment buildings were constructed, the outdoor environment was usually well-appointed. Because of the low density of buildings, communal space was large and the increased green open space presented inhabitants with a pleasant place for social interaction. Generally, the design of houses differed according to location and building standards. Among the different types were one-staircase units for two households, one-staircase units for four households, and multiple units, with a small depth and larger depth units, allowing windows on three sides (figure 3.10 and figure 3.11).

Where small apartment buildings were located along the street, the first floor was used for shop, although lone apartment buildings on small lots could also be found in the concessions in Shanghai and Tianjin. Many were apartments with their own access, and inner corridors served some. Generally, each family had one three-room. These houses were suitable for middle-class families, and foreign companies constructed some for their employees. Functional and financial factors were significant considerations in these designs, with the result that they were usually practical and straightforward (figure 3.12).

3.1.4 Following the Soviet Model (1949~1957)

In the early period of the People's Republic of China, the housing shortage was the major problem. In the planning and design of housing, the most straightforward methods were adopted to build as many houses as possible and in the shortest possible time. Starting from 1953, with economic and technical assistance from the Soviet Union, China embarked on the road to socialist industrialization and establishing a planned economic system. Moreover, this period provided two cornerstones for subsequent urban housing development: namely, that housing construction should serve China's industrialization and, second, that it

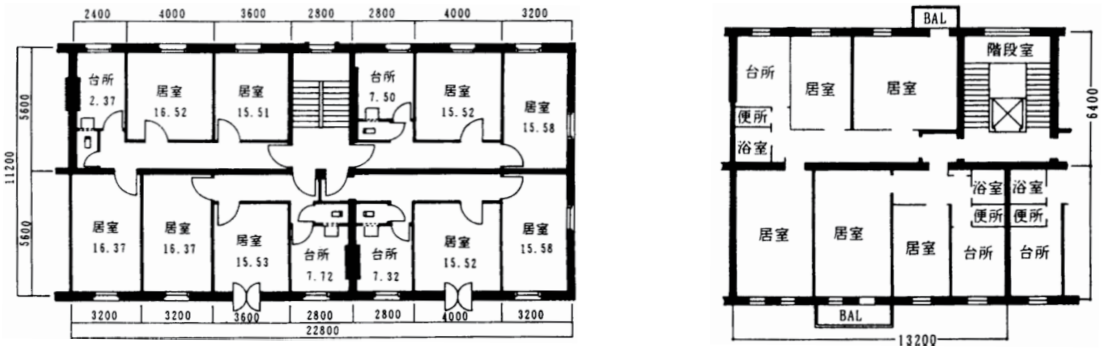


Figure 3.13 No. 301-II standard housing design in 1956(right) and Soviet II-04 standard housing in 1955(left) (from Shinobu 1994, 160)

should follow the Soviet Union's model of housing development. By the end of the First Five-Year Plan, some unexpected circumstances had arisen. In 1956, for instance, Stalin was criticized at the Twentieth Congress of the Soviet Communist Party. Simultaneously in China, the consequences of imbalanced development of industrial and agricultural development also began to emerge, forcing China into a discussion about the path it had taken towards socialism. Meanwhile, those in urban housing who mechanically followed the Soviet model were criticized, thus beginning fundamental questioning of whether the Soviet model was appropriate for China's particular circumstances.

After World War II, modernism greatly influenced reconstruction in Europe and, to some extent, America. Under the influence of architectural theories from the Soviet Union, modernism was criticized in China as a capitalist aesthetic. To counter modernism, the Soviet Union proposed the theory of social realism, which gave birth to a predominant design form characterized by "socialist content and national form." The new republic needed new forms for its architecture, and Chinese architects sifted through their architectural heritage for the national form that would convey this socialist content. After studying Chinese architectural history, some finally found a solution in the composition of a traditional "big roof" with Soviet-style elevations and decorative carvings from Western architecture combined with classical Chinese components and patterns.

In fact, this practice was the goal toward which many of the first generations of Western-trained Chinese architects strove. Indeed, before 1949, Chinese architects had done many experiments in this respect and after the People's Republic's founding. This architectural form enjoyed high esteem and was regarded as a form that best embodied the great New China and its national characteristics—before coming under criticism for economic reasons in 1955 (figure 3.13).

Finding inspiration from Chinese vernacular architecture was also another way to build houses with "socialist content and national form."

China entered an era of contradictions and puzzlement in the mid1950s. The Soviet Union, which had been the model for China to follow, found itself shaken by some unexpected political events, and Sino-Soviet relations soured. The policy of using agricultural resources to develop heavy industry damaged agriculture, which in turn eroded the development of the national economy as a whole. China entered a period when it began to re-examine its road to development. One view favored rapid growth, while the other view opposed it. At this time, Mao Zedong put forward the policy of "let a hundred flowers blossom and a hundred schools of thought contend," encouraging free discussion and examination of socialist development, as well as of other issues. The architectural community re-examined the thorough copying of the Soviet Union, and, within a few years, the earlier standards of urban housing were being applied less rigidly. This period's focus was still learning from the Soviet Union, but it was "a process that rejected the backwardness of Soviet practices and was highly selective" (R. Maikefakuer and Fei Zhengqing 1990, 130).

In 1955, as emphasis once more shifted towards economy housing construction, industrial methods which could furnish la quantities of low-cost housing quickly became popular, and the promotion of a standard design became urgent. As mentioned earlier, entrusted by the State Construction Commission in 1955, the Bureau of City Construction went about the appraisal of the standard design of residential buildings throughout China and solicited plans for standard housing designs intending to popularize selected plans. Subsequently, at a meeting of appraisal held at the end of 1955, an exhibition was staged to ask the experts and the general public for comments and suggestions. The principal criticisms of the standard design included: 1) dogmatic emulation of plans from the Soviet Union; 2) not enough consideration on matters related to inhabitants' livelihoods; and 3) inconvenience in the utilization and allocation of space (Li Yiguang, 1956, 99). The focus of the criticism lay on the specification of the standard design for housing and blind modeling of the Soviet Union, combine an excessive emphasis on thrift. The direct results of these discussions and research were new Chinese architects' attempts to cater to their designs to particular situations in China, and these experiments headed in two directions. The first was the adaptation of the standard design to Chinese circumstances. As described, significant problems of the standard design were housing orientation and ventilation. Since each apartment consisted of many rooms, and each room was rather large, when shared by several families, the family that ended up with rooms that faced north received no sunlight at all throughout the year. It was also difficult for the flow of air when a few families shared an apartment. Moreover,

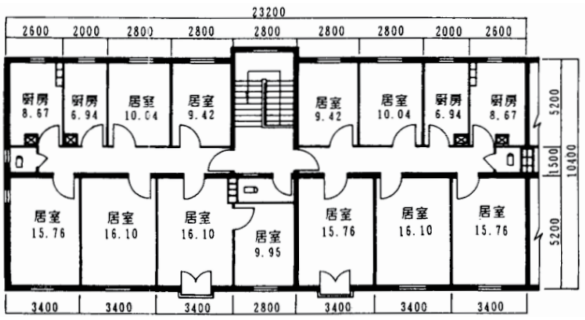


Figure 3.14 The design of housing made in 1955-1956 after standards were lowered (Li chunling 1955, 97)

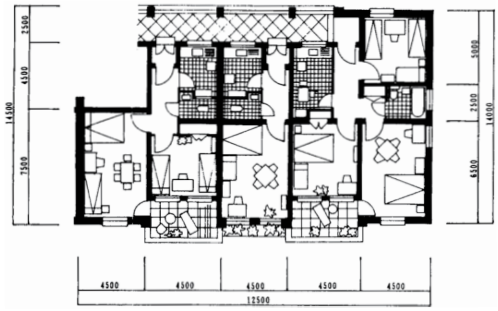


Figure 3.15 Xinfucun village, small-size, open-corridor apartment in Beijing (Hua 1957, 95)

considerable unlighted space existed in the corners of the buildings. With this in mind, a single-unit plan composition of the standard design called the 2-2-2 composition (i.e., three two-bedroom apartments served by one staircase)

The second revision resulted in the emergence of new unit types. Several families sharing one apartment were caused by disparities between the high housing design levels and low levels of basic living standards. Moreover, the composition of an apartment was directly affected by its size. Therefore, new types of apartment designs appeared, notably open-corridor apartments. The lowering of design standards made rooms smaller, and usually, each family occupied only limited space.

Moreover, under this constraint, the former inner-corridor composition could not guarantee that all families had rooms facing south and right ventilation, with only one staircase serving multiple apartments. Thus the open-corridor apartment came into being. The corridor is usually located at the northern side of the apartment and with each apartment consisting of one or more parallel bays of the same depth along the corridor. Bedrooms were located on the south side, while toilets and kitchens were located on the north side near the corridor. The advantage of such an arrangement was that one stairway could continue to serve the whole apartment building. While leaving room for each family to enjoy its own apartment, it had at least one room facing south and right ventilation. In theory, the long corridors in the housing plans were more suitable for one- to two-story structures but were wasteful in space efficiency. In reality, however, the corridors were used by families as storage spaces and were welcomed by residents. The Xingfucun neighborhood apartment buildings in Beijing of 1957, for instance, were representative of the open-corridor apartment (Figure 3.14). This time, housing structures were mainly made of brick and wood, or brick and concrete: most used wooden frames and prefabricated slabs. The advantages were savings in industrial raw materials and ease of construction. Block masonry construction was among the earliest indus-

Figure 3.16 Hongmaogoum masonry housing in Beijing(right) and The Xizhaosi residential area in Beijing (left) (from Lu Junhun 2001, 136; 137)

trial housing systems and was used in the Hongmaogou residential area in Beijing in 1957 (figure 3.15). While discussions over the standard design were still going on, a controversy started over whether to adopt parallel row-housing layouts or perimeter block neighborhood layouts in the planning of residential areas. Supporters of the perimeter block idea maintained that it saved the land, had a complete form, and was convenient for public buildings placement. If each perimeter block neighborhood were considered a small cell, they would shape a sophisticated network of streets, squares, and ultimately the city landscape when many of them came together.

It was also condoned by progressive Soviet ideology. It was believed that the neat form of progressive notion of this planning model embodied the spirit and order of a socialist society. However, as the government began to emphasize the architectural community criticized thrift in housing construction and the big roof, the formalist streak of perimeter block neighborhoods was cast in doubt (Ji Ping, 1956, 103). Significant problems for this kind of planning were claimed to lie in its unsuitability for China's geography, climate, and environment, as well as to people's living habits. Buildings placed along the street produced annoying noises for residents, as noted earlier. Moreover, it was essential to build north-south houses with a limited housing budget and make full use (also noted earlier) of natural ventilation. Unfortunately, the two features were usually sacrificed in the perimeter block neighborhood in favor of a complete form, and some architects believed that instead of paying attention to the form of the residential area, more consideration should be given to particular situations and requirements(Wang Hua 1956, 53)

At the end of the First Five-Year Plan, as mentioned earlier, the Soviet Union's idea of complete planning for a residential area was introduced to China and put into practice. The general plan of Beijing City, which was issued in 1957, stated that residential areas from thirty

to sixty hectares would become basic units where citizens could live (Figure 3.16). Furthermore, the idea of residential area planning was thought to be the embodiment of socialist ideology in an urban society's composition. In "Planning and Construction of Residential Areas in Cities," it was stated that "in big cities of a socialist country. The people's social and political life should be organized around areas facilitated by a complete network of institutions that provided socialist culture and education. As well as other necessary provisions and that such an approach, in the spatial term, would occur in residential areas" (Li pin nie fu 1958, 23).

3.1.5 Hosing standards and the evolution of different apartment (1958~1978)

Between the end of the 1950s and the mid-1960s, China's social and economic development experienced its first significant setback and subsequent readjustment. During this period, the general development strategy was almost the same as pursued in the First Five-Year Plan. After China had broken ties with the Soviet Union, the only difference is that it sought a road toward self-determination with greater attention focused on the speed of development.

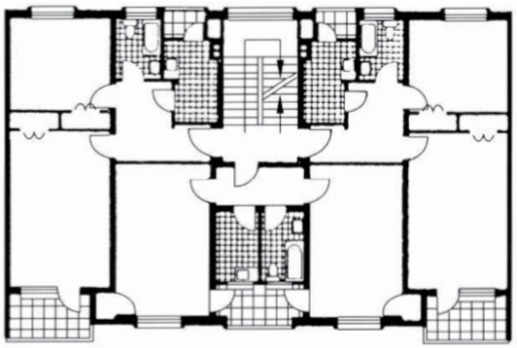


Figure 3.17 The No. 9014 housing in Beijing 1959
(from Lu Junhun 2001, 154)

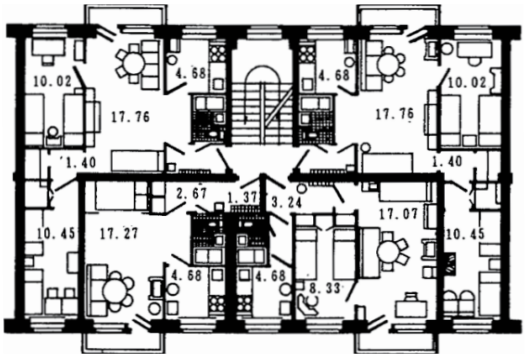


Figure 3.18 Small-size housing in Soviet Union 1956
(from Tomokiyo 1993, 38)

Housing was still in a secondary position in national economic development, although the urban welfare housing system established in the previous period was extended and strengthened. Nevertheless, during the Great Leap Forward, the principle of economic savings in housing design was taken to extremes, and a large number of low-quality houses, unsuitable for use, were completed. By contrast, after the adoption of the policy of "letting a hundred flowers blossom and a hundred schools of thought contend" and following a thorough review of housing design principles learned from the Soviet Union, together with an attachment of greater importance to research, an objective and realistic spirit were injected

into housing design during the period of readjustment and rectification. Subsequently, housing design began to consider residents' demands and actual economic conditions more seriously, and the range of housing types was enriched. In cities, the rapid development of industry and population growth added pressure on available land resources, and, where possible, the cities extended out into the suburbs. The design of residential areas was also popularly adopted by cities. Besides, people's commune buildings appeared, and a planning ideology, based on the idea of people's commune, began exerting an influence on Chinese cities' form and structure. With the Great Leap Forward's progress, the general and over-optimistic economic development estimation made people believe that a communist society would be realized soon. Consequently, housing designers were to be mentally prepared for substantial improvements in people's living standards, with the upshot that some high-standard housing designs emerged after 1959. One example was the standard design of the No. 9014 residential building in Beijing, on the Tsinghua University campus, where the area of a large room reached twenty square meters, and a small room was over fifteen square meters in size (figure 3.17)The Forum on Housing Standards and Architecture was jointly held by the Ministry of Building Industry and Architecture Society of China in Shanghai from 18 June 1, 1958. The forum criticized previous practices of "combining short- and long-term goals and emphasizing the latter" and decided to attach importance to a short-term project. High standards in housing development and the pursuit of large amounts of space resulted in large rooms. Often different generations of one family had to live in one room, creating many inconveniences. The suggestion to increase the number of rooms in one apartment was accepted at the forum, and the idea of the small apartment was popularized, although the idea had surfaced at the end of the First Five Year Plan. For example, small apartments were included in the Xingfucun neighborhood apartment buildings in Beijing (figure 3.18).

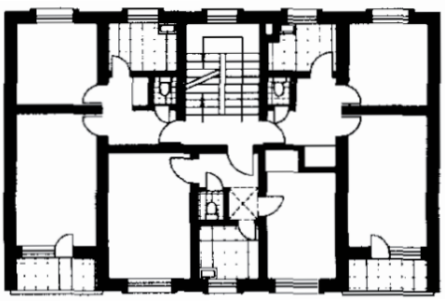


Figure 3.19 Plan of an apartment with short-open corridorr (from Lu Junhun 2001, 155)

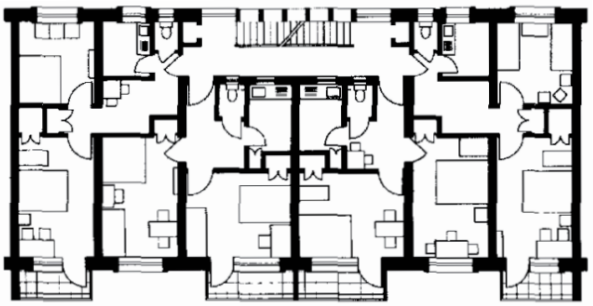


Figure 3.20 Plan of the No. 8014 apartment building (from Lu Junhun 2001, 155)

The design standards proposed during the First Five-Year Plan of four square meters now, six square meters soon, and nine square meters, in the long run, were replaced in 1957 by the actual standard of four square meters per person. Though small, this change was significant because it brought down the preciously high design standard to reflect the real housing condition in China. The change was also crucial because it emphasized citizens' present needs without sacrificing their present needs in exchange for a distant goal. (In fact, the goal of nine square meters per person was not achieved, even in 1978; the figure had dropped to 3.6 square meters, from 4.5 square meters in the early stages of the People's Republic.) With the changes in design standards, rational improvements were made, as mentioned earlier, to the Russian-style inner-corridor flat, bringing it in line with China's climatic, economic, and lifestyle conditions. For example, the Soviet-style flat of three two-bedroom units in a five-bay space (the 2-2-2 dwelling unit's plan in the Russian residential design standard, Figure 3.20) was not reasonable.

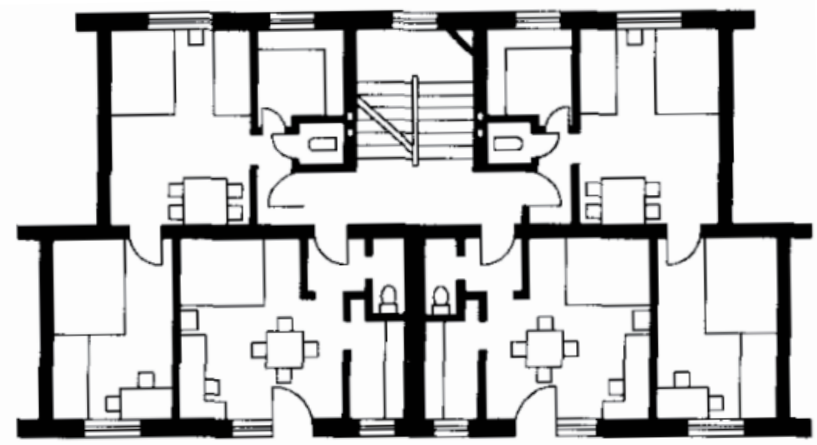


Figure 3.21 Plan of the No. 8011 apartment building

(from Lu Junhun 2001, 156)

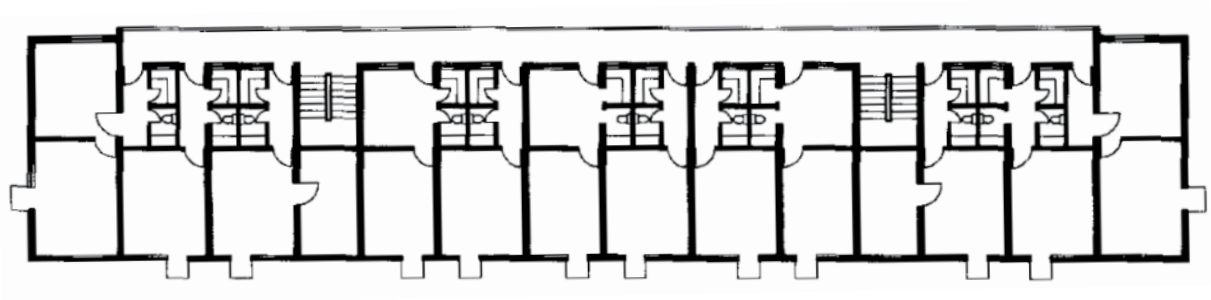


Figure 3.22 Plan of the apartment building with open corridors on Quzhenern Road in Shanghai

(from Lu Junhun 2001, 156)

The rooms were so big that one flat was usually shared by two or more families, some of which ended up in rooms on the north side and received no sunshine. Meanwhile, the kitchen and toilet were placed on the south side in the middle of the unit. Based on such extensive observations, a design of four two-bedroom flats in a six-bay space resulted, whereby the rooms on the south side were either bedrooms or living rooms. The bedrooms of the two flats in the middle were also placed on the south side and could be shared by two families. The two flats on the sides of a single apartment building each had one bedroom facing south and one-bedroom facing north and thus could be assigned to prominent families in a manner that would allow each family at least one room that received sunshine (figure 3.19). The design of the 2-2-2 flat configuration also changed. For example, although the basic layout of the 2-2-2 flat was used in the configuration known as the 8014 Standard Housing Design in Beijing in 1958 (figure 3.20), the rooms' area was smaller than before. The largest room would be from thirteen to fourteen square meters in area, while a small room was around nine square meters. Because of these design modifications, almost all families were able to a flat for their exclusive use.

Meanwhile, another configuration, the 8011 housing plan, also underwent marked changes. Under the influence of the idea of the small apartment, mostly one-bedroom and two-bedroom flats were created. Here, the advantages were obvious. Few families were required to share a flat with others, and because the rooms were smaller, the number of people living in one room was reduced (figure 3.21). This design also reduced the size of kitchens and toilets, allowing the provision of these facilities to each household.

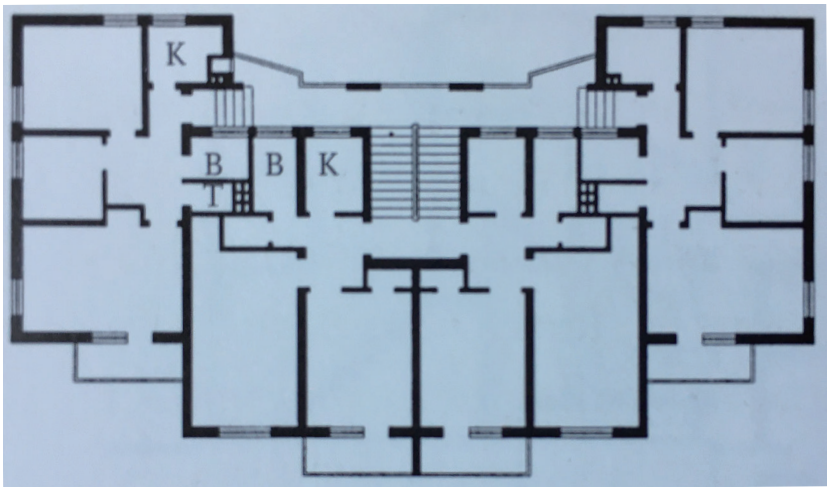


Figure 3.23 Plan of experimental housing in 1964

(from Lu Junhun 2001, 159)

Furthermore, the 8016 Standard Design was a similar example. Based on the small outer-corridor apartment, architects in Shanghai conducted a careful study of this arrangement and the use of the kitchens and bathrooms. The final design they presented featured a two-square-meter kitchen and a two-square-meter bathroom for each unit while not raising the average floor area per family (figure 3.22). A modest living room was created in some small apartment designs as a link to all rooms and a dining place. Such designs were the precursor of the "small square hall" and "bright square hall" configurations that appeared later.

Under the guidance of "readjustment, rectification, supplementation and improvement" in the Central Government, and in commemoration of the twentieth anniversary of the publication of Mao Zedong's "Preface to the Investigations in Rural Areas," the Ministry of Construction and Engineering issued an edict for surveying urban housing. Subsequently, an in-depth survey, particularly about housing standards, was conducted across the country, involving officials and experts from design institutes, housing management bureaus, architectural schools and colleges, and universities. Also, academic exchanges and free discussion of housing problems were a part of the Third Conference of the Chinese Architectural Society in November 1961, and in its annual meeting in December 1963. Influenced by a practical and realistic atmosphere, housing design entered an objective and pragmatic period. Reflections on previous design and construction problems, plus a renewed enthusiasm on the architects' part, became the source of a stream of creative and varied investigations. A debate out over small apartments. Those in opposition argued that because an apartment's lifespan was comparatively long, under the current housing standards if one apartment was provided for one family to accommodate people's needs, the result would be too many one-bedroom apartment standards were raised in the future.

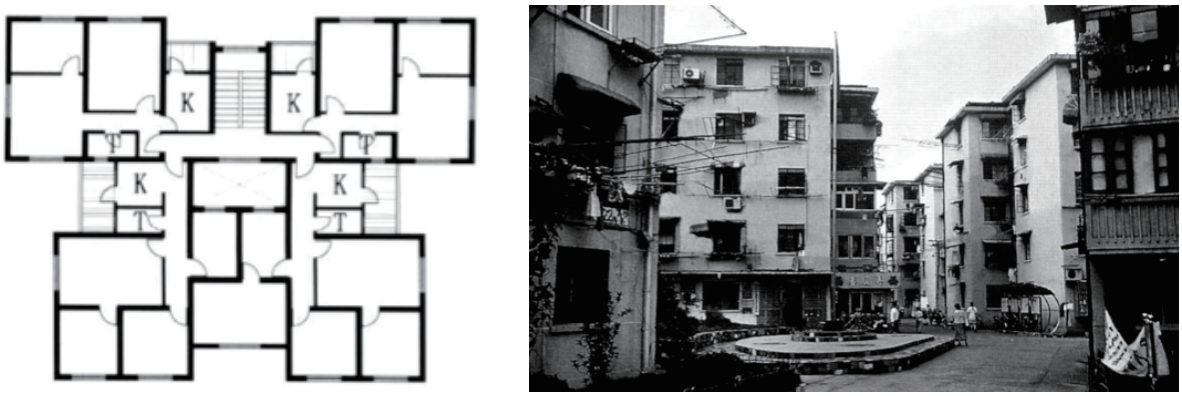


Figure 3.24 Inner-yard apartments in Fangunong, Shanghai

(from Lu Junhun 2001, 160)

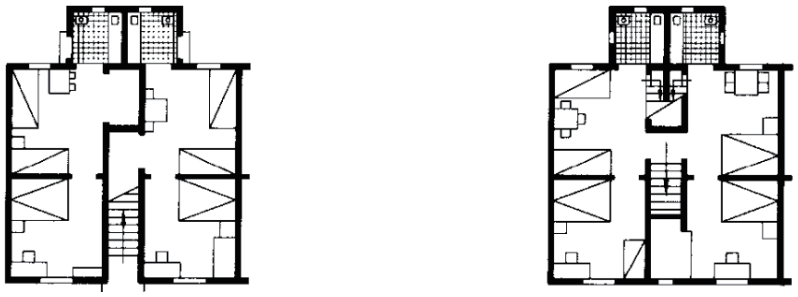


Figure 3.25 Housing for workers in Nanjing

(from Lu Junhun 2001, 161)

These one-bedroom apartments would cause problems in distribution. Therefore, they suggested improving the families' actual living conditions who shared one apartment (figure 3.23). By contrast, those who favored the one-apartment-for-one-family formula argued that "a house by definition is a building that gives shelter to the family members and that one-apartment-for-one-that should be the fundamental right (Yaximembers n, 1962, 26).

.Considering the actual conditions at that time, they suggested building smaller apartments and increasing the number of rooms in each. Overall, it seemed essential to design more small two-bedroom and three-bedroom apartments, as they also believed that one-bedroom dwellings were unsustainable. However, given the low per-capita living space and modest increases in household size, one-bedroom dwellings were, in fact, viable. Assigning a two-bedroom apartment to two families should not be the main way to shelter one-bedroom families. Irrespective of the size of the family, married life is different from a single person's life. Hence, the conclusion was that the one-apartment-for-one-family model best satisfied the needs of family life.

Based on investigations of local geographical conditions and climate, some designs with local features also appeared. Research on traditional construction skills also brought some changes to the practice of copying the Soviet experience. New attempts were made in the housing projects presented at the Zhangjiang Conference of 1961 and the Wuxi Conference of 1963. Among them housed with small internal yards suitable for hot areas, buildings with east-west orientations for cold areas, housing with considerable depth and internal yards that economized land, and independent flats and split-level houses suitable for complicated terrain. In the housing design of Shanghai's Fangunong, for example, architects the sun to decrease radiant heat gain. Small internal-yards were used for ventilation and increased depth and, therefore, to save land along streets (figure 3.24). Another example was the adoption of one-flight staircases in some low-rise houses to make full use of the space under

staircases and in attics(figure 3.25). After more than a decade of social and economic development since 1949, urban residents enjoyed a better life in the 1960s than in the 1950s, and new housing types also appeared. One example was the apartment buildings with shops on the first floor; their appearance met the urban residents' increasing need for commercial goods. It was also a sympathetic method for planning neighborhood environments after perimeter layouts were adopted. The first floor shops, for instance, could enliven the monotonous street scene formed by the gable walls of buildings with a north-south orientation. Such apartment buildings helped solve the problem of urban housing and reflected the period's emphasis on the functional arrangement, circulation, organization, and construction.

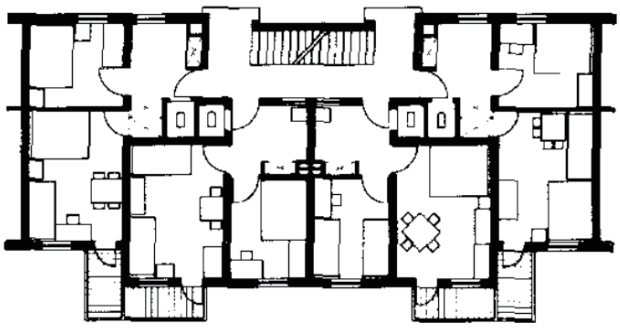


Figure 3.26 Plan of the No.1 Experimental apartment in Tianjin 1974 (from Journal of Architecture 1974, 12)

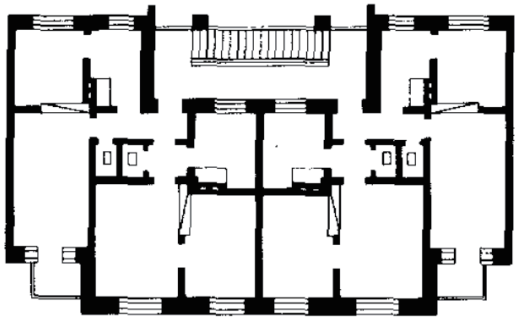


Figure 3.27 Plan of an apartment building in Heilongjiang 1974 (from Journal of Architecture 1974, 12)

The period from the 1960s to the mid-1970s formed a very special page in modern Chinese history. Influenced by the domestic and international political situation, Chinese society suffered through the calamity of the ten-year "Cultural Revolution," which began in 1966 and rapidly became a political storm that swept through the whole country, causing terrible social and political chaos. Not surprisingly, urban construction entered a stage of complete stagnation and urban housing development, controlled by an ultra-leftist ideology, once again emphasized an extreme economy.

The chaos in the early Cultural Revolution caused common concerns in society, and, in the early 1970s, the Central Committee of the Chinese Communist Party began to make adjustments to the development of the national economy, which, to some degree, had a reviving effect. Urban housing construction also moved forward somewhat in terms of standards, available types, and industrialization degrees. Simultaneously, the short supply of land in cities resulted in the emergence of high-rise apartment buildings and a general increase in the density of residential districts. In 1973, the State Construction Commission issued "Proposals for Revising the Building Standards of Apartments and Dormitories," stipulating that 1)

the floor space per family was to be thirty-four to thirty-seven square meters and thirty-six to thirty-nine square meters in extremely cold areas, and 2) multi-story buildings should be the major type of dormitory. In large and medium-sized cities, buildings should have four to five stories, with per-square meter costs of no more than fifty-five, sixty-five, and eighty yuan in the south, north, and icy areas, respectively. Nevertheless, as can be seen, these standards were much higher than those of 1966, and floor space, instead of living area, was used as the criterion to limit an apartment's area—the evolution of Different Apartment Types.

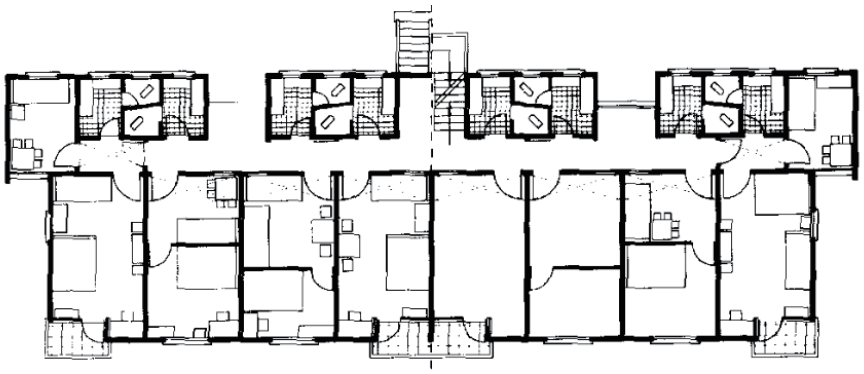


Figure 3.28 Plan of a residential building in the Wenchong Shipyard, Guangdong province

(from Lu Junhun 2001, 178)

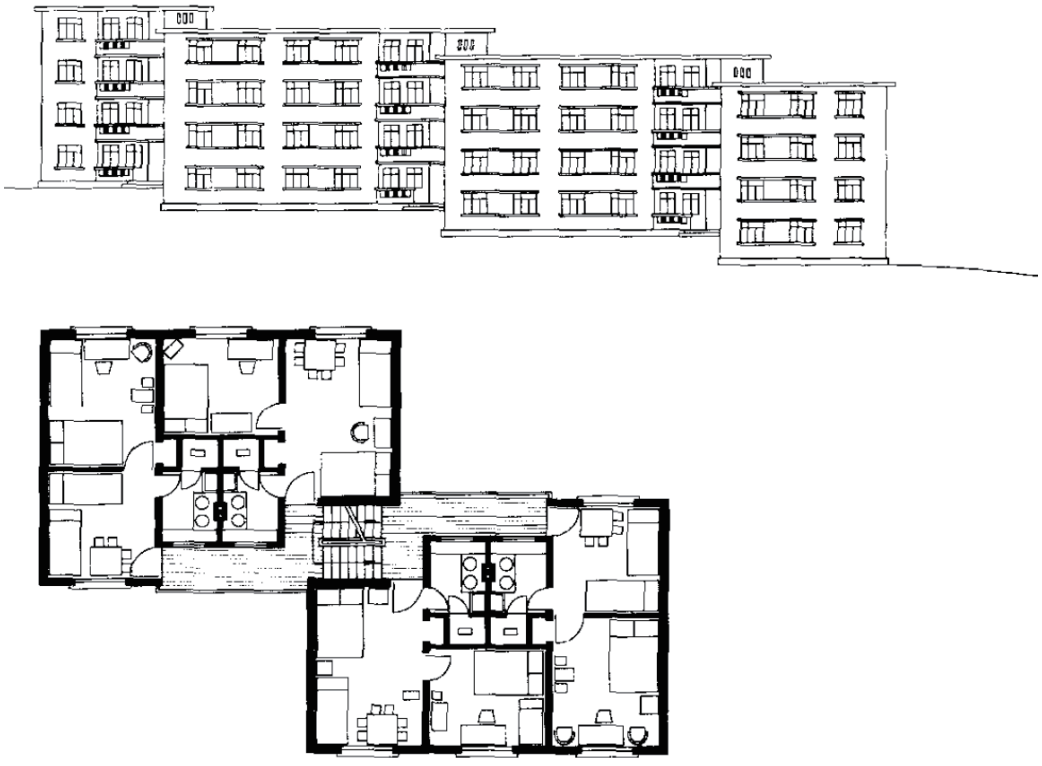
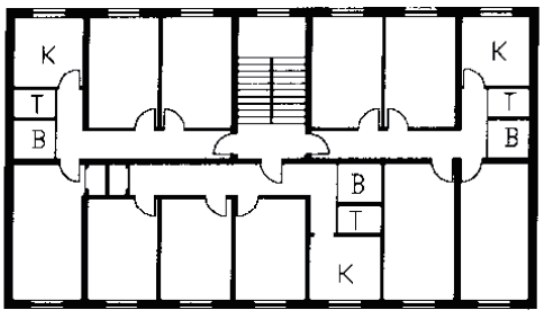


Figure 3.29 The standard apartment building of 1974~1975 in Sichuan province

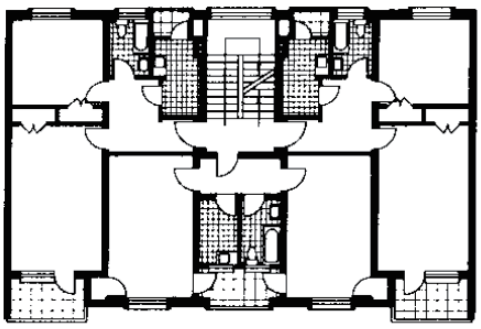
(from Lu Junhun 2001, 178)

Concerning housing standards, the one-apartment-for-one-family idea, and small apartments were widely accepted. Since the per family area was small, the most common dwelling units were those with short, open corridors. One staircase served four two-bedroom apartments, and families shared toilets in such a unit, although they had separate kitchens. Resembling the 2-2-2 standard design (three two-bedroom apartments sharing a staircase) of the Soviet Union, described earlier, such dwelling units adopted the 2-2-2-2 from (four two-room apartments sharing staircase) within six bays.

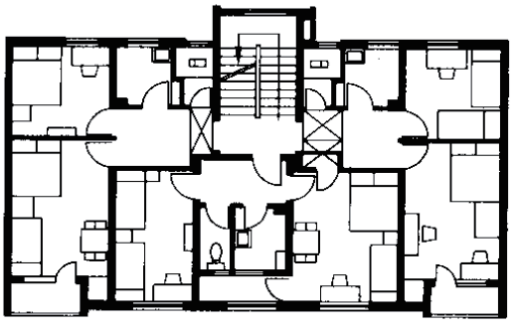
The 2-2-2-2 ensured the orientation and ventilation of such an apartment and economized on the constructed land area (figure 3.26). China covers a vast territory, with different parts of it varying greatly in climate and people's habits and customs. Unified standard design, therefore, could not meet the needs of such different regions simultaneously and, since local governments established their standard design institutions in 1959, as mentioned earlier, localization became an essential aspect in the promotion and implementation of standard design. Governed by specific fixed indices, localities made revisions and adjustments to the standard design according to their specific conditions and requirements.



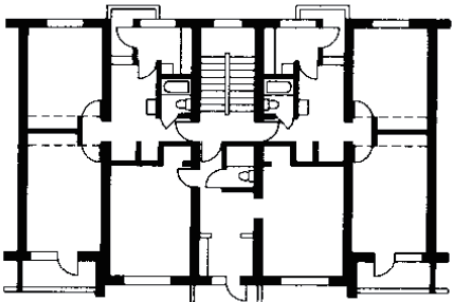
No. 301-I Strandard housing



No. 9014 Strandard housing



No. 73-II Strandard housing in Beijing 1973



An aprtment building with a small-lighted living room

Figure 3.30 Chang in design from hallway to a small-lighted living room: from design No. 301, No. 9014 to an apartment building with a small-lighted living room: Later the hallway was enlarged to function as a dinning room (from Tomokiyo 1993, 39; Fujita 1994, 162, Lu Junhun 2001, 179)

Throughout, it was required that the local people's actual housing needs were satisfied while also conforming to the state's residential and building standards, as well as to methods of industrialization. For instance, in northeast China and other bitterly cold areas where there was no central heating, a firewall—a wall with flues for space heating—was included in many housing designs (figure 3.27). However, in the south, with a hot and humid climate, the most critical task was to keep every apartment well ventilated and dry, as well as to reduce the radiant heat from the kitchen to other rooms. Thus, some unique forms of dwelling units appeared, including the type with every family having two doors opening off the open corridor (Figure 3.28). As a result, attention was paid to the impressive houses and apartments built on mountain slopes developed and applied (figure 3.29).

After the concept of standard design was introduced in the 1950s, there had been fluctuations in how the standard was controlled. However, the level of living space per capita basically remained at 4 to 4.5 square meters in cities, and, therefore, neither the design standard. Nor related service standards reflected the efforts made by architects to improve urban residential conditions. Under rigid space standard controls, only a limited influence could be produced, proceeding along the lines of some particular housing design techniques and details.

A case in point was the abovementioned localization of the standard design. Besides, there was a shift away from passageways to a small lighted living room inside an apartment, as noted earlier. Effectively, the passageway connecting rooms in the earlier standard design merely served as a passage. However, in the late 1950s and early 1960s, the width of the passageway was expanded to make a small square room used for dining or as a temporary bedroom, but, because it was too small and received no natural light, it was seldom adopted in later housing design (Wang Shouju 1978). Later, influenced by the concept of increasing the apartment's depth, the same square room was placed in the middle of the apartment and received light indirectly from elsewhere in the dwelling unit. Such apartments were called "the small, lighted livingroom type" (figure 3.27). Besides this innovation, a new apartment type, with a living room of some fifteen square meters, began appearing in Guangzhou to meet the needs of returned overseas Chinese (Tomokiyo, 1994, 60).

Moreover, both "the small, square living room type" and "the larger livingroom type" proved valuable contributions for later housing design in China. Simultaneously, it can be seen that architects, while complying with the strict control of housing standards, made improvements to dwelling functions and made the apartment as efficient as possible. Also, changes took place in the facade and design details of urban apartment buildings. After the traditional big

roof was criticized in the 1950s, urban apartments became a secondary issue, as noted earlier, and attention was paid to function rather than to facade decoration. The practice of providing a balcony for its effect on the facade, without considering internal function, had been abandoned. Instead, the facade was mostly a simple brick wall or concrete frame. Some simple ornaments on window frames, eave ends parapets, and balconies' layout ensured that every family had its own outdoor space.

3.1.6 The concept of territory distinction in China

Although the basic floor plans of Siheyuan vary little throughout China, the names applied to them do, as several earlier references suggest. Typically, there are three structural divisions-three 'rooms' or bays-in the horizontal main building; thus, the unit is termed a 'three-jian building' [*sanjianwu*(三间屋)]. In many re- spects this is quite similar to the yiming liangan [one bright, two dark or one opened, two closed(一明两暗)] three-jian form described earlier for northern Chinese dwellings.(Ronald G. Knapp 2000, 46).

This "bright" means public space, and "dark" means private space. In other words, there is a public space that can be accessed in the center of the building and a bedroom is located on either side. This "bright" is usually named "Tang" in the northern region and "Ting" in the southern region. The characteristics of this space must pass through the central public space in order to enter the bedroom. This public space is similar to the characteristics of modern living rooms, such as ancestor rites, receptions, and dinning.

Although there's a difference between northern and southern courtyards, their essential characteristics are almost the same. In a courtyard compound there will be an open yard, or more than one, surrounded by single-story rooms. Siheyuan construction is always symmetrical. The main house is on the central north-south axis, and the less-important structures are positioned on the west and east sides. Normally, a siheyuan will contain three courtyards, while smaller versions might have only one courtyard and larger versions might have as many as five courtyards. Below is the general layout of siheyuan.

The traditional logic in allocating the Zhengfang in the house is that it should be deep. The morphology of '—' shaped block suggests critical clues in finding the hidden design logic of modern houses in China. The Zhengfang should be deep, and although it is not topologi-

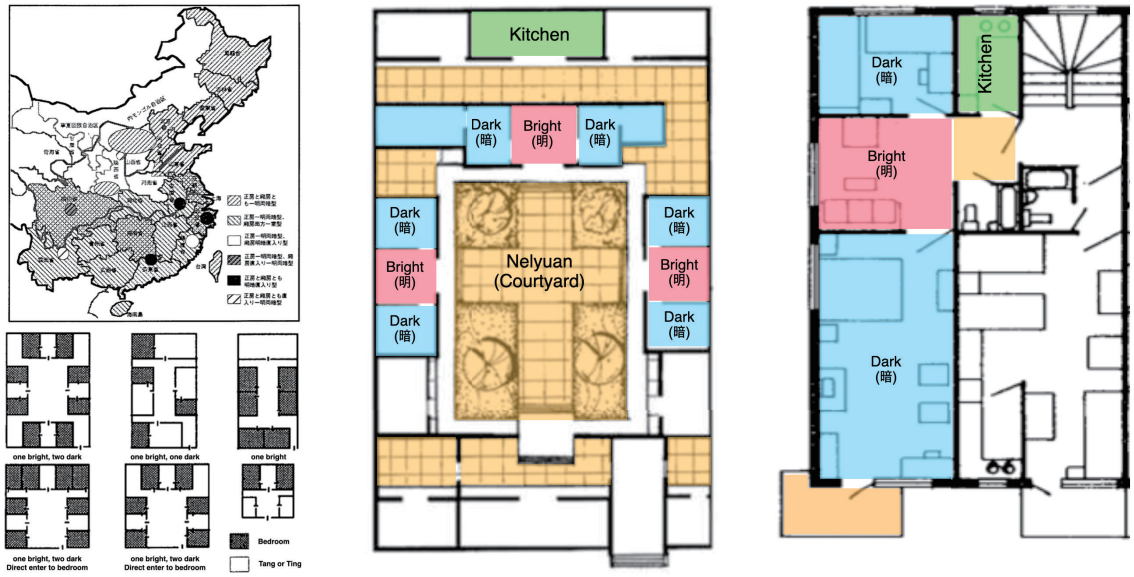


Figure 3.31 The concept of territory distinction

(left plan: reproduced from Zhou and Aoki and Kamiwada 1999, 183, middle plan : reproduced from Jin 2019, 77, right plan: reproduced from Tomokiyo 1994, 58)

cally deeper than other sectors, it is always geometrically concealed behind the tang (public sector) and the room and grounded on the deeper corner of the site. The Tang, on the other hand, is affected by traditional planning logic that it should be in the center.

Although it cannot be regarded as the center in this Zhengfang ('-' shaped geometry), it is the symmetrical center of the spatial composition. This symbolic concept of space allocation has become a strong convention in China for 2,000 years and, therefore, is naturally transmitted to the modern house. The diagram linking the three main spaces, Fang(main bedroom), Zutang, and courtyard, can epitomize the spatial characteristics and the topology of these spaces.

These two living spaces on top named after their user(Zhengfang: household's space, Xianfang: lineal ascendant's space) and spatial characteristics (Zurang: master living space, Ting: living space for each family), unlike their modern counterparts, the main bedroom, and living room, and this may be due to the fact that these rooms could not be associated with particular functions. This spatial composition can also be confirmed in the 1980s public sector apartment houses. Ting, which reappeared after 1960, re-established connecting private spaces and supporting public activities in the center of the housing(figure 3.31).

3.2 Evolution of Domestic Space in China

3.2.1 Introduction : from the old and new

In 1949, China built the People's Republic of China, and the war and liberation caused the city's houses to be damaged, and a large population entered the city. To solve the problem of the urban housing shortage, low-level housing was supplied in large quantities. After the Cultural Revolution in 1976, the supply direction of housing increased rapidly, and due to the failure of population policy and the problems of the government's management system, the people lived narrow and overcrowded lives. The Chinese government has tried to solve the problem of housing shortages by supplying large quantities of apartments. In the early days, the supply of housing was set as the primary goal, such as following the Soviet Union model or building a low-level residential environment. Since the Open-Reform in 1979, it has begun to search for a reasonable direction for housing, and in 1998, the real estate market with real meaning was formed. In the 1990s, after only three decades, it became the most dominant housing type in the city. If it was the traditional central courtyard house that molded the typical domestic life of China until the 60s, now it is the modern apartment houses that the prime position (figure 3.32).

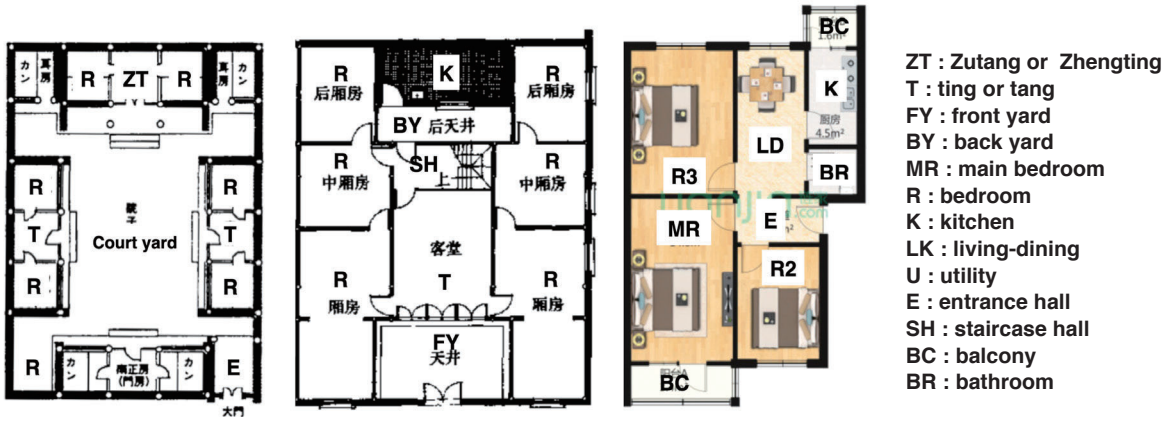


Figure 3.32 Traditional house in Ming and Qing Dynasty (Siheyuan), Old Lilong house in Shanghai 1876, and apartment house in 1984.

(left plan: from Nan ***et. al.,*** 1999, 182, middle plan : Chen 1993, 78, right plan: from Lian 2020, 95)

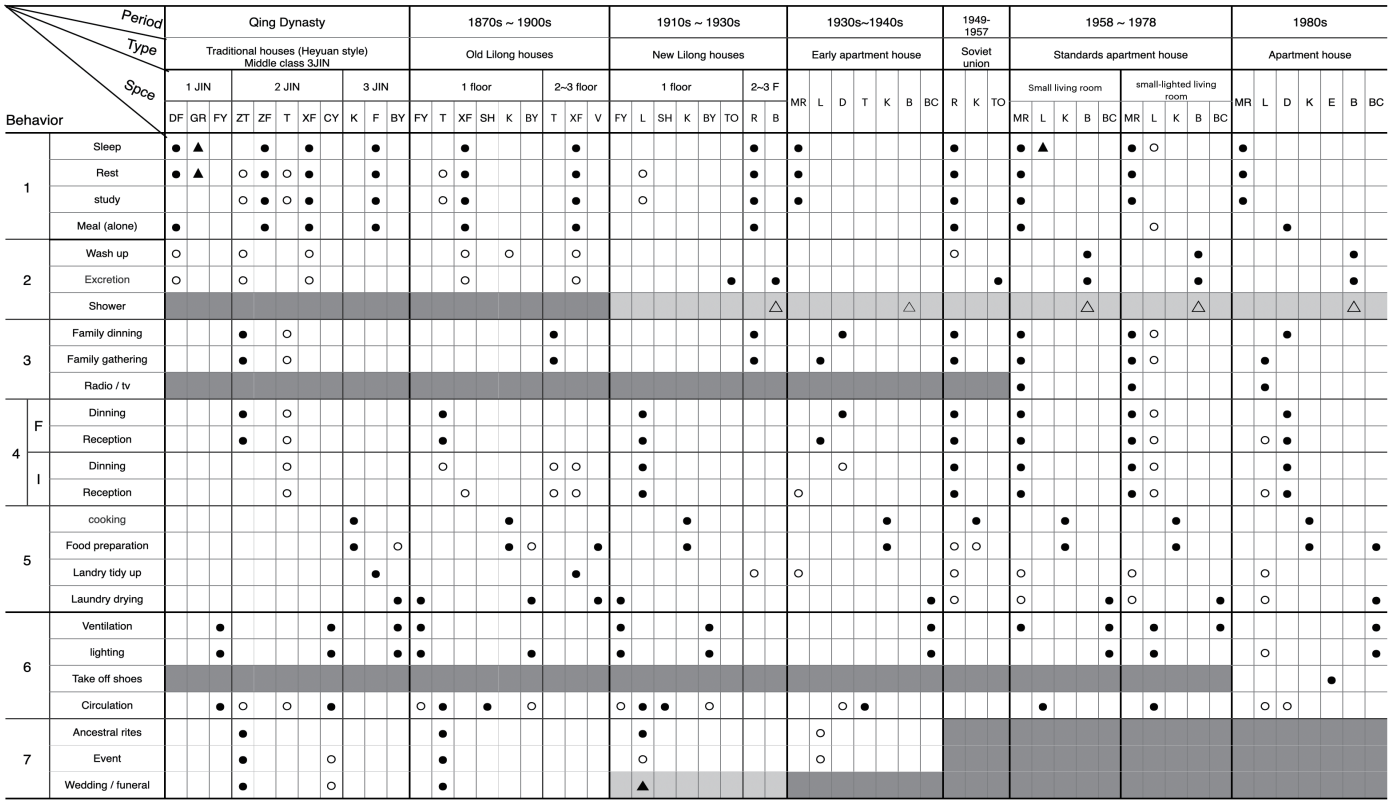
The same analysis method as in Chapter 2 Korea is applied. The " Behavior-space" interactions; how the behaviors om each partition space are preserved, migrate, and finally regroup to form new spatial frameworks.

On the surface, morphologically, those two types are entirely different. Figure 3.32 shows that the central courtyard house, which is inward-looking, has now turned into the self-contained modern apartment house outward-looking. This situation is where the continuity and change cannot be measured simply by the space syntax value of each partitioned space. In other words, for example, the old Ting and modern main livingroom are not equivalent even though they share a considerable amount of characteristics. To deal with this subtle problem, it is needed to focus on described in the previous chapter the "space-behavior" interactions, how each partition space's behaviors are preserved, migrate, and finally re-group to form new spatial frameworks.

This conceptual framework enables the investigation of 'space-activity interactions, the first sub-question of this thesis – how is an old spatial organization mapped onto a new setting that is formally and functionally different? - will be answered. Besides, this investigation will provide a basis for a further analysis that will bring the issue of 'level-distinction,' and this will answer the second sub-question - how is an old conceptual dimension in space transferred through a transformation process?

In the following sections, the movement of activities is drawn graphically in diagrams and then converted mathematically to space syntax values. They are measured at seven important stages of evolution, each of which is characterized by an emergence of a distinct housing pattern, which is: the traditional courtyard house, the lilonghouse, the the lilong aprtment, the first 2bed apartment house, the typical 3bed apartment house.

Based on previous studies, functional spaces were classified according to residents' behavior, from traditional Korean houses in the Ming and Qing era to apartments in the public sector in the 1980s. Residents' behaviors were divided into seven categories: personal behavior, hygiene behavior, family behavior, reception, housekeeping, service behavior, and non-daily behavior(table 3.1).



1: Personal behavior, 2: Hygiene behavior, 3: Family behavior, 4: Reception, 5: Housework, 6: Service, 7: Non-everyday life behavior, F: Formal, I: Informal.

ZF: Zhengfan, ZT: Zutang, XF: Xiangfang, T: Tang or Ting, Y: Yard(FY: Front yard, CY: Courtyard, BY: Backyard), DF:Daozuofang, GR: Guest room. B: Bathroom, L: Livingroom, TO:toilet, V : Veranda SH: Stair Hall

●: Main behavior(●: male ●: female, ●,● ○ : Sub behavior, △ : Seasonal behavior ▲ : Temporary behavior

Table 3.1 The transition of resident's Behaviours in china

3.2.2 Traditional code and its transfer to the early houses

China's traditional Siheyuan houses are widely distributed throughout the country. Siheyuan, literally meaning quadrangle in Chinese, refers to a common traditional Chinese compound. Such compounds have a history of over 2,000 years; they date back in embryonic form to the Western Zhou Period (1045–770 BC). This kind of quadrangular compound has historically been the template for most Chinese architecture. Nowadays, most existing siheyuan in Beijing are relics of the last two dynasties: the Ming (1368-1644) and Qing (1644-1911). On the one hand, they are the template and cultural symbol of Chinese traditional architecture; on the other hand, the living conditions in many siheyuan are difficult, with overcrowding and lack of private toilets. Although the basic floor plans of Siheyuan vary little throughout China, the names applied to them do, as several earlier references suggest. Typically, there are three structural divisions-three 'rooms' or bays-in the horizontal main building; thus, the unit is termed a 'three-jian building' [*sanjianwu*(三间屋)]. In many re- spects this is quite similar to the yiming liangan [one bright, two dark or one opened, two closed(一明两暗)] three-jian form described earlier for northern Chinese dwellings.(Ronald G. Knapp 2000, 46).

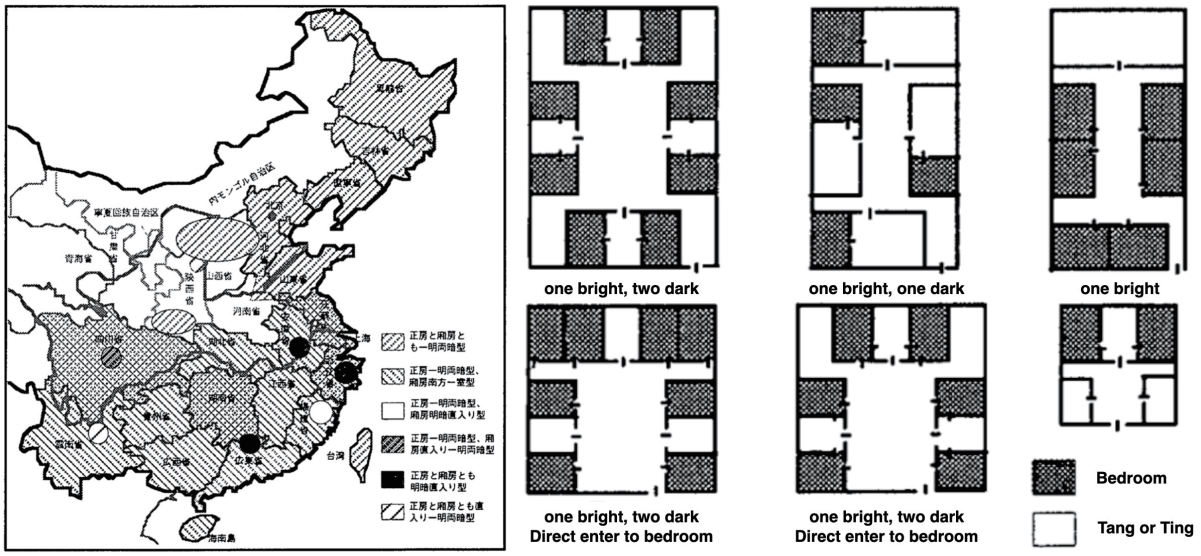


Figure 3.33 Distribution and type of "one bright, two dark" Siheyuan

(source : reproduced Zhou and Aoki and Kamiwada 1999, 183)

This "bright" means public space, and "dark" means private space. In other words, there is a public space that can be accessed in the center of the building and a bedroom is located on either side. This "bright" is usually named "Tang" in the northern region and "Ting" in the southern region. The characteristics of this space must pass through the central public

space in order to enter the bedroom. This public space is similar to the characteristics of modern living rooms, such as ancestor rites, receptions, and dinning. (figuar 3.33)

Although there's a difference between northern and southern courtyards, their essential characteristics are almost the same. In a courtyard compound there will be an open yard, or more than one, surrounded by single-story rooms. Siheyuan construction is always symmetrical. The main house is on the central north-south axis, and the less-important structures are positioned on the west and east sides. Normally, a siheyuan will contain three courtyards, while smaller versions might have only one courtyard and larger versions might have as many as five courtyards. Below is the general layout of siheyuan. (figuar 3.34)

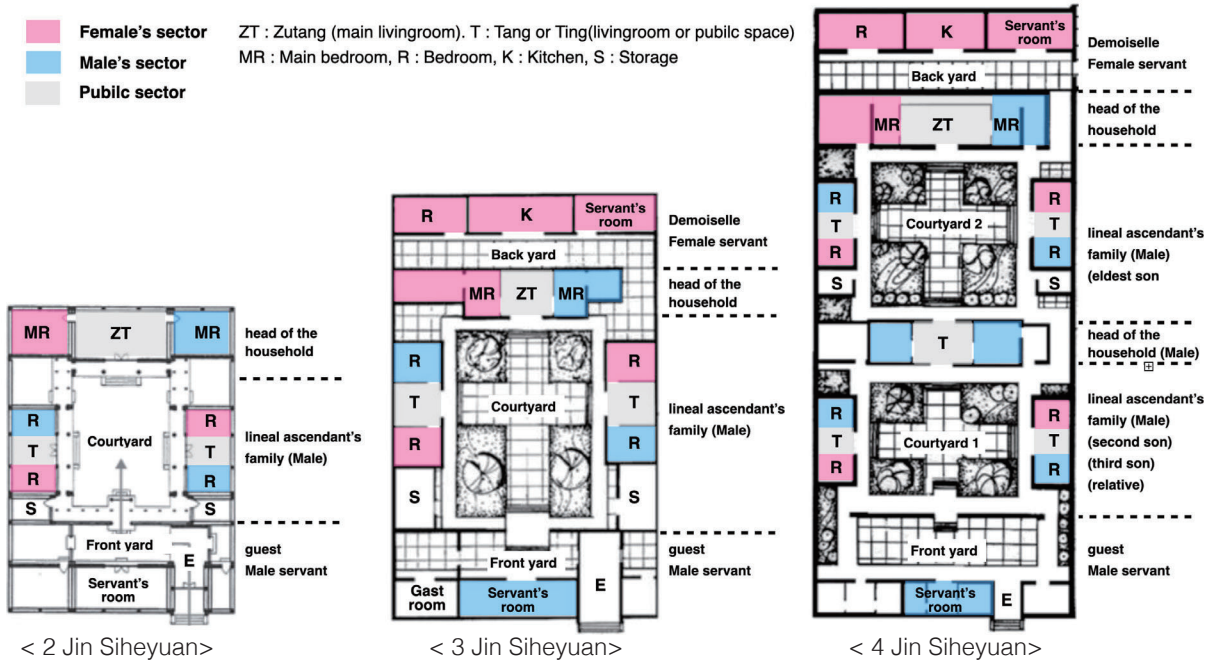


Figure 3.34 Spatial composition of traditional Siheyuan in Beijing

(From Ming Dynasty to the First Opium War 1360s~1840s)

(source : reproduced Jin and Zo 2019, 77)

The traditional logic in allocating the Zhengfang in the house is that it should be deep. The morphology of '—' shaped block suggests critical clues in finding the hidden design logic of modern houses in China. The Zhengfang should be deep, and although it is not topologically deeper than other sectors, it is always geometrically concealed behind the tang (public sector) and the room and grounded on the deeper corner of the site. The Tang, on the other hand, is affected by traditional planning logic that it should be in the center. Although it cannot be regarded as the center in this Zhengfang ('-' shaped geometry), it is the symmetrical center of the spatial composition. This symbolic concept of space allocation has become a strong convention in China for 2,000 years and, therefore, is naturally transmitted to the

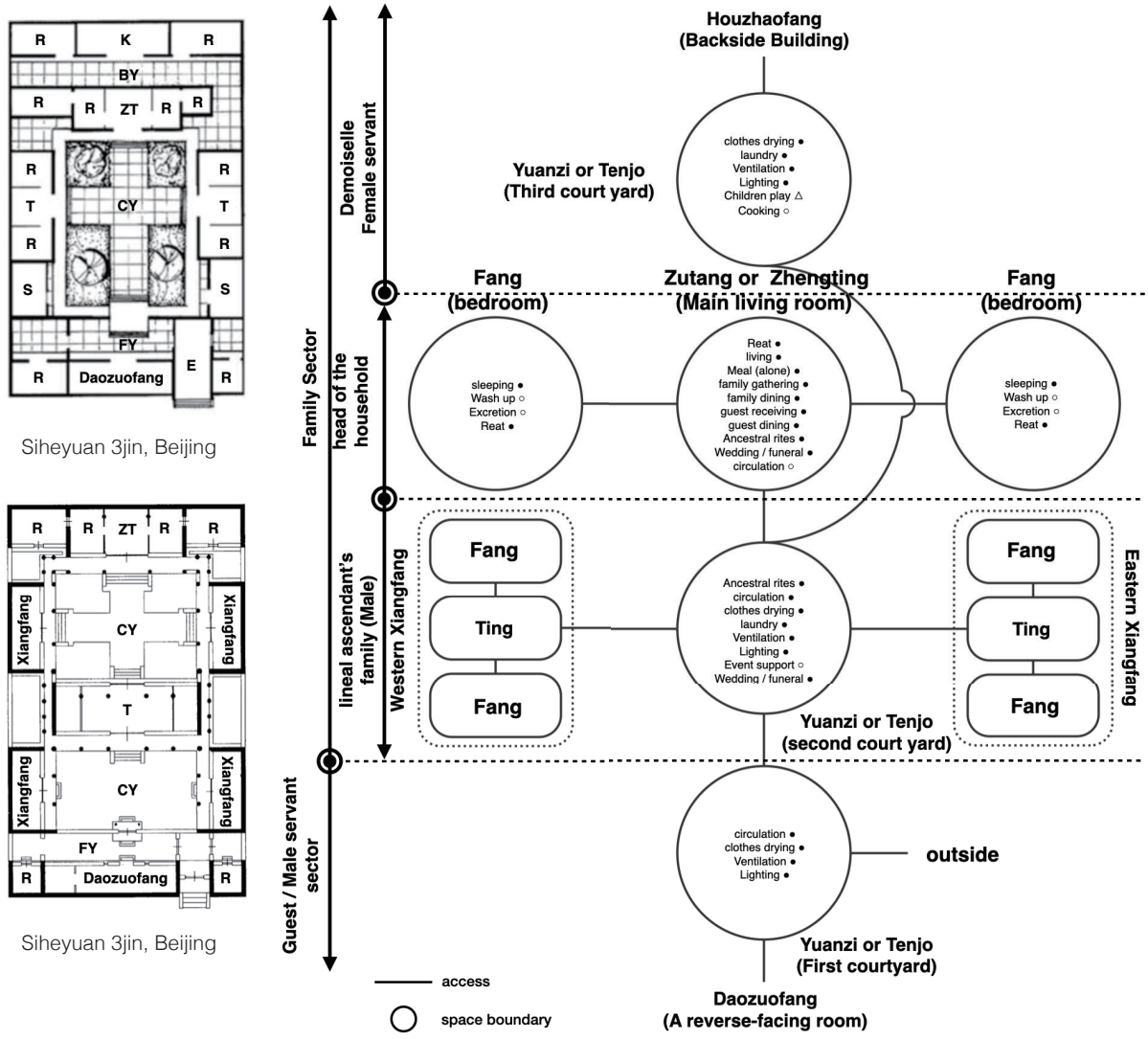


Figure 3.35 Traditional domestic code < 0 > in the Siheyuan and " —" shaped block

modern house. The diagram linking the three main spaces, Fang(main bedroom), Zutang, and courtyard, can epitomize the spatial characteristics and the topology of these spaces. These two living spaces on top named after their user(Zhengfang: household's space, Xianfang: lineal ascendant's space) and spatial characteristics (Zurang: master living space, Ting: living space for each family), unlike their modern counterparts, the main bedroom, and living room, and this may be due to the fact that these rooms could not be associated with particular functions. In the diagram, some representative behaviors of each space are showing inside the circles. (figuar 3.35)

Instead loosely programmed, theses spaces could accommodate various kinds of functions, including providing support for space nearby. The fang always supports each other with private behaviors. The zutang always supports whole family dining, gatherings, ancestor rites, and events. The courtyard support wet or dirty jobs, especially, it is a multi-purpose space,

and it is used when many receptions were needed. The location of the kitchen is not clearly known on the scale of 1 Jin and 2 Jin; typically, a corner of the courtyard or part of the Xianfang is used temporarily. In more than three Jin, it is located in a backside building(Houzhaofang) located in the back yard on the backside of the Zhengfang. Since these behaviors tended to be scheduled divided by function, the fang can be categorized as " private space" and the zutang and Ting and courtyard as "public space".

The Fang's user is determined by the direction. The right side is always a concept higher than the left side. Based on the central public space, the male uses the right bedroom, and the female uses the bedroom on the left. Also, based on the central courtyard, the building on the north side is used by the head of the family, the eldest son's family in the east, the family of the second son, or the female brother in the west. The two types of Directional structure were developed to keeped Confucian ideology and Feng Shui theory, they encapsulated the conceptual "gender distinction" and "family hierarchy distinction" This spatial code described above governed the hosing culture for centuries with authority but, when the new housing type until were introduced from the early 20th century, changes began to be made. Those traditional behavior-space relations based on interactions to make different combinations in new domestic settings.

The first wave of morden houses began after the frist Opium War(1942) to meet the grwing demand in many port cities(Guangzhou, Xiamen, Fuzhou, Ningbo, Shanghai) across the country, and after second Opium War(1858), many more port cities have been opened by Western powers. At this time, western leased territory were built in many port cities, and construction of Western capital companies accelerated population concentration. During this period, the first generation of modern homes was developed in Shanghai, and later, houses that combine the characteristics of traditional Chinese houses with those of Western houses were designed.

There are many views on the origin of this modern house, but this study presupposes a spatial composition derived from the traditional courtyard house in the southern region. Compared with the traditional siheyuan house, the overall morphology of these plans significantly differed in that courtyard moved out of the central position to surround the houses, which now are mostly double-row and triple-row structures. On a closer look, however, it is still found that the traditional domestic code is still manifest the same topological relation of the three essential spaces has survived to preserve the traditional way of living(figure 3.36). Many changes in spatial composition have emerged, especially the changes in the courtyard and attached building most dramatically. The courtyard deviated from the central posi-

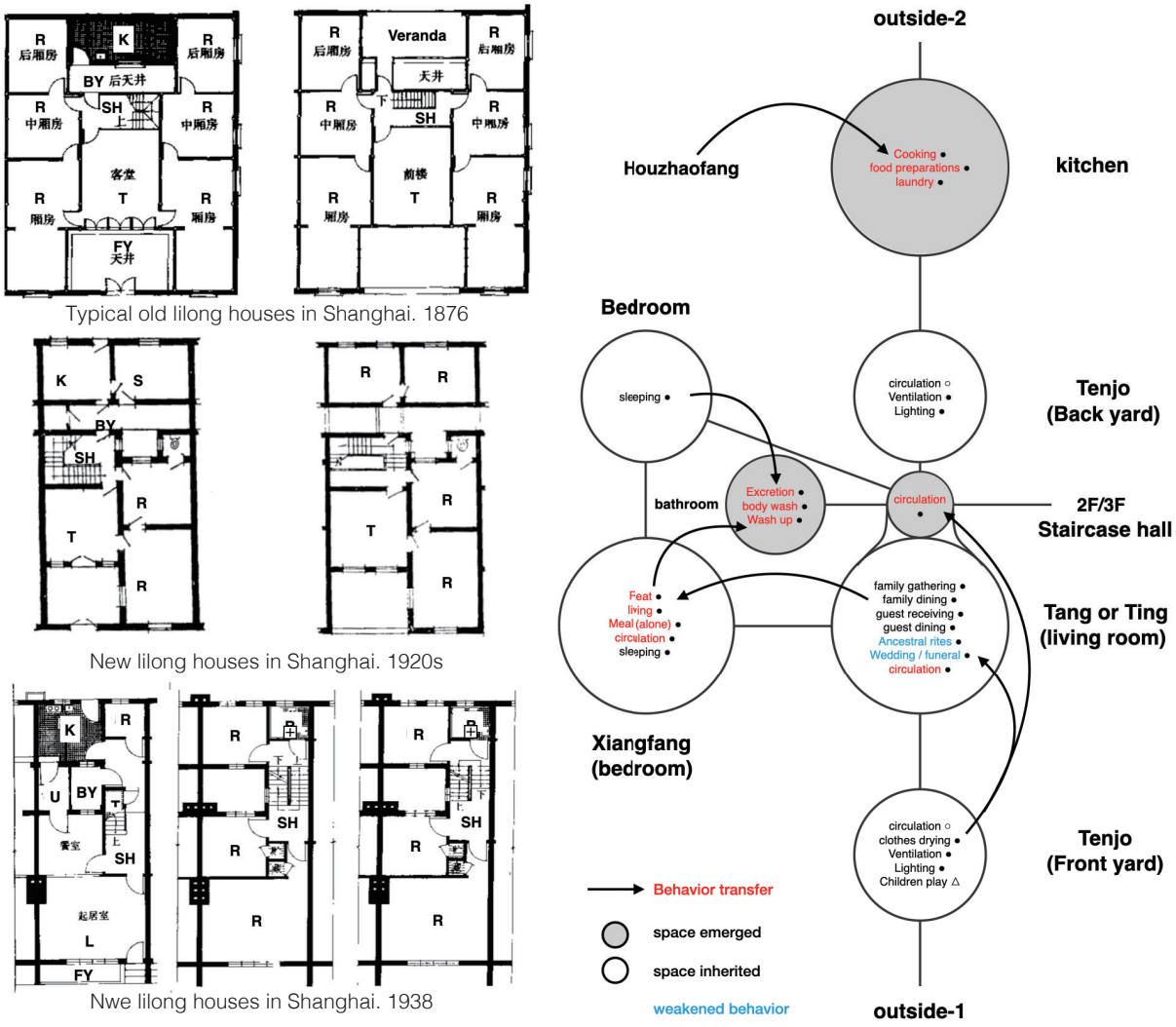


Figure 3.36 Old Lilong house and domestic code < 1 >

tion into the front and back yards. This spatial configuration is intended to provide ventilation and lighting to each bedroom. The attached building has a service function that supports life and is located in the center of a neighboring life connected to the back alley.

While the primary spatial link is maintained, some significant changes have been made. First, the staircase hall was attached to the ting on the backside to mediated the ground floor and second floor, thus taking away from the courtyard the behavior of circulation, and In addition, the attached building was expanded with a backyard in between. The attached building consists of a pantry or kitchen and is physically separated from the main living space. The newly created space inherited the behavior from the traditional old courtyard. In other words, based on the traditional “one light, two dark” spatial composition method, the spatial depth expanded horizontally and vertically. In this phase of evolution, the staircase hall and ting(living room) became the most integrated space taking the function of

circulation form courtyard. However, there are differences in the nature of the two spaces. The staircase hall incorporates the circulation of the vertical space, and the living room has the characteristic of preserving the private space. The new lilong houses have been built after 1920, and bathrooms and toilets are inside the house, which is different from old lilong houses. It is a two-row or one-row structure to maximize land use and is 2 to 3 stories. The bathroom becomes the most independent space taking the behavior of hygiene from the bedroom. The ting placed in the spatial center loses the symmetry of the odd space, and the spatial depth increases vertically.

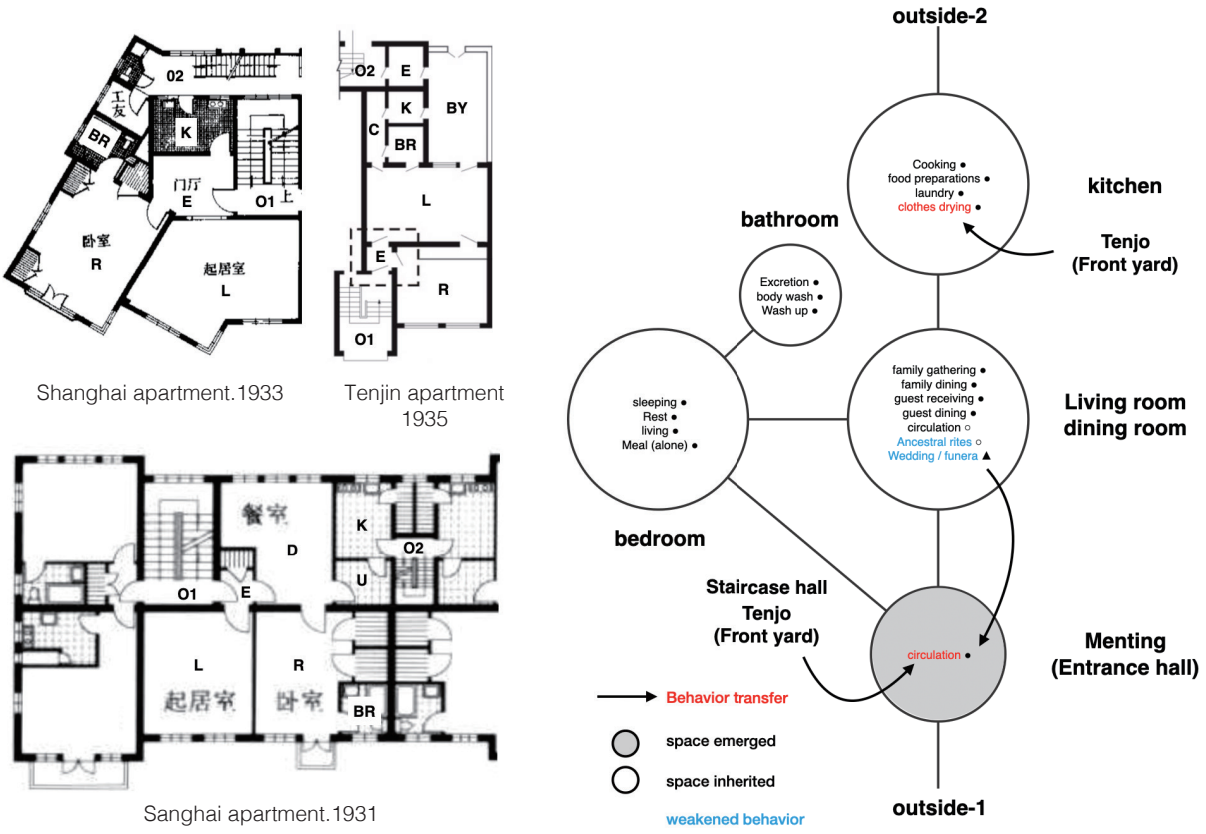


Figure 3.37 Early apartment houses and domestic code < 2 >

Although the initial housing was a space for large families, the structure of the family gradually decreased, and the residential space tended to diverge to respond to various conditions(Han 1998, 187). The function of the space was differentiated and became apparent, and new spaces such as study rooms, bathrooms, and kitchens were created. In particular, the new house was divided into a space for guests and servants on the first floor, an owner on the second floor, and a space for children and relatives on the third floor. In addition, as the planar type increases, various types of spatial composition appear. These modern uraban houses were the frist seneration of modernized homes that suggested possible ways of modern confiiguration that can enclose the indigenous pattern of living; hence they strongly

affected the early apartment houses plans that followed. At the beginning of the 20th century, China made economic development for a short period of time, and Western-style apartments appeared mainly in Shanghai and Tenjin. On the other hand, there were apartment houses built by Chinese real estate developers based on lilong houses. The change with the spatial depth between the living room and the kitchen is became shallower. The entrance hall was to mediate the inside and outside, thus taking away from the courtyard the activity of circulation. It is interesting to note that this “formalistic depth-increasing” in the shallowest part of the house – to emphasize the rites of “going into the house” – is quite contrasted with the “utilitarian depth-decreasing” between the livingroom and the kitchen in the deepest part. In this phase of evolution, the entrance hall has become the most integrated space to preserve the independence of other bedrooms, living rooms and other spaces. (figure 3.37).

3.2.3 Evolution of apartment house plans: 1949 ~ 1980s

After constructing the People’s Republic of China in 1949, a socialist sharing system and a socialist economic system were established. The house ownership was converted to the state, and the management and production of the house were practiced independently in the government. In the early stages, a large-scale apartment design in the Soviet Union was built as it was, and then a standard housing design in China was developed to take into account the situation in China. The standard house design is the lowest level house in which all families live in a single room with a public service space (kitchen, toilet, hallway, etc.) with the goal of supplying the house.

The economic power and construction technology to solve the housing shortage did not meet as expected. The plan to supply a large amount of inexpensive housing did not proceed quickly. Although the supply of housing has increased sharply since the end of the Cultural Revolution in 1976, due to population policy failures and management system problems, the ordinary people are still living in small and overcrowded areas. (Lin and Yang 1982, 44). In 1984, the average area of a housing unit was 56 square meters, but in order to achieve the goal of less than 50 square meters in the 80s and less than 55 square meters in the 1990s, it was limited to the area of the house. On the other hand, the spread of electrical appliances is remarkable. In cities, it has reached about 100% for TVs, about 40% for refrigerators, and about 75% for washing machines, and it is a fact that this is promoting the demand for increasing the area of houses.

Urban Apartment complex in China after World War II can be classified into three types according to the time series(Tomokiyo 1993, 35). The first period was concise, and large-scale housing was supplied by following the Soviet Union's standard design. In the second period, large-scale housing in the Soviet Union could not meet China's social and economic needs. The trend has changed from large-scale housing to small-scale housing, and in order to save the corridor area, Overlapping-bedroom housing(套間型住宅) has been developed that passes through one bedroom and moves the other bedroom. In the third period, Ting-type houses(厅型住宅), which reflect on the uncomfortable habitability of Overlapping-bedroom housing and emphasize traditional Ting characteristics, appeared and developed.

It relied on the Soviet Union for technical and economic assistance for ten years after constructing the People's Republic of China. In 1953, The Ministry of Construction and Engineering of the People's Republic of China was established, and the system of revival and founding was reorganized, and the technology of the Soviet Union wasintr0oduced to support this. At the time, the Soviet Union engineers were responsible for establishing the main building techniques and construction processes. From 1953, China established a national five-year plan, and the new urban housing was built by imitating the standard design of the Soviet Union(301 plan and 302 plan). It was a two-room type (50m^2) and a three-room type (74m^2), which was quite spacious as one housing unit. At that time, 4-5 people were the standard family size in China and set up 4m^2 as the living area per person.However, in reality, standard housing in the Soviet Union lived for one household in one room. In other words, there was a phenomenon in which two to three families lived together in one housing unit (figure 3.38). During this period, "reasonable design and irrational use" was the design slogan, and the Soviet Union also planned housing until the mid-1950s on the premise that a large number of families reside in one housing unit.

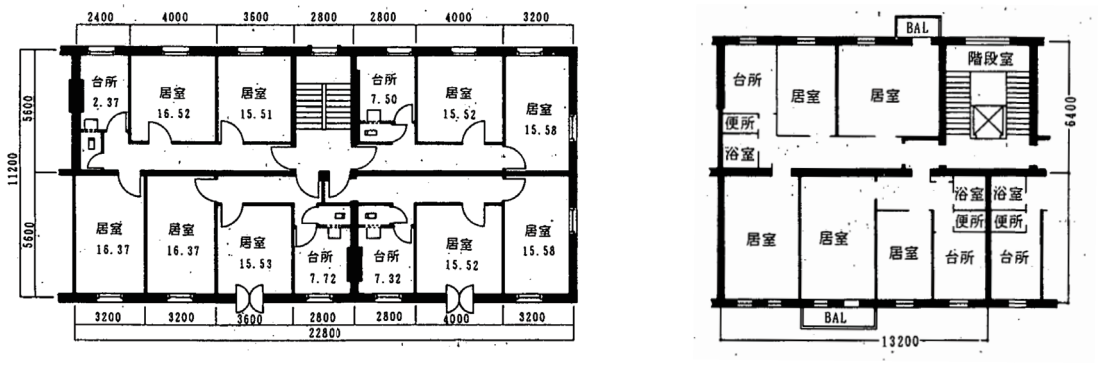


Figure 3.38 China 301-II type standard design in 1956 (left) Soviet Union II-04 type standard design in 1955 (right) (source: Tomokiyo 1993, 37)

However, there was a difference in residential area per person between China and the Soviet Union. China aimed to maintain 4m^2 per person, and the Soviet Union sought to maintain 9m^2 per person.Trying to maintain this level of the stock price has important implications. It is a criterion that decisively changes the residential behavior of residents. For example, the standard for a 303 type and 305 type house (figure 3.39). planned by China is a plan with 4 kitchens, 3 bathrooms, and 11 bedrooms (total of 138.45m^2) between 9.42m^2 and 16.1m^2.

Therefore, the plan is based on 37 people in China and 15 people in the Soviet Union living in one housing unit. Assuming an average of four family members, nine families in China and four in the Soviet Union live together. Even considering the number of toilets and kitchens, the difference in the behavior of the residents is clear.

In 1955, the economic key policy was implemented, and it was decided to reduce the cost of building houses by 50%. Still, it was challenging to propose effective methods other than lowering construction costs. For this, the housing designer presented an exterior corridor type house(外走廊式方). Proposed “Beijing Xingfucun Village Plan(北京幸福村街計)” and “Beijing Youanmen Experimental Housing Plan(北京右安門実験性住宅).” This type of house reached the lowest residential area level, but it was not effective in reducing the total building area and construction cost. It was the limitation of early Chinese housing designs (figure 3.40).

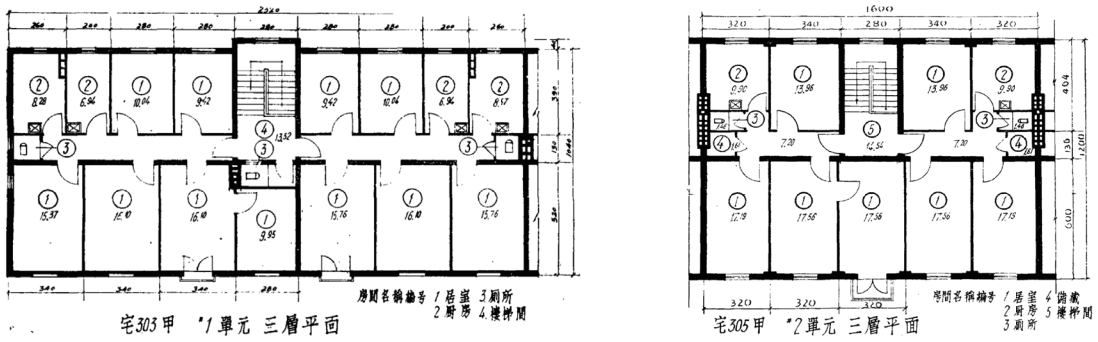


Figure 3.39 303-I type standard design (left) 305-I type standard design (right)

(source: Ding 1955, 51-55)

Houses of this type can freely enter each unit through an exterior corridor, and small-scale housing can be planned. Besides, it is advantageous for sunlight and can improve the quality of ventilation. However, depending on the region, it is vulnerable to wind, rain, and heavy snow. This plan has a residential area of less than 4m^2 per person. It was a principle that four people live in one bedroom to unreasonably reach the residential area level.

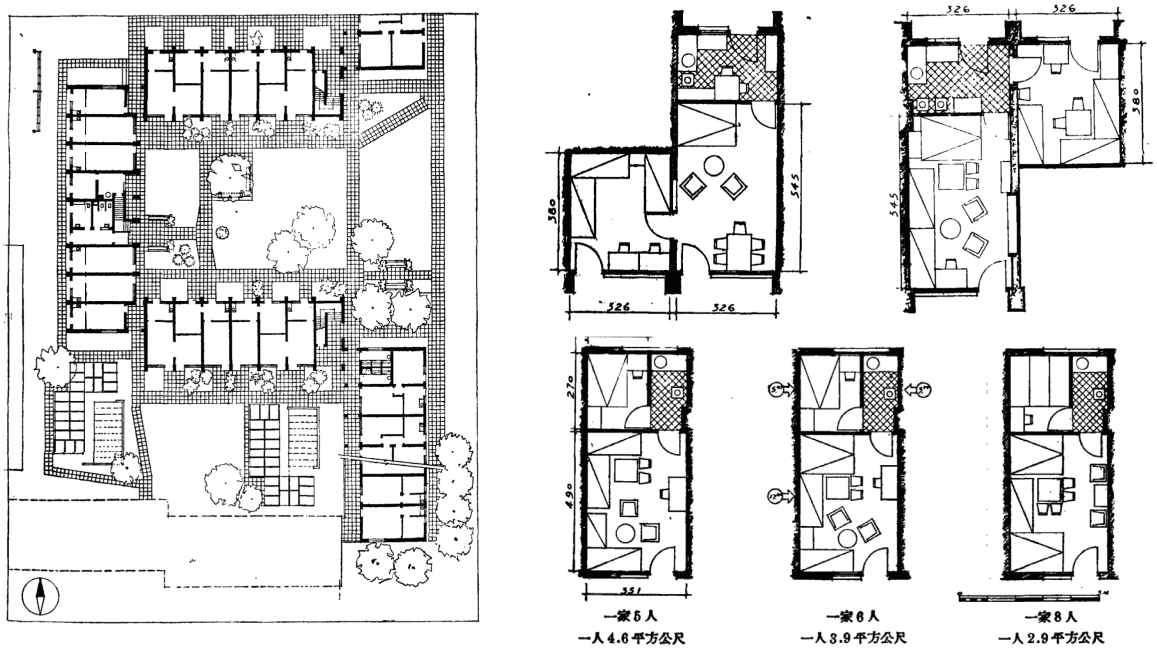


Figure 3.40 Beijing Youanmen Experimental Housing Plan

(source: Hua 1955, 27-30)

In order to reduce housing construction costs, not only the housing area limitation but also the construction area and cost per person were considered. In other words, in addition to the residential area limitation, an index for evaluating the economic plan of the house (plan coefficient [*k*]) was introduced (figure 3.41). It was required to calculate the effective housing area according to specific investments and review its economic feasibility.Simultaneously, as this move, it criticized the existing housing design ideology and raised the need for housing for only one household(Zhang 1965, 113). They also proposed housing by dividing them into three levels, including senior executives, workers, and other classes, and suggested categorizing the types according to the number of families to proceed with the single-family independent housing policy.

$$\text{Plan coefficient } (K) = \frac{\text{Residential area} + (\text{Coefficient X Total area})}{\text{Cost X Building area}}$$

Figure 3.41 plan coefficient (*K*)

(source: reproduced from Li 1956, 101)

Meanwhile, the Soviet Union's housing supply plan began to slow down, and the standard of housing area 56~60m^2 and residential area 35m^2 was significantly reduced (housing area 40m^2, residential area 27m^2).

It started to plan and build its own small-scale houses(figure 3.42), and China has embraced this trend. Independent small-scale housing planning and construction began, and China continued research and reflection on housing by reflecting this trend. At the time, a researcher(Peng and Qu 1956, 45) at Tenjin University judged that small-scale houses with external corridors were suitable in the Yangtze River's southern area, where the winter minimum average temperature was 0°C or higher.

In particular, the study strongly argued for the separation of bedroom and dining room. Another researcher(Zhao 1957,38) divided the main housing types into "inner corridor type" and "external corridor type". The interior corridor type conforms to the current design philosophy. However, environmental conditions such as kitchen, toilet, and bathroom are low. The exterior corridor type is suitable for applying "independent households houses" and "small-scale houses" but heavy rain and heavy snowfall. Vulnerable to and pointed out the problem of stability. New ideas were embodied to improve this irrationality. Corridor was integrated into the anteroom and used when necessary, and connecting toilets and bathrooms improved the residential environment's quality with the outside (figure 3.43). Criticizing the research on existing housing and the reality of following the Soviet Union housing, he proposed an "Overlapping-bedroom housing (套問型住宅)" that reflects China's unique characteristics(Bi 1957, 36-40).

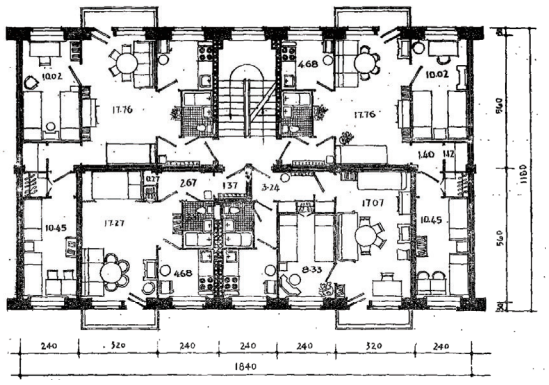


Figure 3.42 Soviet Union housing plan, 1956

(source: Sharonov 1956, 8)

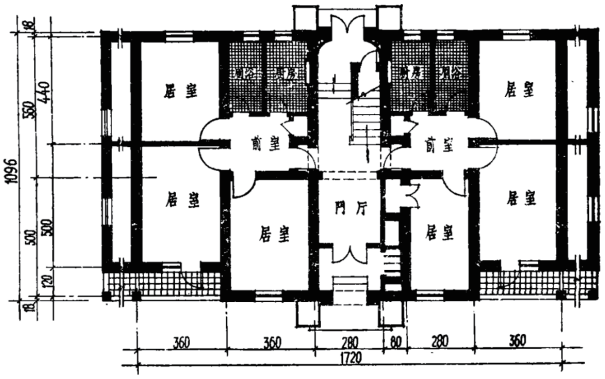


Figure 3.43 New residential floor plan, 1957

(source: Zhao1957, 43)

New ideas were embodied to improve this irrationality. Corridor was integrated into the anteroom and used when necessary, and connecting toilets and bathrooms improved the residential environment's quality with the outside. The housing plan developed so far has a staircase lined up parallel to the main building's back. However, the new plan has four dwelling units placed in a story. Therefore, the house's frontage is narrow, and it has a circulation structure that moves from one bedroom to another bedroom. This plan was a special model

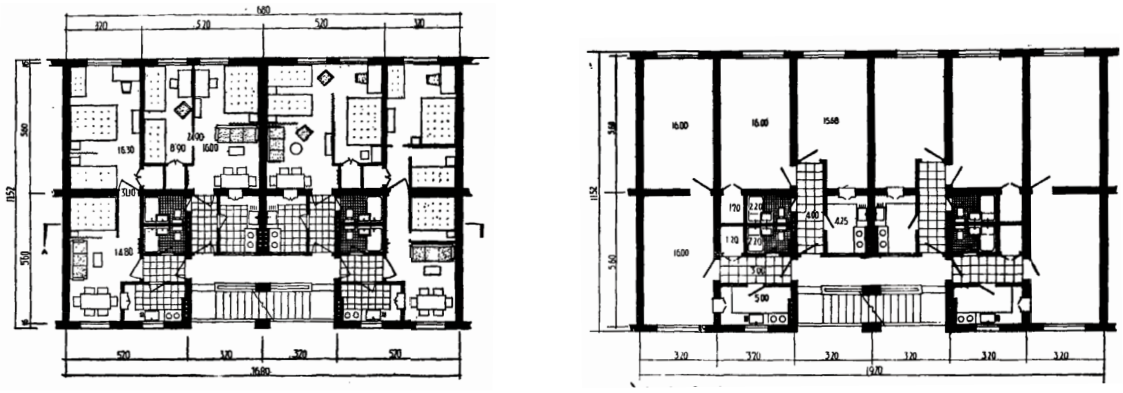


Figure 3.44 Overlapping-bedroom housing housing

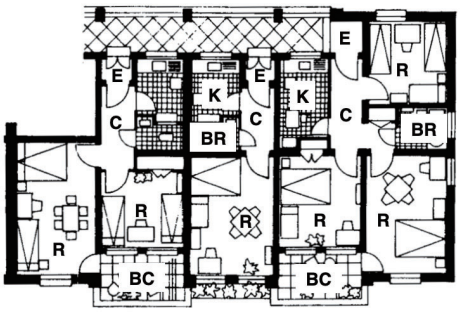
(source: Bi 1957, 36, 37)

established to spread small-scale houses, but later spread widely across the country (figure 3.44). The sample plan collected data from ***Chinese architectural journals*** (1954-1989). “Small scale house” and “Overlapping bedroom house” developed by adapting to China’s local situation. In this process, many transformation types were born, but the elemental spatial composition is maintained. All collected plans have a similar circular pattern. The small-area house entered from the outer corridor to emphasize each household’s independence, and the inner corridor connects the bedroom, kitchen, and toilet. (figure 3.45).

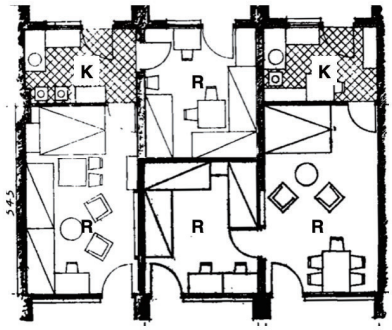
China has undergone many changes under the influence of the Soviet Union. Traditional urban structures collapsed, and housing policies and supply plans demanded different dwelling behaviors. Due to the lack of urban housing, all behavior was concentrated in one bedroom. Besides, traditional ancestral rites gradually disappeared due to socialist ideology, and funerals and weddings were transferred to local specialized facilities. While the primary spatial links are broken, some significant changes have been made.

The most important change was the “Ting” with the living room function removed from the house’s interior. Also, traditional courtyards, front yards, and back yards were not needed in modern urban housing. Ting’s function was moved to the bedroom, and the position of the courtyard, which supported circulation and many behaviors, was relocated to a Interior corridor while maintaining mobility only.

The overlapping bedroom house is the same system as a small house, but the plan is to reduce the corridor area and improve the internal environment. (figure 3.46). In Chinese houses, names such as ***Zhengting***(正庁), ***Menting***(門庁), ***Keting***(客庁), and ***Canting***(餐庁) have been used since long ago. However, the composition of “Ting (庁)” in urban housing was excluded after the constructing of the People’s Republic of China. Although in the 1930s,



Beijing Xingfu Village Residence,1955



Beijing Youanmen Experimental Housing 1955

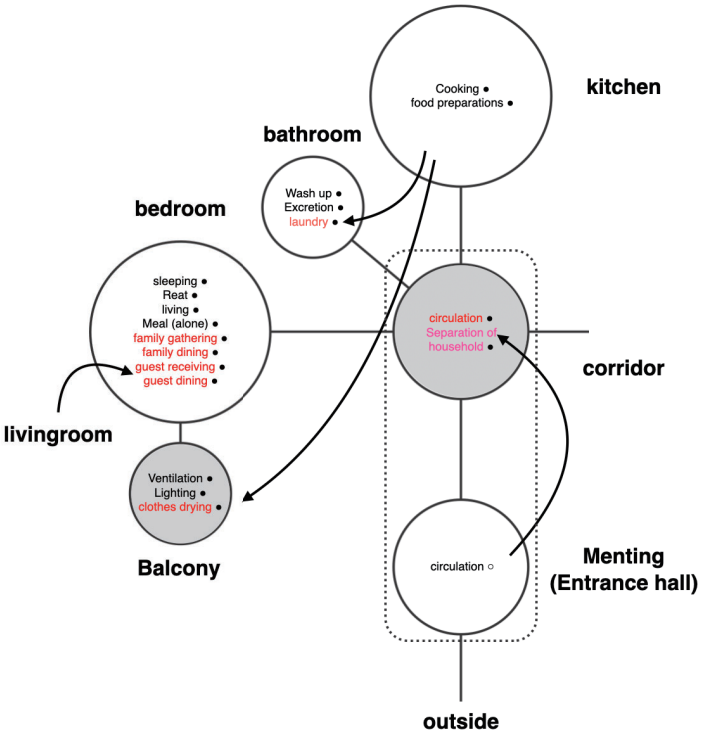
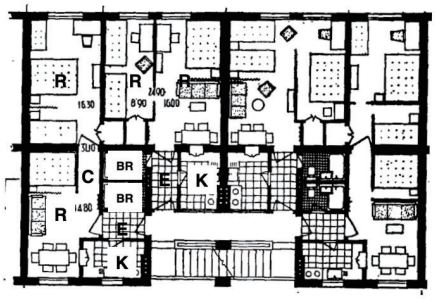
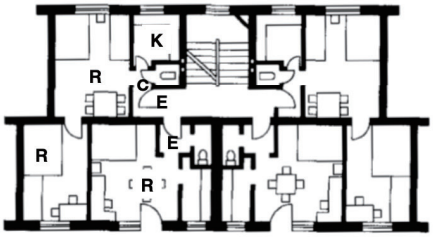


Figure 3.45 Small scale housing and domestic code < 3-1 >



Beijing Youanmen Experimental Housing 1955



8011 type Housing in Beijing, 1960

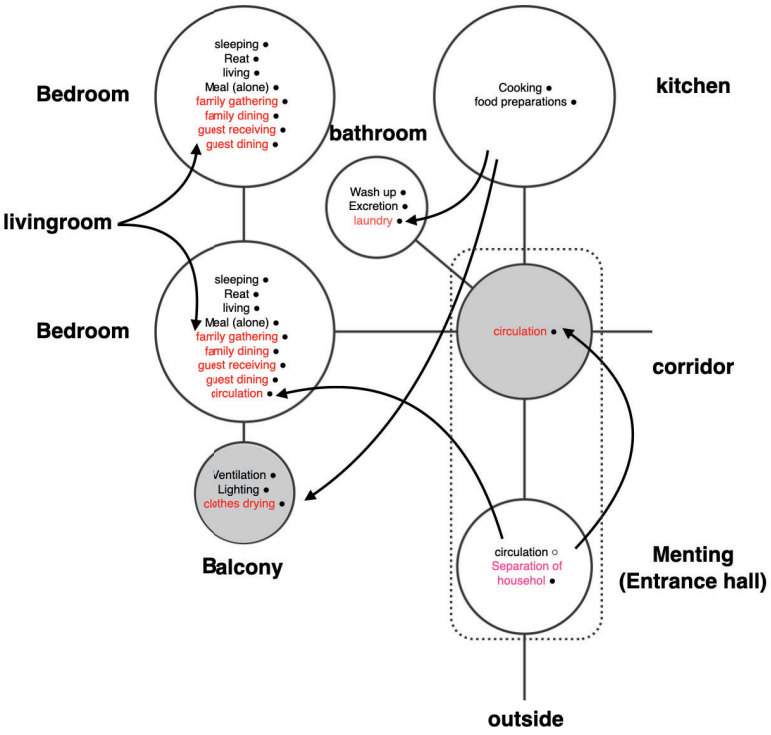


Figure 3.46 Overlapping-bedroom housing and domestic code < 3-2 >

early-period apartment housings in ports like Shanghai and Tianjin could be found. It can be concluded that it was impossible to build houses based on their own culture due to the influence of standard housing in the Soviet Union.

Ting type houses can be classified into the early-Ting type and late-Ting type according to their role and function(Tomokiyo 1994, 60). It was believed to have disappeared from Chinese housing history until it was discovered in an overseas Chinese house in Guangzhou in 1959. These overseas Chinese houses were free from Soviet influence and inherited the image of traditional Chinese Ting. However, it has a different meaning from the traditional Ting of Ting-type houses that have appeared in China after that. Considering the historical housing point of view, it can be said to have the same meaning as the living room popularized since 1980 (Mo,1959). Ting and Menting planned in Wuhan, and ***Xiaofangting***(小方厅) in Hebei Province influenced Ting, which appeared in provincial cities throughout the early 1960s. Besides, it aims to reduce residential areas and secure dining space while aiming for "small-scale houses."(Wuhan Industrial and Civil Architecture Design Institute, 1960, 22).
The concept of Ting, which appeared in the 1960s, is the same as the late-Ting-type house that was popularized in the 1980s but was used as a buffer space to separate households in China's society where two households live in one dwelling unit. In the 1960s, in most large cities in China, it was common for one household to live in one bedroom.

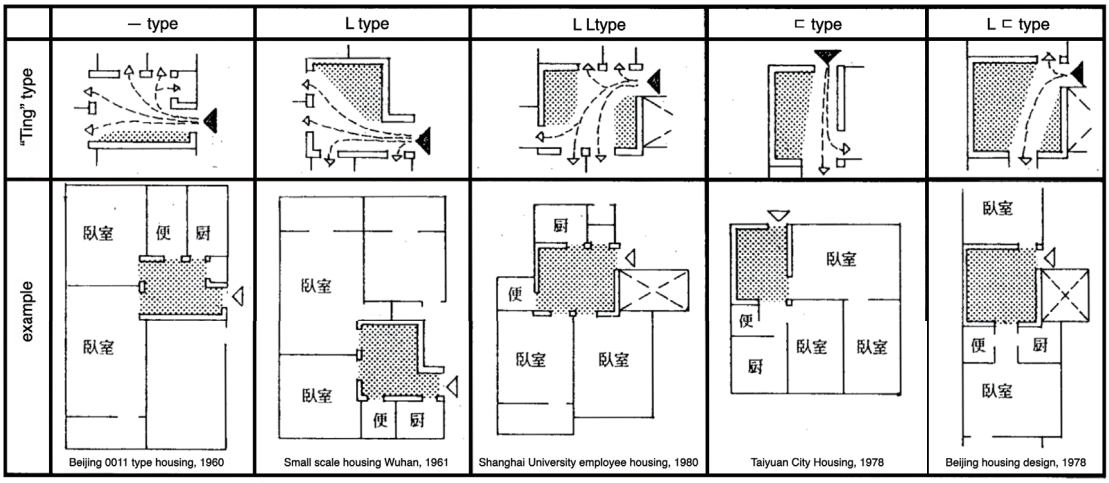
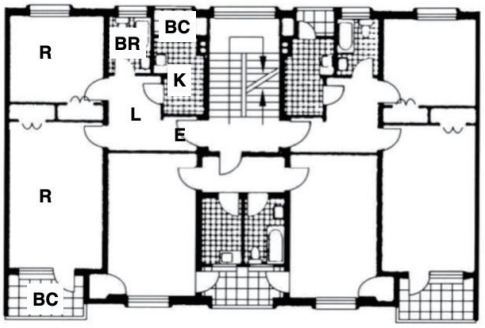


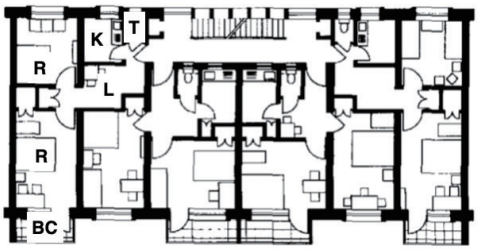
Table 3.2 Types of "Ting" and examples of Ting type houses

(source: reproduced from Tomokiyo 1994, 6)

Therefore, early Ting played the role of the entrance and storage space to enter each generation. Besides, the frequent movement of residents made it unsuitable for a stable living space. Meanwhile, china started rapid economic growth after the Great Cultural Revolution ended in 1970, and the spread of Ting gradually expanded. It was unilaterally called ***Fang-***



No. 9014 housing in Beijing .1958



No. 8014 housing in Beijing .1958

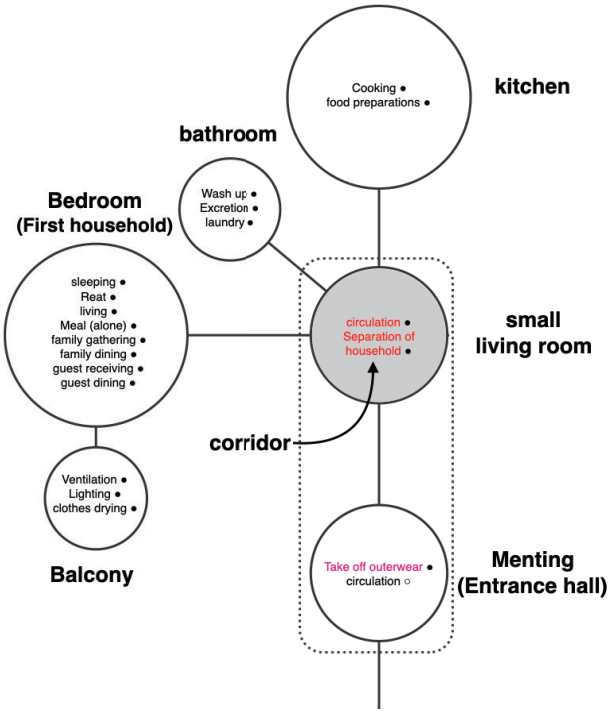
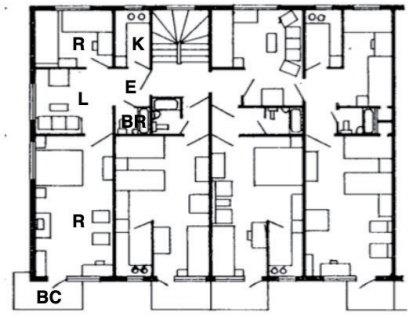
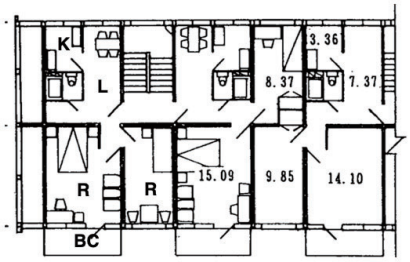


Figure 3.47 Early Ting type housing and domestic code < 4 >



No. 9014 housing in Beijing .1958



No. 9014 housing in Beijing .1958

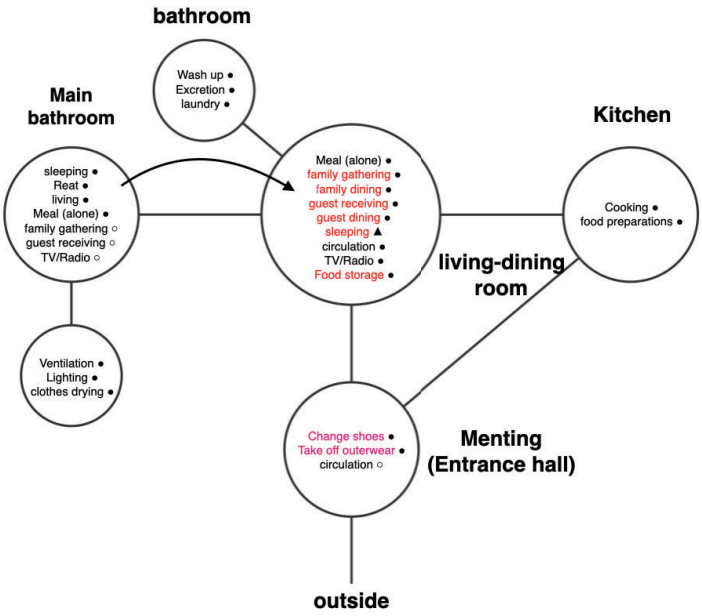


Figure 3.48 Late Ting type housing and domestic code < 5 >

ting (方厅), and it was narrower than the bedroom and used for dining, family gatherings, and reception spaces. It was also temporarily used as a bedroom. Moreover, after 1980, almost all housing plans have included Ting, a characteristic of late Ting type houses (Table 3.2).

While the primary spatial links are maintained, some minor changes have been made. The inner corridor has been integrated into “Ting,” which serves as a living room, transforming into the center of circulation connecting the interior and exterior (figure 4.47). What is characteristic is a space similar to a small entrance at the entrance of the house. A space called Menting can be found in apartments in the early 1930s (figure 3.37), and the same type of space as anteroom in 1957 is inherited (figure 3.43). It is also found in new lilong houses (Shanghai and Tenji) (figure 3.37). Considering the circulation structure that enters traditional Chinese courtyard houses’ interior, it is believed that the first courtyard has the same function as acting as a buffer between the family’s living space and the exterior. Some studies (Shinobu 1994, 165) state that Chinese entrances do not have the same concept as Japanese entrances. It has a traditional concept in which individual Chinese buildings are gathered to form a residential space. Buildings and buildings are not physically connected, but a courtyard or garden is installed to form a buffer space. Although not found in all cases, this small entrance also serves to separate the living room and service space (kitchen and toilet). This trend is clearly expressed in Beijing’s No.9014 house in 1980 (figure 3.48).

These modern apartment houses were the second generation of modernized homes that suggested a possible way of modern configuration that can enclose the indigenous pattern of living; hence they strongly affected the apartment house plan in the 1990s.

3.2.4 Topological paths in evolution

Over-viewing the whole process, some import points can be summarized. The traditional link of the four essential spaces was still preserved in the Lilong houses of the 1870s to 1920s, but when it comes to the large scale apartment houses in 1950s, all relationships are rearranged, and the yard disappears, leaving small fragmented spaces to preserve some of its behaviors. The significant indication that suggests the initial code structure is the adjacency between the main living sector(bedroom, living room) and the service sector(kitchen, toilet, bathroom) , which a like a rule, appears in every typical plan.

The living room was settled in the apartment house in China, by combining the circulation function to the traditional courtyard and the public character of the “Ting,” and it links the remaining essential spaces. The function of circulation, therefore, has been transposed from the courtyard to the corridor and the the living room. The next four graphs illustrate the topological paths of the behaviors by means of Standardized Integration(i) values (from figure 3.49 to 3.52).

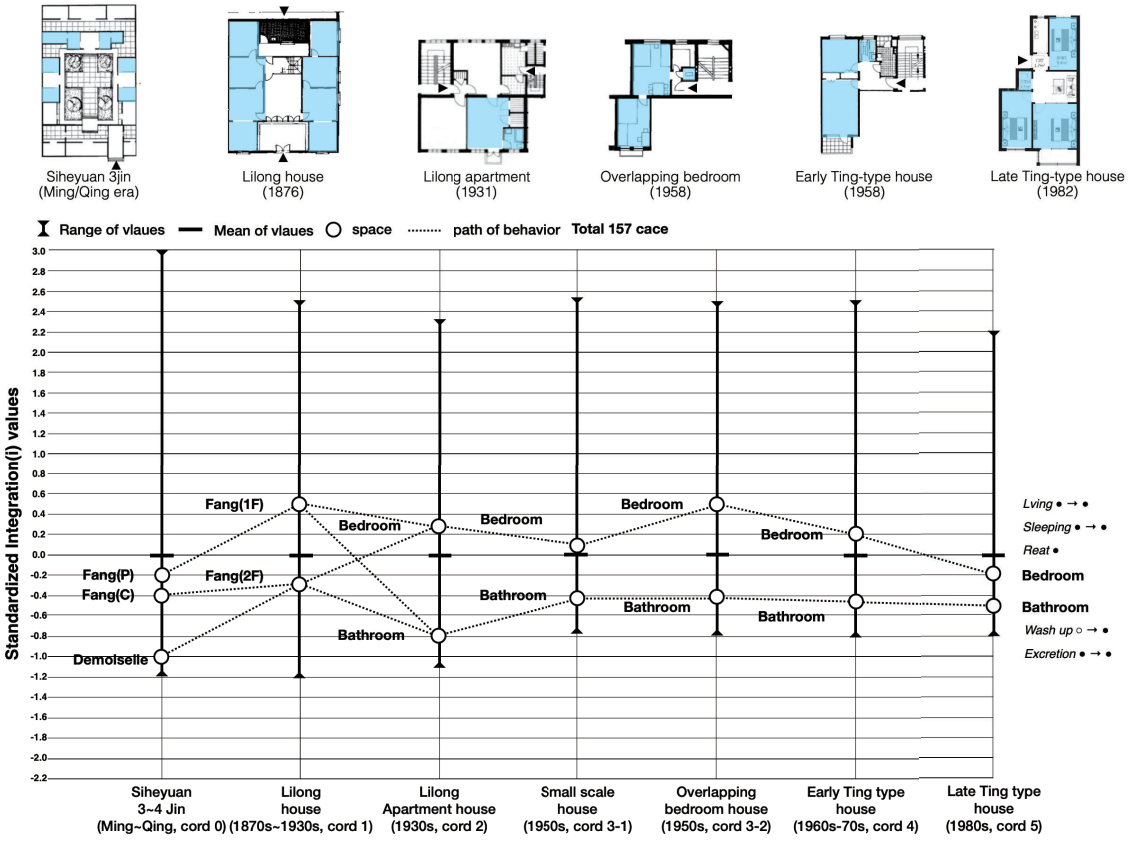


Figure 3.49 Topological paths of behaviors of the Fang

Each graph shows the traces of behaviors that came from one of the four keyspace. Using Standardized Integration(i) values which show the degree of integration, precisely how these activities are assigned their topological position in each phase of the housing evolution can be revealed. First, figure 3.49 shows the diachronic movement of the behaviors that once belonged to the Fang, the counterpart of the modern main bedroom. The five representative behaviors in the old Fang change their position in terms of Standardized integration values but remain together in a single room until the third and fourth phase of the evolution. In the third phase, as the toilet develops into a modernized Internal bathroom, the behaviors of wash up and excretion moves form the Fang to the bathroom. In this phase, It was the early period when urban houses were transferred from houses with traditional courtyards to multi-family dwellings.

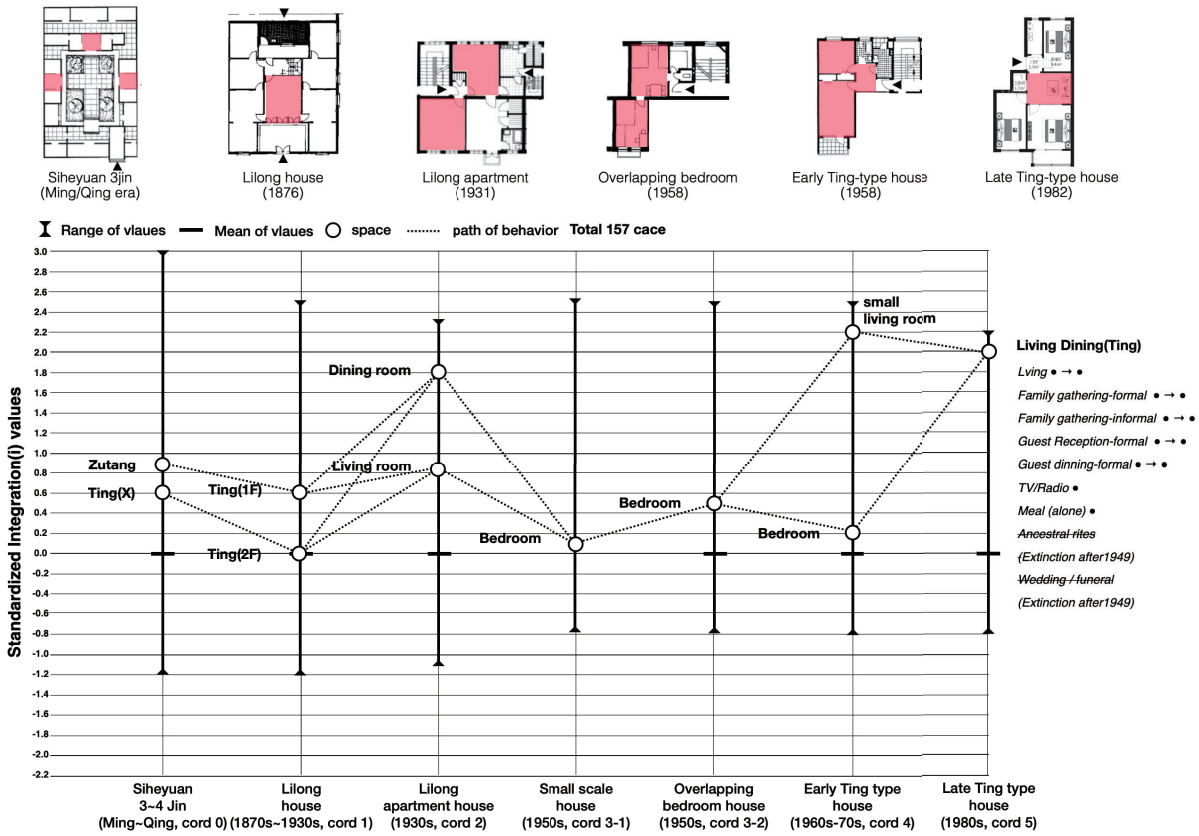


Figure 3.50 Topological paths of behaviors of the Ting

Several individual buildings or 2-3 story houses were reduced to a single story. In the extended family system of the Ming and Qing era, the living space of parents and children were separated, and in the lilong house that appeared in the late 19th century, the first floor was used by heads of households and guests, and families used the second floor. Through the six phaese of the transition, of nine main behaviors of the Fang are spread into the two spaces, the main bedroom, the living room, and the bedroom, Therefore, through the be-

havior-spaces interactions, the Fang becomes the most activity-retained space amongst the four key spaces. The old Ting and Tang in the trational house was the space for living, family grthering, and dinnig. All the way through their maigration, these behaviors are kept higherthan the mean in Standardized Integration(i) values, thus positioned in more integrated part of the house. They merge to a living room and dinning room in the third phase when the Ting inherits the function of each Ting and becomes the most integrated space due to the demise of the courtyard. However, since the 1950s (phase 4-5), Ting, which has the most behavior, has been merged into the bedroom. However, since the 1950s (phase 4-5), Ting, which has the most behavior, has been integrated into the bedroom. When the final phase was reached, Ting recovered the old Ting's behavior, but the previous phase's influence remained, leaving some of Ting's functions in the bedroom (figure 3.50). In traditional courtyard houses, the kitchen was space not only cooking and food preparation but also for body washing in winter and bathing in all seasons. As soon as the modern new lilong house was equipped with a bathroom, the behavior of body washing was separated from the kitchen(-figure 3.51). In traditional courtyard houses, the kitchen was not positioned. In 1jin and 2jin-sized houses, the kitchen was configured in a courtyard or unused building, and in dwellings 3jin and above, the kitchen was placed in Houzhaofang, located in the backyard.

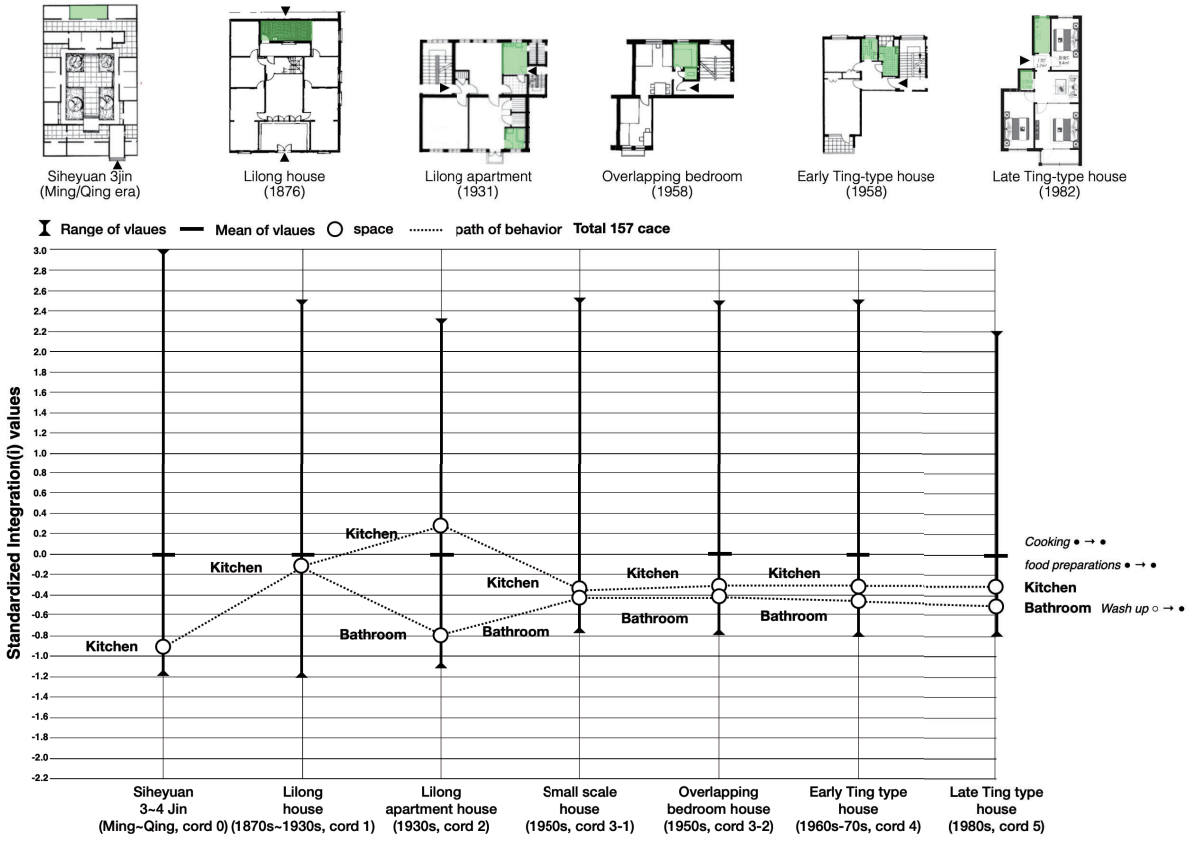


Figure 3.51 Topological paths of behaviors of the kitchen

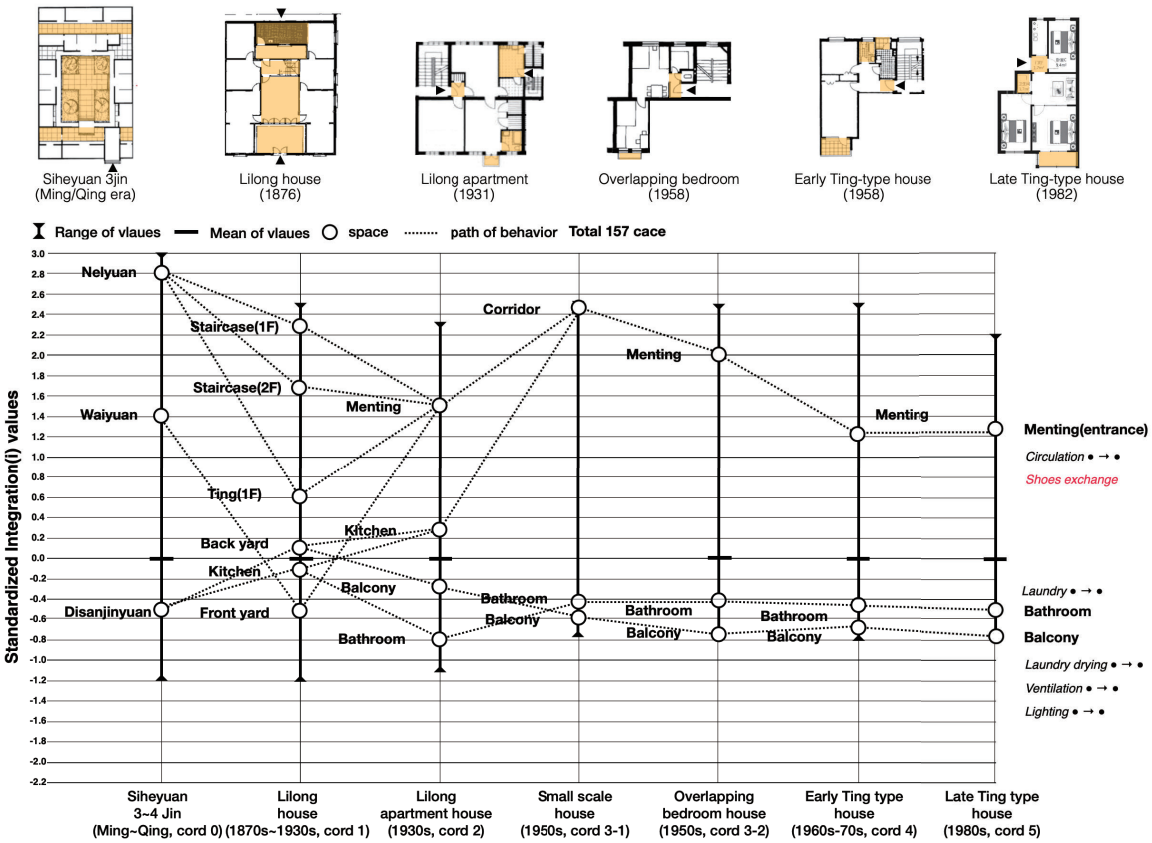


Figure 3.52 Topological paths of behaviors of the courtyard

In the traditional Siheyuan Gardens such as Huizhou and Shaanxi and Beijing Siheyuan, the cooking space is organized separately from the residential sector. Therefore, the Standardized Integration(i) values of the kitchen are maintained at a low level below the average. However, in lilong houses and early-period apartment houses, kitchens are connected to back alleys or stairwells, appearing higher than other periods' kitchens. Although mentioned in previous studies, food culture in China is often organized separately from living spaces using many spices and oils. The most startling change of all is the transformation of the courtyard. The multiple roles of this outdoor space have been successfully re-distributed into the four newly emerged spaces in the modern apartment houses, as previously illustrated in the domestic code diagrams. The balcony, and the bathroom have inherited its behaviors, and the living-dinning are now supporting its function as a circulation space. Again, this process of "behavior relocation" can be better understood when seen through the topological graph(figure 3.52). The behaviors derived from a single space, the courtyard, are migrating through the different routes and spread across the domestic field. It is evident from the graph that the behaviors that once belonged together in the most integrated apace are diverging gradually toward the other end, the most segregated space. In fact, it is a natural result caused by the reversed characteristics of the old and new house configurations. The main substitutes for the courtyard, i,e., the balcony and the utility, are destined to be placed

on the perimeter in apartment houses, and this location is likely to have lower Standardized Integration(i) values.

3.2.5 “one bright, two dark” as underlying force in evolution

Chinese housing has undergone a number of changes over the past 100 years. Korea, China and Japan are closely related geographically, but have developed with different social systems. In particular, it was strongly influenced by Russia under the socialist regime. The 1950 one-bedroom house plan was an essential cause of the collapse of traditional housing structures and changes in people’s lifestyles. The composition of traditional Chinese houses has a configuration that organically complements one public area and two private rooms. It is impossible to enter the private area directly from the outside and can be entered through the central Ting. It has a system that expands space by arranging this basic structure around the courtyard. Chinese housing has undergone several changes over the past 100 years. Korea, China, and Japan are closely related to geographically but have developed with different social systems.

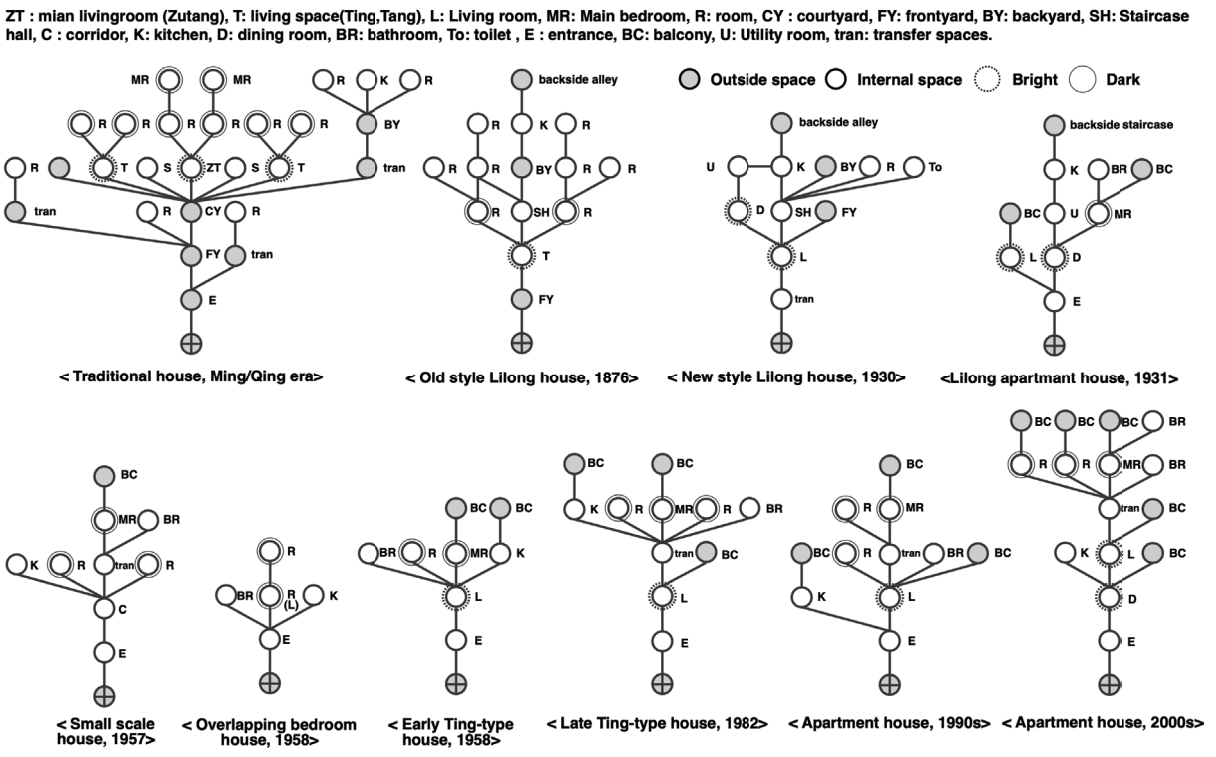


Figure 3.53 Justified graphs of the houses in China from late 19c to 2000s

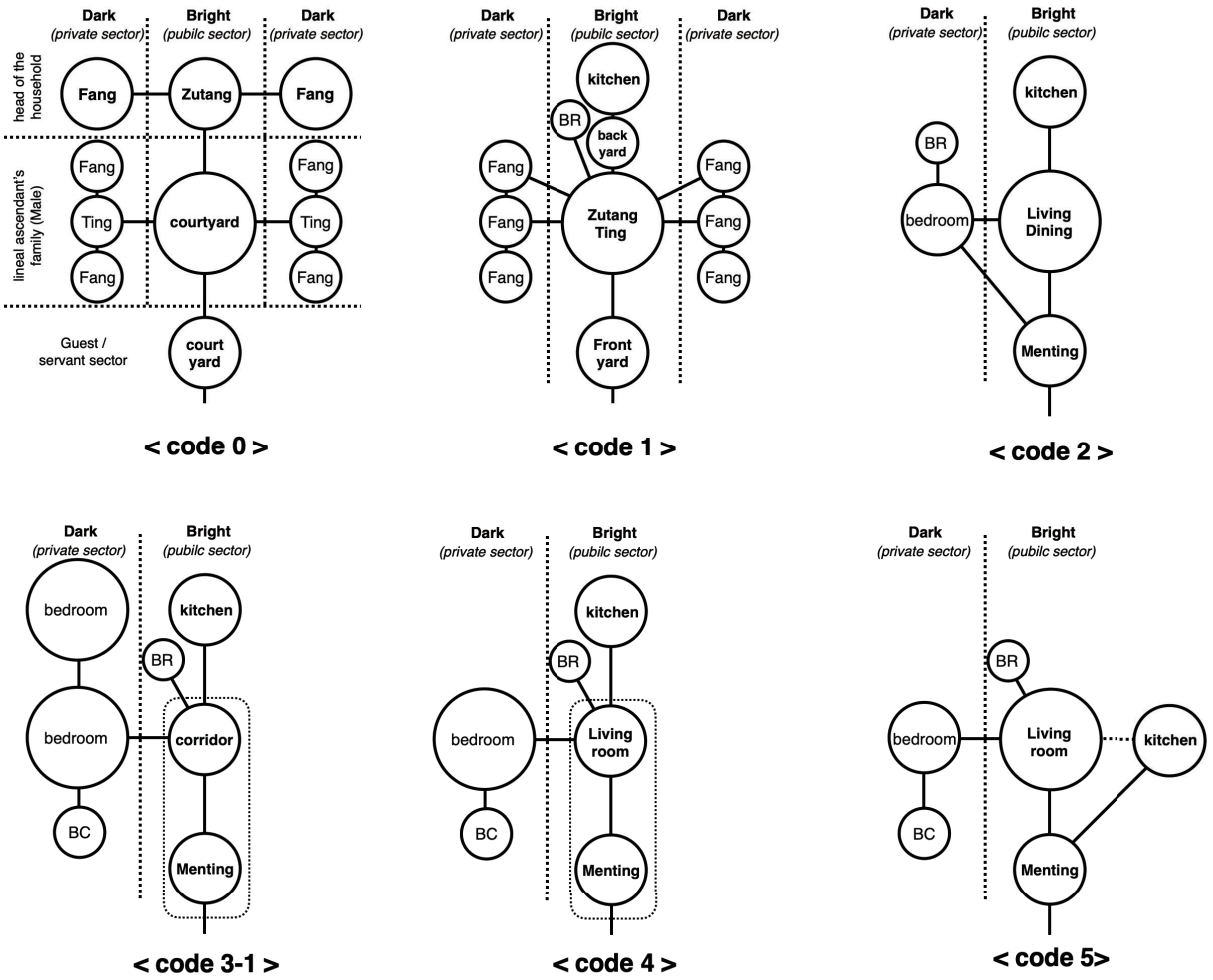


Figure 3.54 Transition of the boundary territory distinction

In particular, it was strongly influenced by Russia under the socialist regime. The 1950 one-bedroom house plan was an essential cause of the collapse of traditional housing structures and changes in people's lifestyles. The composition of traditional Chinese houses has a configuration that organically complements one public area and two private rooms. It is impossible to enter the private area directly from the outside and can be entered through the central Ting. It has a system that expands space by arranging this basic structure around the courtyard.

In figure 3.53, a traditional courtyard house can be found in the structure of two Fangs connected to Ting, which is connected to each courtyard. The courtyard is the main dwelling area, and the courtyard, which can be reached first from the outside, is the area for male servants and guests. The back yard is the living area of the unmarried woman, the kitchen, and the female servant. In each courtyard, the site is firstly divided, and the area is divided secondarily through Ting. Such spatial separation systems are also found in early urban houses. The back yard of the lilong house is a space for ventilation and securing the amount

Figure 3.55 Apartment plan (1986) and apartment plan(1998), apartment plan(2006)

(source: reproduced from Lian and Choi 2019, 55)

of sunlight, while the buffer space separating the kitchen from the main house and the front yard has the same function. It inherits the front alley - courtyard - Ting - Fang spatial structure and the spatial composition leading to the backyard - kitchen - back alley. Such a configuration can also be found in early apartment houses. The houses built in Shanghai and Tianjin have a spatial composition that leads to the exterior - Menting (entrance hall)-living room. As stated in the previous chapter, when considering the Chinese residential lifestyle, the Chinese entrance hall has no behavior occurring in the entrance halls of Korea and Japan as follows ; take off shoes and rise to the high floor.

Menting and the space hanging in front of the kitchen, found in early urban houses, can be judged as inheriting the traditional Chinese spatial composition method of ventilating the space before entering the primary dwelling space and separating the space through the courtyard. This trend has been further emphasized since 1970. In the 1980s, a living room with a modern meaning became popular, and all movement was concentrated in the living room. In the 1990s, the structure changed from the entrance hall to the kitchen, and in the 2000s, it was settled as a dining room-kitchen and living room-bedroom (figure 3.55).

The typical Chinese plan after 1990 is the 2DK/L type, and the number of family members has decreased due to China's one-child policy, so housing for 2-4 people has become common. In addition to the main bedroom, one or two bedrooms are planned, and when the size of the dwelling unit increases, the dining room is divided from the living room.

The 3LD/K type was modified from the 2LD/K type, and a number of L/D/K type cases appeared in the area of 70m^2 or more. In the form of an independent dining room, there were

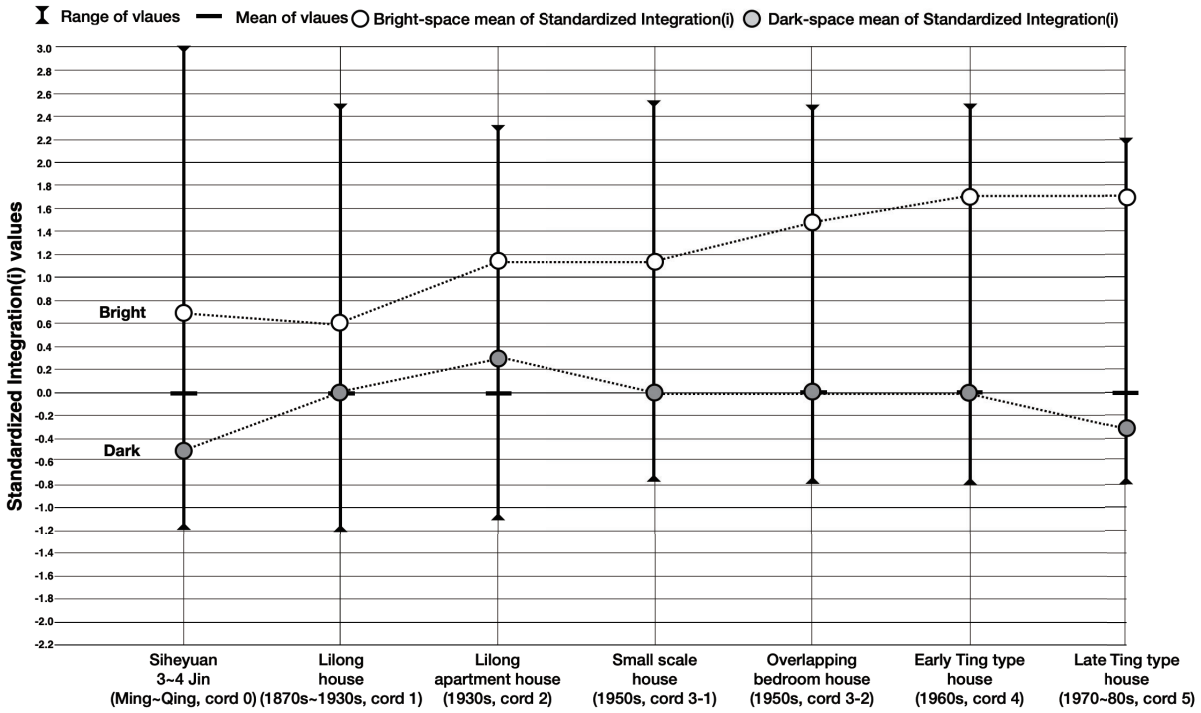


Figure 3.56 Transition of the mean Standardized Integration(i) values of bright and dark spaces

many cases where the dining room was divided into other spaces such as the living room, bedroom, and kitchen. It can be seen that the dining room is a vital family community space in the Chinese apartment plan(Shim and Kang and Cho 2000, 27).

Now it is possible to convert these justified graphs to Standardized Integration(i) values (figure 3.56). In the graph, the dark dots represent the mean Standardized Integration(i) values of dark spaces and the white dots that of bright spaces. As expected from the justified graph, the mean Standardized Integration(i) values of dark spaces in the traditional urban house are lower than those of bright spaces. This result is natural because bright areas such as Ting, Menting, and Canting are connected to dark areas such as bedrooms, bathrooms, and kitchens. However, it should be noted that the contrast between the two areas is gradually increasing. Dark areas have a smaller range of changes than traditional courtyard houses, but bright areas have increased to a higher level. (figure 3.53).

3.3 Respect of Spatial Structure on Gender and status

3.3.1 Introduce

A house is not a simple physical structure containing a family's life, but a cultural space that reflects various aspects of the culture. Aamose Rapopot (1969) emphasizes the relationship between housing form and culture according to human behavior and social institutions. Traditional housing is a space that reflects the unique social structure, institution, and natural environment of each culture. The form and spatial composition of the dwelling are not caused by accidental requirements but is formed by the family relations, social structure, and values of a specific range of groups that share culture and values. Besides, the process of occurrence - extinction - repeat according to the changes and demands of life trends.

Family groups, according to all social structures and cultures, have characteristic practices in spatial use. The house's spatial composition and the behavior of the residents change according to the age, gender, position, and role of each family member. The order in which we live is divided into living spaces according to families' and individuals' positions and roles. Exploring how to recognize the spatial structure and give meaning provides the basis for understanding the time-series transition of houses more quickly. In this chapter, we start from the premise that there will be differences in the concept of traditional residential spaces depending on the characteristics of family relationships (gender) and status (age, class, visitors).

As described in the previous section, cultural cause of Korea develops unique characteristics during development, and its social characteristics are strongly reflected in traditional housing. Besides, throughout modernization, the introduction of Western-style housing, lifestyle changes, improvement of women's human rights, changes in family structure, and urbanization weakened traditional notions and influenced houses' perception. However, the Korean concept of floor level highlight the differences as they inherit it into modern houses.

Research on the Chinese traditional housing can be found easily, and through various approaches, differences and commonalities are expressed. However, there are many approaches to analyzing cultural characteristics from psychology, anthropology, history, and social science. Although attempts can be found from a topological and spatial point of view,

the validity is judged to be low due to errors in the analysis sample or errors arising from a lack of understanding of traditional houses in a specific country. Existing studies have a limitation of grasping each space of traditional housing individually and fragmentarily. Therefore, in this chapter, the spatial topological properties and structure of the overall house and the overall residence behavior are interpreted in connection with each space's meaning.

This section aims to understand the correlation between traditional houses' spatial composition in China and the family structure. There is a sub-purpose to interpret the typical traditional housing of each country. The study's subject is set from the 17th to 18th centuries, which established the cultural value of each country. The study's scope is to Select traditional houses from the Ming-Qing Dynasty in China. The research data collection is based on each country's official publication date, and the typical type is selected by referring to the papers published by the ASC(Architectural Society of China).

The analysis method of the spatial composition of a house uses spatial syntax to derive the topological centrality of a specific space quantitatively. Classifying the spaces according to gender and status and using the T-test analysis method, one of the statistical verification methods, each space is judged for the difference in the integration value (i).

3.3.2 Family structure and housing spatial composition

In China, the family is the highest concept, and every individual's thoughts and behaviors are developed and evaluated to contribute to the interests of the family. Chinese homes are oriented towards a large family, and with a paternal line alliance structure for blood ties, only blood ties are recognized as family members. In China, the family is the "strategic center for an individual's social life" and is the "economic unit" and "religious unit" that combine production and consumption. Members of one's family thought of the ideal to pursue living in the same space as possible and form a large family.

China distributes property without discrimination between sibling age, legitimate children, and illegitimate children based on the principle of Equalized Inheritance. In the inheritance system, property rights are the main element, and the right to administer rituals is a secondary element.Even if the father dies and, if the assets are sufficient, the brothers live in the same house and form a family community. Equalized Inheritance can divide property,

but patriarchal rights and ancestral rites rights do not. In China, only the father's patriarchal rights are destroyed during the family division process, and new patriarchal rights are created. Therefore, the expansion of the Chinese family has a divisional cell form.When family expansion, in China, ancestors are divided into ancestral rites rights or are held together in one building, so unlike Korea, ancestral rights are not significant.

Space			Behavior (daily)	Behavior (non-daily)	Primary user	Sub-user	Gender	Floor type	Floor level
Nelyuan	Zhengfang	Zutang	reception, meal, family gathering	ritual ceremony	head of the household mother-in-law	relative, whole family	both	stone	Down
		Fang	sleeping, meal, body wash, excretion	-	head of the household mother-in-law	-	both	stone	Down
		Erfang	storage	-	head of the household mother-in-law	-	both	stone	Down
	Xixiangfang	Ting/Tang	reception, meal	-	oldest son's family	relative, visitor	both	stone	Down
		Fang	sleeping, meal, body wash, excretion	-	oldest son's family	-	both	stone	Down
		Erfang	storage	-	oldest son's family	-	both	stone	Down
	Dongxianfang	Ting/Tang	reception, meal	-	second son's family	relative, visitor	both	stone	Down
		Fang	sleeping, meal, body wash, excretion	-	second son's family	-	both	stone	Down
		Erfang	storage	-	second son's family	-	both	stone	Down
	Courtyard		circulation	funeral, wedding	head of the household	relative, visitor	both	earthen floor	Down
	Ting		reception	ritual ceremony	head of the household	relative, whole family visitor	male	stone	Down
Waiyuan	Daozuofang	servant room	sleeping, meal, body wash, excretion	-	servant	-	male	stone	Down
		Guest room	sleeping, meal, body wash, excretion	-	visitor	-	male	stone	Down
	Front yard		circulation	-	head of the household	relative, whole family visitor	남	earthen floor	Down
Disanjinyuan	Houzhaofang	Kitcnen	cooking, food preparation	-	servant	-	female	stone	Down
		servant room	sleeping, meal, body wash, excretion	-	servant	-	female	stone	Down
		Room	sleeping, meal, body wash, excretion	-	Demoiselle	-	female	stone	Down
	Backyard		circulation, rest	-	Demoiselle	servant	female	earthen floor	Down

Table 3.3 Family structure and spatial composition in China

Siheyuan in China is a representative type of Han Chinese housing and was constructed in various sizes and shapes. The space in the center of the main building has a higher concept than the space on the side, and the left facing the courtyard is higher than the right.

The building's center is used as a public space and left, and right are used as private spaces. In other words, "Ting" or "Tang," which is a public space, opens receptions, assemblies, and ritual acts, and is a higher concept than the private sector. Zutang is where the ancestors' spirit tablet is enshrined and a public space for families where family meals and meetings are held. Besides, the male's space is located in the front, and female space is located in the rear or a corner. The spatial hierarchy, according to the family structure, it is determined by depth and direction. The eldest of the family occupies Zhengfang on the north

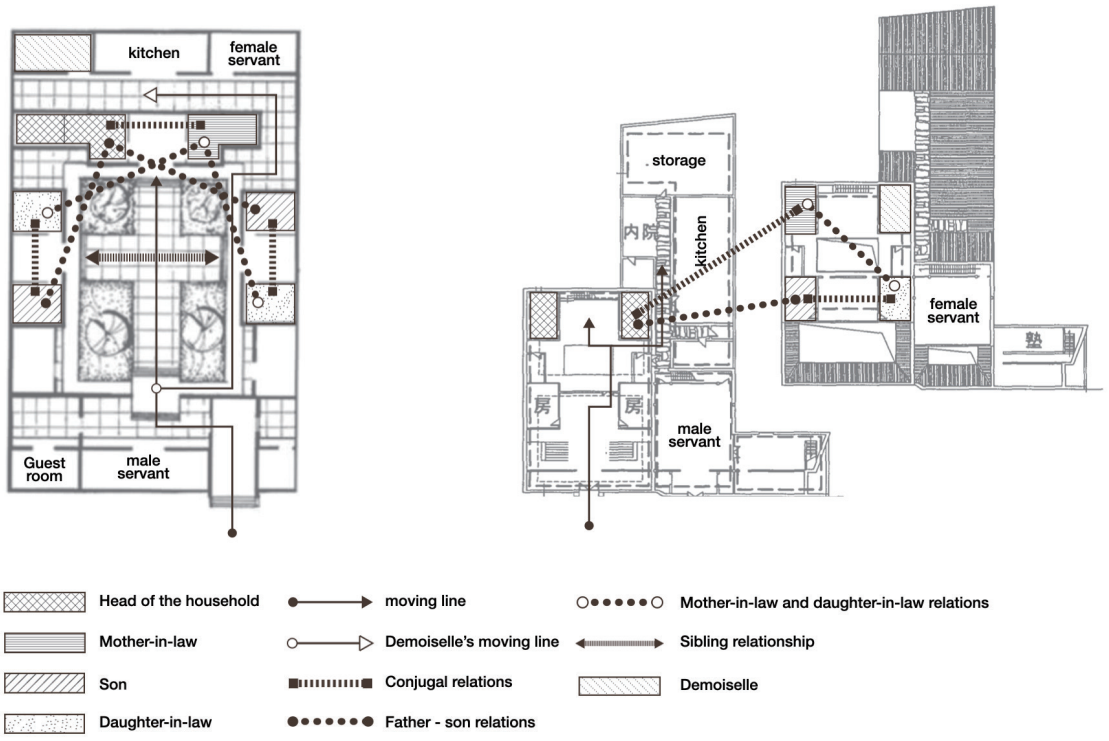


Figure 3.57 Family structure and spatial arrangement of traditional housing in China

side of the courtyard and lives in Xiangfang on the left and right according to age. Married children are separated on the left, unmarried children are on the right, and boys' rooms are on the left, and girls are on the right. There is also a hierarchy in the use of the courtyard. The first courtyard is a space for servants and space for guests to wait. The second courtyard is for the head of the household and the immediate family, and the backyard is for unmarried female children and female maids. According to the hierarchy, traditional Chinese houses are divided into space hierarchies to distinguish users and differ in size and height.

China is an extended family, and females have a relatively equal relationship with males. In the extended family system, since many households live together, the female group and the male group share the housework, and each household has an independent living space. The head of the household in China serves as the lead of family members, while homemakers manage the property. Compared to Korea and Japan, females have an active woman image, claim property rights, and have a status equal to a patriarch's rights. Therefore, the head of the household and housewives' has the characteristics of mutual checks, and the division of roles is autonomous and active.

China, which aims to be an extended family, seeks to have children grow up, live with parents, and have three generations and four generations live in one house. Several buildings

are built on one land, and a courtyard is placed in the center, and each building is an independent household. It can be judged that each household's privacy is respected and that it maintains an equal relationship. Unlike Korea, males and females have an equal position, and couples in each household live with respect for their privacy. This is because household independence and hierarchy are higher than the male and female hierarchy.

This section examines the socio-cultural family system and the spatial composition of houses in the Ming and Qing era. The previous section confirmed a clear spatial difference between the parent's generation and the child's generation in the Ming and Qing era family structure, and the living spaces are separated.

The high phase degree of a specific space in any spatial configuration means that space is at the topological center of the overall spatial configuration. It means that access from that space to all other spaces is easy.

Comparing the male's space and female's space					
Gender -1					
Variable		Males (n=110)	Females (n=96)	*t*-value	prob
Integration value	M SD	0.85373469 (0.045)	0.7701286 (0.018)	3.07	0.002
Gender -2					
Variable		Father (n=20)	Mother (n=14)	*t*-value	prob
Integration value	M SD	1.070254 (0.092)	0.9279609 (0.014)	2.56	0.018
Gender -3					
Variable		Eldest son (n=16)	Daughter-in-law (n=16)	*t*-value	prob
Integration value	M SD	0.823303695 (0.001)	0.8233037 (0.001)	0	1
Gender - 4					
Variable		Second oldest son (n=16)	Daughter-in-law (n=16)	*t*-value	prob
Integration value	M SD	0.8193995 (0.001)	0.8193995 (0.001)	0	1
Gender - 5					
Variable		Father (n=30)	Unmarried-Daughter (n=16)	*t*-value	prob
Integration value	M SD	1.094833106 (0.064)	0.6328678 (0.005)	8.59	0.000
Gender - 6					
Variable		Eldest son (n=16)	Unmarried-Daughter (n=16)	*t*-value	prob
Integration value	M SD	0.823303695 (0.001)	0.6328678 (0.005)	6.26	0.000
Gender - 7					
Variable		Second oldest son (n=16)	Unmarried-Daughter (n=16)	*t*-value	prob
Integration value	M SD	0.81939951 (0.001)	0.6328678 (0.005)	6.29	0.000

Table 3.4 Family structure and spatial arrangement of traditional housing in China - gender

Comparing the space according to status					
Status -1					
Variable		Parents (n=60)	Children (n=132)	*t*-value	prob
Integration value	M SD	1.0948331 (0.064)	0.9137644 (0.042)	3.71	0.000
Status -2					
Variable		Father (n=20)	Son (n=32)	*t*-value	prob
Integration value	M SD	1.070254 (0.092)	0.821352 (0.001)	2.57	0.029
Status -3					
Variable		Mother (n=14)	Unmarried-Daughter (n=16)	*t*-value	prob
Integration value	M SD	0.9279609 (0.014)	0.6328678 (0.005)	5.73	0.000
Status -3					
Variable		Mother (n=14)	Daughter-in-law (n=32)	*t*-value	prob
Integration value	M SD	0.9279609 (0.014)	0.821352 (0.001)	2.30	0.060
Status - 4					
Variable		Eldest son (n=58)	Second oldest son (n=58)	*t*-value	prob
Integration value	M SD	0.956690442 (0.035)	0.9483271 (0.034)	0.16	0.865
Status - 5					
Variable		family (n=192)	visitor (n=26)	*t*-value	prob
Integration value	M SD	0.96543445 (0.055)	0.845089981 (0.018)	2.45	0.025

Table 3.5 Family structure and spatial arrangement of traditional housing in China - status

As seen in the previous section, in the Siheyuan (Figures 3.49), the parent's generation space shows a relatively high integration value than the child's generation space. It means that the parent's space is more accessible from all spaces than the child's space and has a lower spatial depth.

To verify these results in detail, the average (T-test) is compared by extracting the Gender and status of each space. As a result, it was confirmed that the male space's average was higher than that of the female ($p<0.00$). The head of the household had a higher mean of the mother-in-law's integration value ($p<0.01$). This difference in space between men and women appears differently in children's generation ($p<1$). In other words, a topological difference could not be found between the couples of children's generation, and they are being connected equally. However, it is interesting to note that the unmarried-daughter space shows lower integration values than other male family spaces.

The results in terms of social status are very interesting. In the previous section, in the Ming and Qing era, Confucian thoughts had a significant influence, and there was a difference in social status between the parent and child generations. From a topological point of view,

there was a topological difference between the head of the household and the sons (p>0.00), and no difference was found between the mother-in-law and daughter-in-law and sons (p>0.16)(p>0.86). If the spatial hierarchy is organized based on the results above, the order of "the head of the household spaces > mother-in-law = daughter-in-law = sons" appears.

3.4 Conclusion : genotypical property of space

In this chapter, we have considered the transition process of South Korea's domestic space. The conclusion from the spatial-Behavior dimension is as follows; a) Fang has a private space in Chinese housing and has maintained that characteristic until apartment houses in the early 1930s. In standard design apartment houses, the principle of separating the traditional public-private realm has been broken, as all behaviors are concentrated in one bedroom. Since the 1970s, Ting (living room) has been introduced, and since the 1980s, the integrated value of bedrooms has recovered to the level of traditional housing. b) Ting is a space placed in the center of the house to accommodate various public behaviors such as family gatherings, meals, and receptions. This spatial composition has been maintained up to Lilong houses in the 1930s, and Western-style living rooms and dining rooms were proposed in Lilong apartments. Since 1980, a living room with a modern meaning has been established. As described in Tomokiyo's (1994) study, it is not easy to judge that Ting, which appeared after the 1960s, inherits the traditional Ting. However, it is important that the integration value of the space where public behavior occurs is maintained at a high level throughout the era. c) The kitchen space maintains a low integration value throughout the era regardless of the type of house. In other words, it can be interpreted that the kitchen in Chinese houses is spatially separated, and there is a strong tendency to separate it from the primary living sector. d) Traditional Chinese courtyard is a space for dividing the occupant's territory and lighting and ventilation. In the 1870s, the Lilong house has been connected to the front and back yards for space movement and ventilation, and since the 1930s, the courtyard's behavior has been inherited from the entrance and balcony.

In symbolic dimension, the territory distinction was leading the evolution of domestic space in China. Traditional Chinese houses had a structure that distinguished public-private spaces, which was found in early urban houses. Looking at the spatial composition of apartment houses after the opening of China, in the process of increasing the number and area of rooms, Menting or tings were placed between the entrance and each bedroom to form a

public space. Besides, in houses since the 1990s, it was confirmed that each bedroom's integration value decreased. This phenomenon can be interpreted as a result of the spatial principle of arranging independent living spaces found in traditional Chinese courtyard houses and private spaces that can be accessed through public spaces.

The transformation process of the domestic code described in this chapter is to show that it is not simply the changing arrangement of rooms but the interaction between the space and its activities within the domestic field that can precisely define the new space, and there is an indigenous concept of territory-distinction that was actively involved in this process. Guided by these underlying forces, the evolution of the housing in China has followed certain topological paths to adapt the old genotypical properties to the new physical environment, and the user's reaction described above shows that these values do persist through the formal changes.

Chapter 4

Evolution of Domestic Space in Japan : diachronic space syntax analysis

4.1 Housing in Japna

4.1.1 Traditional house(~1868)
4.1.2 Middle-class housing(1868~1940s)
4.1.3 Hosing standards in public sector (1951~1970s)
4.1.4 The concept of "Omote" and "Ura," "Mae" and "Oku" in Japan

4.2 Evolution of Domestic Space in Japan

4.2.1 Introduction : from the old and new
4.2.2 Traditional code and its transfer to the early houses
4.2.3 Topological paths in evolution
4.2.4 “Mae - Oku” and “Omote - Ura” as underlying force in evolution

4.3 Respect of Spatial Structure on Gender and status

4.3.1 Introduce
4.3.2 Family structure and housing spatial composition

4.4 Conclusion : genotypicial property of space

4.1 Housing in Japna

4.1.1 Traditional house(~1868)

Japan has a unique history amongst Eastern Countries, having never being conquered as a nation. Furthermore, it is isolated from Mainland Asia, and it is selective importing of foreign ideas, and technology has to lead to a unique culture on the island archipelago. It is the first influences coming from Mainland China by way of Korea, then from Industrializing Europe after its seclusion period, and most recently from the Americas during its occupation.

Japan is an archipelago of islands on the pacific coast of Asia. It is bordered on the west by the Sea of Japan and on the east by the North Pacific Ocean. The archipelago consists of thousands of islands, the largest of which are Hokkaido, Honshu, Shikoku, and Kyushu. These Islands lay east of the Korean Peninsula, with Kyushu neighboring South Korea and Hokkaido neighboring Far East Russia. The country lies between 24-46 degrees north latitude and 123-146 degrees east longitude. Due to the archipelago's strato-volcanic nature, 72% of the islands are mountainous, with its highest point being Mount Fuji at 3,776m. The population is hence concentrated on the remaining coastal plains and intermontane basins. The landmass of Japan is said to be 364, 485km2.

Pre ***Heian*** [平安] Period Japan, japanese civilization is said to have started when the cultivation of grain, rice in particular in the ***Yayoi*** [弥生] period. The labor-intensive nature of rice agriculture, especially in a country with little beasts of burden necessitated a large workforce, bringing families together to form communities, villages and eventually states. As such the farming of rice was and to this day still is a very important part of Japanese life and society. However, Japan as a nation (with a central government), didn’t start until the Asuka period (590-710). Before this, the nation was merely a loosely connected series of settlements. During the Asuka Period, the Yamato Government conglomerated power in the ***Kinki*** [近畿] area creating a central court and attempted to and succeeded in bringing rival states under its control. The Yamato emperor became the head of the county and he along with his court ruled his people creating the basis for the country to now call Japan. Japanese culture and government was then a mixture of primarily Chinese and Korean principles and elements. However, these were all adjusted and appropriated to the climate and temperament of the Japanese archipelago and its people. These principles were furthermore mixed with

local traditions to create a culture that was distinctly Japanese.

Since then Japanese life, society, and culture became deeper and more distinct. The emperor and the imperial family became wealthier as he extended his domain to the north and south. The Imperial family built large and handsome capital cities in Nara and then Hiei (present-day Kyoto). These cities were well planned with grid systems and blocks and large ornate palaces for the emperor and his court. Japanese society, philosophy, and culture flowered. Architecture also flourished as temples and the elite begin to patronize famous craftsmen who developed ornate styles suitable to the high-class.

The most powerful of the medieval warriors patterned their homes and many of their customs after those of the descendants of the Heian-period aristocrats, who had lost actual ruling power but still commanded enormous prestige because of their distinguished history and culture attainments. These higt-level ***samurai*** [武士] adopted the Shinden style for their own mansions, including the added garden complex. But the Shinden style itself began to change in the medieval period. One major development was toward spacial division according to function, with more fixed partitions between public and private spaces in the main hall and more separate structures built for different purposes. One important new building that appeared particularly frequently in the homes of the nobility was the ***kaisho*** **[会所]**, literally "meeting place," for audiences and entertainments with guests.(H. Mack Horton 1985, 70)

The pair of screens introduced earlier showing the Gion Festival depict in a different section the manor of the ***Hosokawa*** [細川] family, one of the powerful deputies of the ***Ashikaga shogun*** [足利幕府] (figure 4.1).

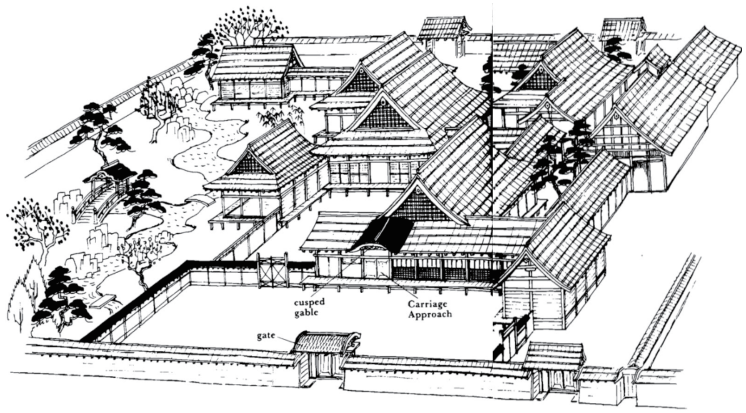
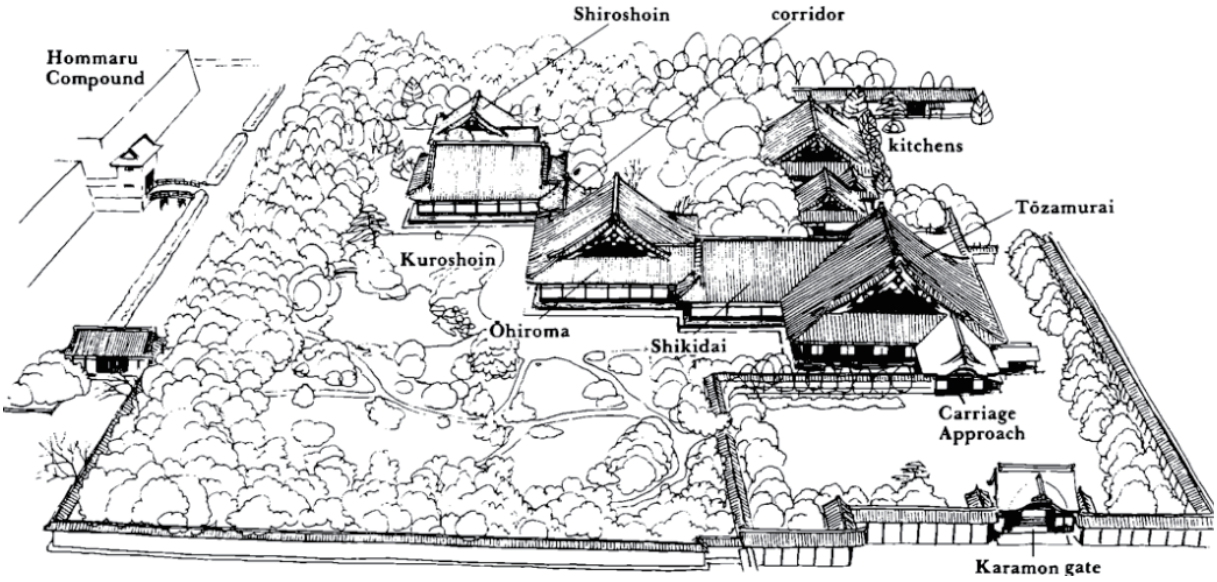


Figure 4.1 Mansion of the Hosokawa family in Kyoto

(from H. Mack Horton 1985, 70)

The constituent structures are arranged on a diagonal in the northeast of the compound, and a garden with a stream occupies the southwest. One approached the complex from the south through a gate, then entered the residence itself via the Carriage Approach (***Kurumay-ose*** [車寄せ]), here covered with a dark roof fit with a cusped gable (***kara-hafu*** [唐破風]).

The Ninomaru Palace of ***Nijo*** [二条] Castle(figure 4.2), also in the Heian Capital, has the same general placement of buildings as the Hosokawa Mansion. The castle was built from 1601 to 1603, and the ***Ninomaru*** [二の丸] Palace is thought to have been added from 1624



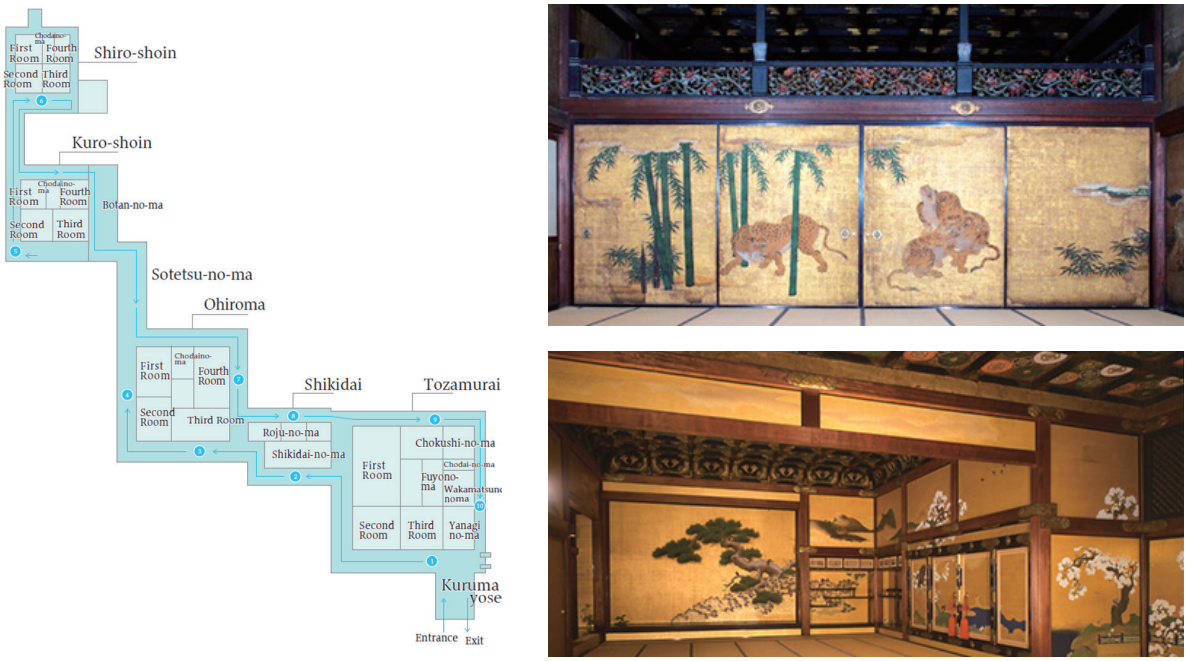


Figure 4.2 Ninomaru Palace of Nijo castle in Koyoto

(from H. Mack Horton 1985, 71; World Heritage Site Former Imperial Villa Nijo-jo Castle Website)

to 1626 by the third ***Tokugawa shogun*** [徳川将軍], Iemitsu, in preparation for an imperial progress by Emperor ***Gomizunoo*** [後水尾]. Originally roofs of the Ninomaru Palace were not of tile but cedar bark, which would have made it resemble the Hosokawa Mansion even more strongly. Its various buildings are divided according to purpose, with, from the bottom right, the Carriage Approach for entering the complex, the ***Tozamurai*** [遠侍] for samurai retainers, the ***Shikidai*** [式台] for initial reception of guests, the ***Ohiroma*** [大広間] for formal audiences, the ***Kuro-shoin*** [黒書院] for more private interviews and daily business, and finally, just visible at the back, the Shiro-shoin [白書院] for the master's personal use. The kitchens, directly to the north behind the Yozamurai, are extant as well, as is the pond to the southwest.

Due to their Neo Confucianist values, the Tokugawa government tried not to involve themselves too much in the economy. However, in order to sustain their prominence (and arguably also to make sure they didn't spend money on military power), the Samurai were implored to live in and maintain one or more residences of a sort that was befitting of their status. They were supposed to be a learned class, and as such were discouraged from farming or craftwork and especially trade, However, this economic system where an entire class lived lavishly off the backs of the others wasn't economically feasible.

The Shogunate eventually had to reduce the stipend of the samurai below them eventually forcing many of the lower samurai to turn to agriculture and craftwork in order to make ends meet. Protocol and accord were important in the samurai class and even in the smallest of homes, a ***Shoin*** [書院] style ***Zashiki*** [座敷] was important. This space was the study of the samurai, the place of the head of the household and where guests were met. It is strongly associated with the head of the household and typically only he would on an everyday basis inhabit this space, studying and conducting business.

The process of entry of an important visitor would be through a gateway (also necessary by sumptuary law) to the ***Genkan*** [玄関] (formal entrance) and into the Zashiki. Depending on the wealth and status of the samurai there may be antechambers between the Zashiki and the Genkan. The Genkan was reserved for formal occasions. If the samurai was important then this formula was scaled up with larger gates and more rooms and possibly several zashiki. The Zashiki generally was the best room and overlooked an ornamental garden. However, even the samurai foot soldier would have a Genkan and Zashiki of some sort. The earth floored section of the samurai house was rather small. The family spent their days in the lower rooms of the house and would use a separate entry. (Figure 4.3)

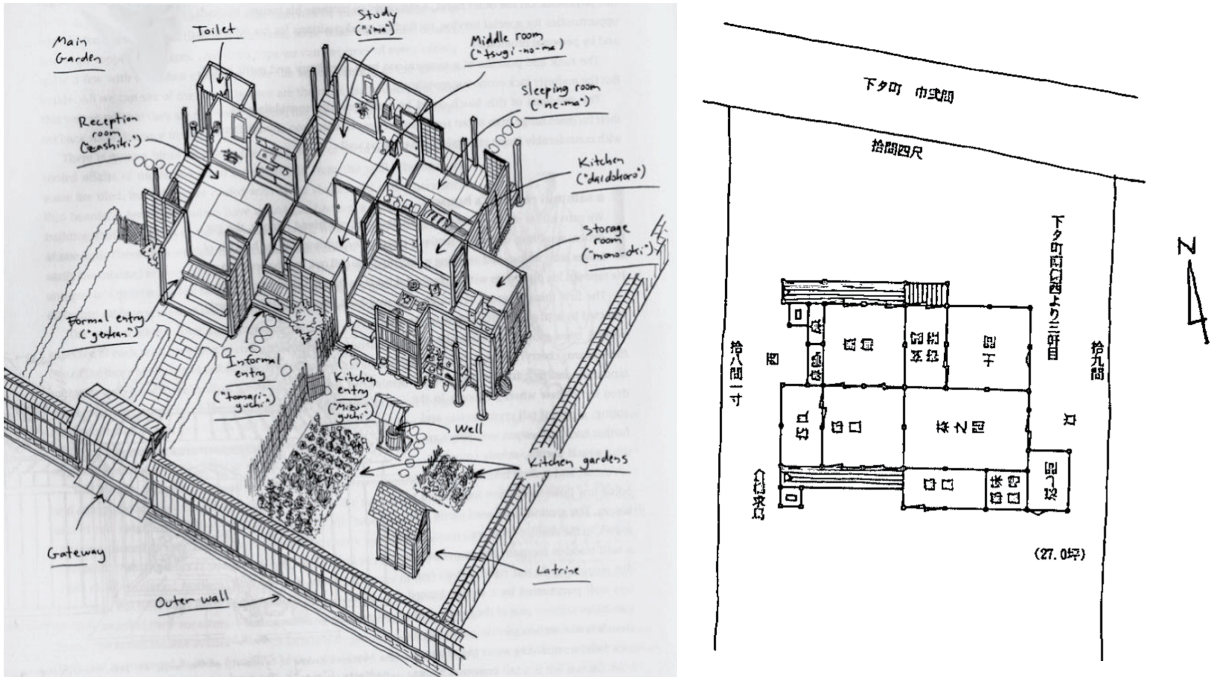


Figure 4.3 Typical lower-middle class Samurai house and Edo late samurai housing ***Takato Domain*** [高遠藩]

(from Brown, 2009, 77 ; Ooka and Aoki 1994, 38)

In contrast, There was also a ***Minka*** [民家] for the general people. The term Minka, literally meaning “houses of the people,” covers a great variety of residential types, from the great houses of village headmen and rich merchants to the huts of the poorest farmers. In the context of the four divisions of society, Minka was the dwellings of farmers, artisans, and merchants (i.e., the three non-samurai castes). This connotation no longer exists in the modern Japanese language, and any traditional Japanese-style residence of appropriate age could be referred to as Minka. Minka is characterized by its basic structure, its roof structure, and its roof shape. Minka developed through history with distinctive styles emerging in the Edo period. It even applies to the houses of Shinto priests and the lower levels of the warrior and even courtly hierarchies; in short, to all houses not belonging to the members of the very highest social strata in premodern Japan.

The types of Minka are as diverse as their owners, and most have been renovated or enlarged following the changing needs and incomes of successive generations of inhabitants. Most of the very old Minka that still survive belonged to village headmen or other wealthy commoners, which makes it difficult to generalize about Minka as a whole. Undoubtedly this large Minka formed a relatively small percentage of the total. Those owned by village headmen began to incorporate Shoin-style elements as the Edo period wore on, particularly in the sitting rooms (zashiki) where representatives of the shogun’s government were received. But the use of these high-class accouterments was limited, in theory at least, by sumptuary

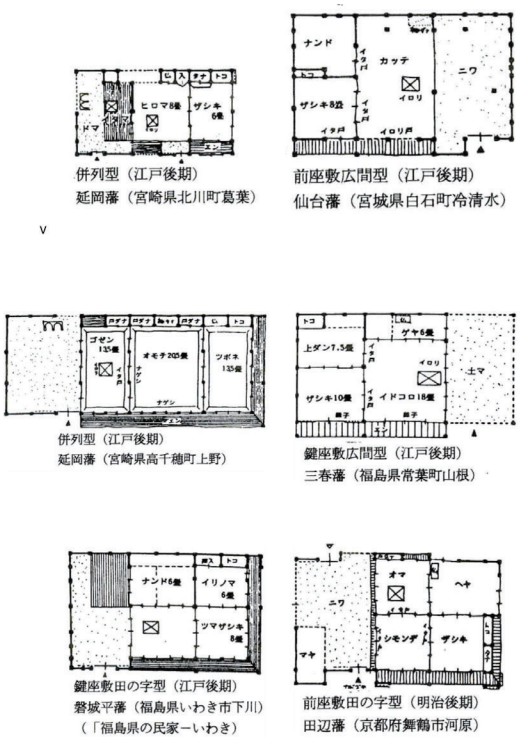


Figure 4.4 Typical plan of Edo era and Meiji period Noka (from AIJ 1989, 177)

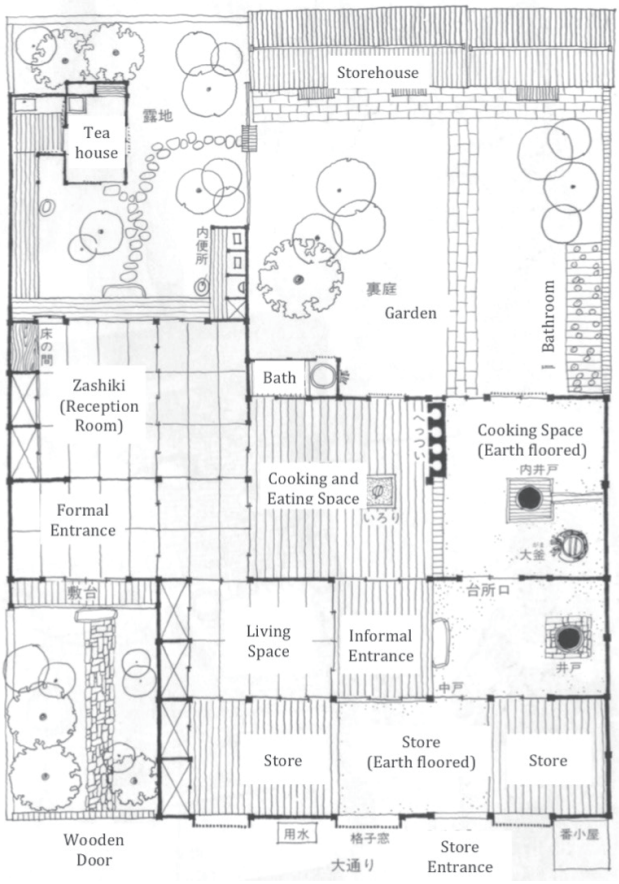


Figure 4.5 Typical Edo era Machiya (from Inaba, Nakayama 2000, 62)

laws designed to preserve rigid class distinctions. Minka comes in a wide range of styles and sizes, largely as a result of differing geographic and climatic conditions as well as the lifestyle of the inhabitants. They generally fall into one of four classifications: farmhouses ***Noka*** [農家] townhouses ***Machiya*** [町屋], fishermen's dwellings ***Gyoka*** [漁家] and mountain dwellings ***Sanka*** [山家].(JAANUS. Retrieved 2013-11-09.)

The ***Machiya*** [町家] was distinctive as it was a house that had to receive guests regularly. It was both extraordinarily public and private. Machiya is a traditional wooden townhouse found throughout Japan and typified in the historical capital of Kyoto. Machiya (townhouses) and Noka (farm dwellings) (figure 4.4) constitute the two categories of Japanese vernacular architecture known as Minka (folk dwellings). Machiya originated as early as the Heian period and continued to develop through to the ***Edo*** [江戸] period and even into the Meiji period. Machiya housed urban merchants and craftsmen, and a class collectively referred to as ***Chonin*** [町人] (townspeople). Therefore there was a need to maximize street frontage for the business but also create private spaces (figure 4.5).

As such, they were generally long and narrow in character. The store takes up most of the frontage of the house and, in most cases, would take all the frontage on the main street. The living areas were behind this. The merchants though considered to be the lowest caste, had a lot of material wealth, and some acclimatized themselves to the customs of the upper castes. Furthermore, some indeed had to entertain samurai, and it wasn't unheard of for wealthy merchants to lend money to samurai, which made them even more distasteful to the samurai. As such, their houses have a lower earth floored section for everyday living, and then the spaces for entertaining were away from these earth floored areas towards the rear of the house. Defying the sumptuary laws, wealthy merchants had Zashiki which were hidden in the back of the house or on second floors away from the hustle-bustle of the store, the street and the daily life of the family.

4.1.2 Middle-class housing [中流住宅](1868~1940s)

Japan in the ***Meiji*** [明治] period has undergone many changes in modernization, beginning with civil servants, new classes (salaried workers, 俸給生活者) have appeared such as teachers, soldiers, and bank workers. This social class established its position in the late Meiji 20s(1947), and most of these social classes were ***Shizoku*** (warrior families, [士族]) (Aoki 1983, 85). During the process of modernization, the number of salaried workers increased rapidly, and dormitory and enlisted housing or independent households were constructed for them. As such, work was separated from the house, making their lifestyles utterly different from the farmers and merchants.

The Japanese post-war economic miracle brought the prominence of this class to the pinnacle of society. Japan became divided into an upper class of business executives and high-status public servants and a lower class of workmen and daily laborers. We see a shift in the composition of the middle class from disbanded samurai and successful merchants to white color employed salarymen. At the same time as all this is occurring, we see the appearance of the "Interior corridor house [中廊下型住宅]," the "Central living house [居間中心型住宅]" and the "Apartment house" typologies. (Kobayashi 2010, 34)

The origins of the modern Japanese house are in the houses of the lower-middle class samurai (figure 4.6) (Aoki 1983, 85; 1986, 14, Ooka 1999, 120, Suzuki 1988, 31, Kobayashi 2010, 44). Since the Meiji period, the principle of spatial composition of housing that sep-

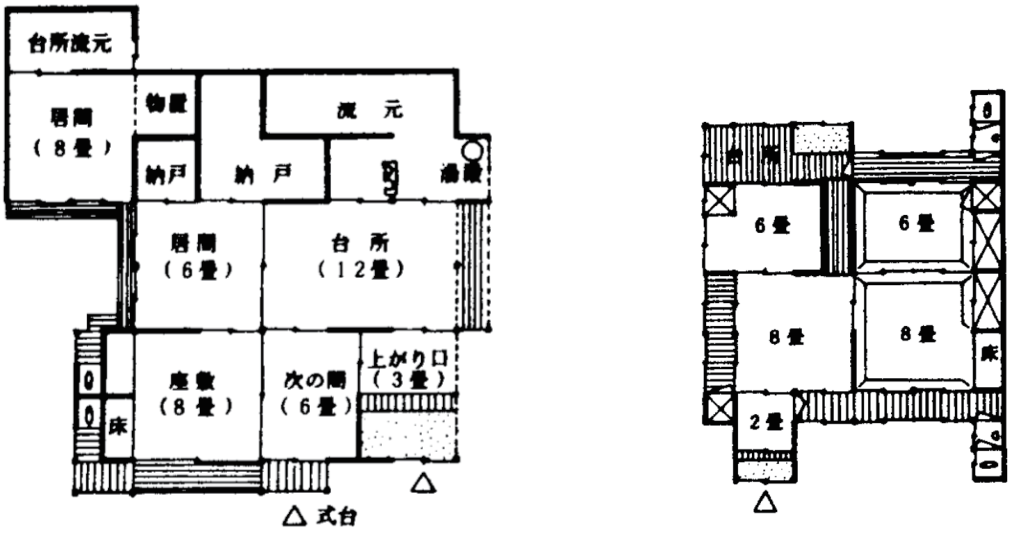


Figure 4.6 Typical lower-middle class Samurai house (a) and middle-class house in Morioka city, 1886 (b)

(from Aoki 1986, 14 ; AIJ 1989, 177)

arates the reception sector and family life sector is not limited to samurai housing but has also been applied in a farmhouse. It was as their homes were separate from their working place. Further, the Meiji government instituted the "***Ie*** [家]" based "***Kahuchousei*** [家父長制]" (patriarchy) for all homes, which was modeled on the samurai family.

This came from the traditional Samurai "Ie" of the Tokugawa period in which the father was responsible for all the rights and responsibilities of the family as a whole (not the individuals), and this position was inherited by the first son. In the merchant class, there was a more democratic succession of the family (sometimes even to a daughter) to ensure the sustainability of the family business. In the farming family, the entire family was important as laborers included women who had their own roles and responsibilities. In craftsmen, status was based on ability and, as such, succession was to who had the most capacity. Therefore in the initiation of the "Kahuchousei" (Paternal Household System), the Meiji government took the rules of the Samurai class and spread it nationwide.

The middle-class house consist mainly of two types of sector : ***Zashiki*** [座敷系] and ***Chanoma*** [茶の間系]. Zashiki sector is composition with Zashiki Installed a ***Tokonoma*** (床の間) - ***Tsuginoma*** [次の間], It is a space ready for reception. Chanoma sector is a living space inside the family that includes a bedroom, centered on Chanoma, which supports family dining and living, and is a space area by a servant space that includes a toilet and a female maid's [女中室] room. Before the Meiji era, the principle of house spatial composition existed with a distinct distinction between Zashiki and Chanoma sectors.The behavior taking place in each sector were completed within the space, and did not invade each other's territory.

For example, figure 3.47(a) is typical lower-middle class Samurai house, the visitor's circulation is separated from the family's circulation. Visitors climb to the Genkan (Main entrance, [玄関]) and head to Zashiki through Tsuginoma, Families use the sub entrance (***Doma***, [土間] and enter Chanoma. Besides, two toilets are provided, and the behavior in each sector is completed without invasion of other territories. After the Meiji period, when examining the plan of middle-class houses, many types of plans with overlapping areas appeared. That is, a change occurred in which the Zashiki sector and the Chanoma sector were fused. In the process of modernization, middle-class housing has changed according to the times. Still, the demand for family living space has increased, and the independence of the Chanoma space has been emphasized as the needs change (Aoki 1983, 89).

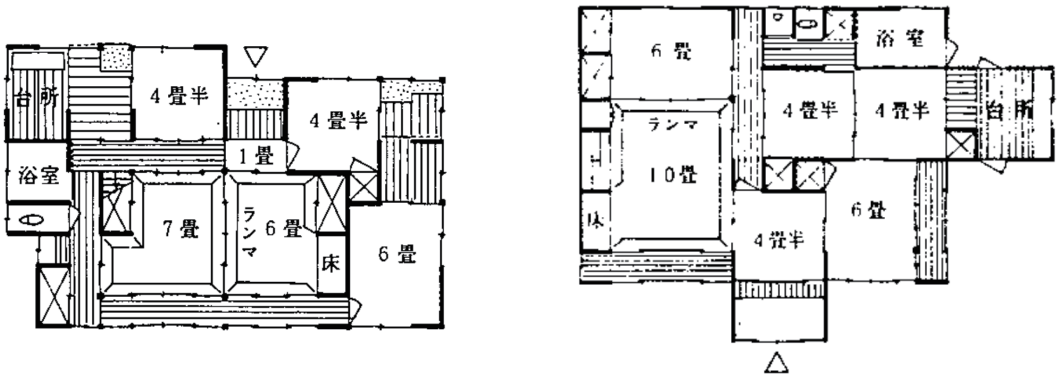


Figure 4.7 Typical Interior corridor house (left : North entering horizontal type, right : South entry vertical type) (from Aoki 1986, 91 ; 94)

The characteristics of Interior corridor house that appeared from the ***Taisho*** [大正] era through the ***Showa*** [昭和] era have evolved to solve these contradictions in life. Visitors, families, and female maids were treated as corridors to prevent intrusions into each other's territory (figure 4.7). There are two possible causes of this type of housing. First of all, the problem of moving along the toilet and bathroom. The former house had separate toilets for visitors and families. These toilets were reduced to one, mostly in the Zashiki sectors. This configuration makes it difficult for families to use the toilets when a visitor comes. Second, it is a matter of movement for the service of female maids. Female maids' activities take place in most of the homes, such as Zashiki, kitchen, and Chanoma. There are fewer problems during the daytime when family members go out, but problems occur only during family time after dinner.

The movement of a female maid who passes through the Chanoma, increases the tension of family activities. Due to the above two reasons, it can be presumed that Interior corridor house have appeared, and that corridors have been introduced into the houses.

In Japanese modern housing history, a central living house has been proposed as opposed to a Interior corridor house (Suzuki and Oka and Kirihara 2008, 143). In Japan, the right to democracy became recognized and became widespread in the economic boom of the Taisho democracy. There were great strides in gender equality as Western culture infiltrated Japan. At this time, we also see intellectuals returning from the west, claiming the need for Individualized rooms. Their chant was “from guest based to family-based”. Along with this, they started designing and building houses composed of living rooms and individualized rooms.

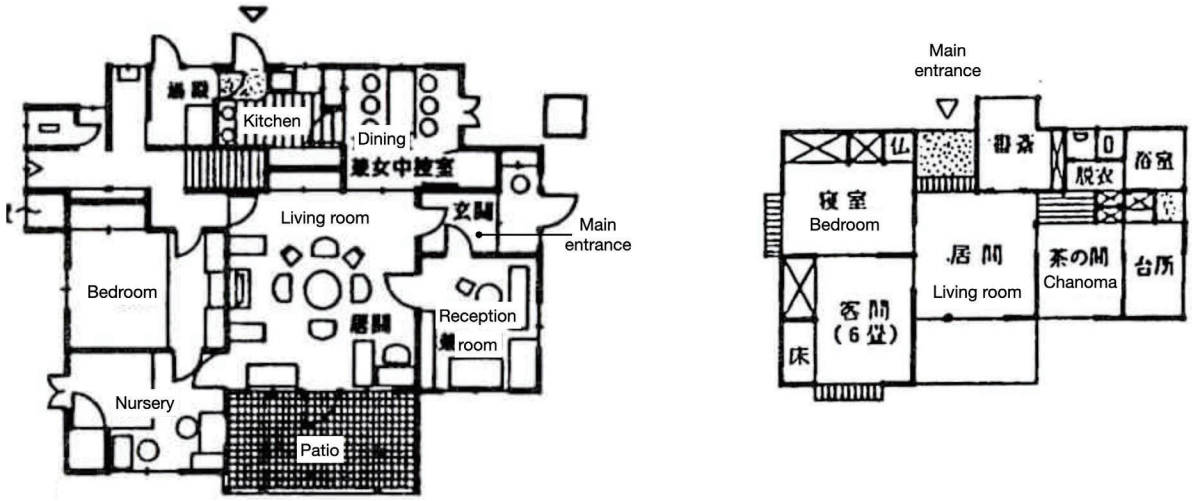


Figure 4.8 Exhibited Housing in Culture Village, 1922 and Central living house, 1926

(from AIJ 1989, 184; Serizawa 1926, 7)

The company at the lead of this was called “***Americaya*** [アメリカ屋],”; a company that designed and built with the American house as ideal. Also, the appearance of ***Jutaku*** (housing, [住宅]) magazine helped to push this trend. At this time the following design became a famous example of the housing improvement movement. This was from a housing exposition in Tokyo in Taisho 11 (1922) in which the architects of the time showed what they considered the ideal house. The Housing improvement themes of the exhibition were along the lines of “spreading chair living” (as opposed to sitting on the tatami floor in traditional homes), Family-based living (the importance of the privacy of women and children, a place for the Family to gather) and so on. In Living Centered Housing, the living room was placed in the south of the house, where sunlight was the best; there was a separate room for children, the entire house was chair-based & western style. Overall this house exhibited the theme of the exhibition well (figure 4.8).

At first, this type of housing was a luxury and did not become widely popular. In comparison to the Interior Corridor house, which was a descendant of samurai housing, the Living Cen-

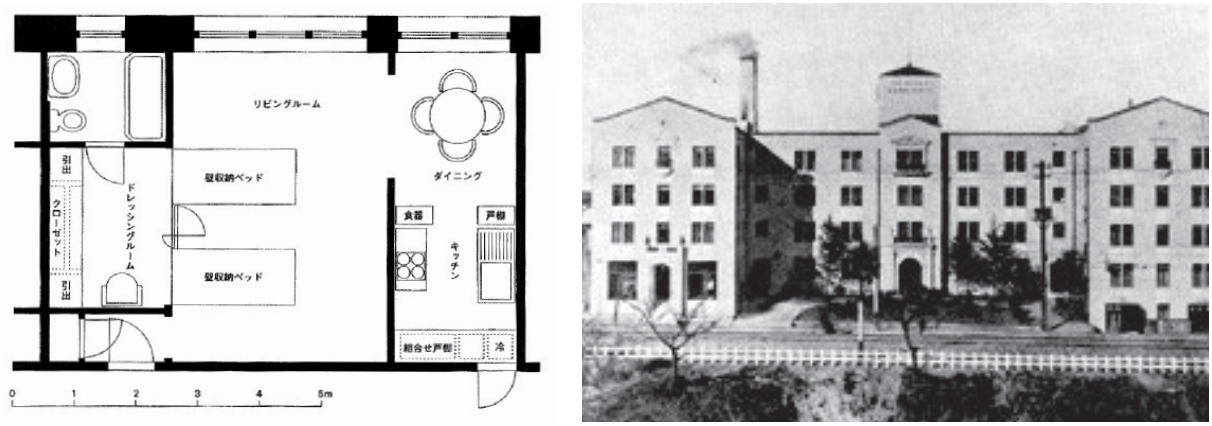


Figure 4.9 Ochanomizu Bunka Apartments and 3-bed type plan, 1925

(from MADORI Catalog 2001)

tered House seemed too much like the western-based proposal of an architect. The living and individualized rooms of this type of housing would not become widespread until the economic boom after the Second World War.

Intellectuals coming from America brought another theme back with them, this was to make stone apartment buildings the standard. This gained importance as a response to the Great Kanto Earthquake and the devastating resulting fire. The government based *Dojunkai* [同潤会] was formed and built 2,500 concrete apartment units in an effort to improve housing and fire resistance. However, even before this a citizen based group created the first real apartment building; the 1925 *Ochanomizu Bunka* [お茶の水文化] Apartments (figure 4.9).

At the time the cost of building in concrete was four times that of wood so the rent was very high. It was one room 8 *jo* [畳] (tatami mats) in size and had no kitchen but a month's rent was the same as that of the starting salary of a university graduate at the time (80 yen). The interiors were westernized entirely, and intellectuals returning from the US, parliamentarians, foreigners, and so on lived there. However, as stated by Morimoto Atsuyoshi (professor of law), "considering that there were no maintenance fees, it was actually rather cheap." This is as there was no yard cleaning fee, no need for maids, or heating fees.

Architects with wealthy patrons designed the houses shown in magazines and expositions. As such, they always had maid's rooms. However, as stated by Aoki (1983, 92) this did not reflect the reality of the populace. The average middle-class Interior Corridor house was built by someone who was not a trained architect for a family who could only dream of having a maid. Even within the middle class, we saw significant differences in wealth. As such, for the lower middle class, there was a need for a house that would reduce housework or make it

more efficient (as at the time, cooking and washing was a great deal of manual labor). On the first floor of the Ochanomizu Bunka Apartments were a fully staffed party hall, restaurant, and laundry services. This meant that by the pooling of resources, the inhabitants could have these luxuries for cheaper. This significantly reduced their housework without the need for a maid. In this way, the disappearance of the maid is one of the reasons why apartments became popular. This movement to reduce the workload of the wife will continue to post a pacific war in the dining kitchen.

4.1.3 Hosing standards in public sector (1951~1970s)

The Pacific war pushed the general recognition of the new urban housing movement. In the war, the widespread destruction of housing allowed for housing redevelopment, starting with the lower classes. During the war, the working class's economic structure was dealt a devastating blow, so what led the housing modernization movement was government-provided public rental apartment buildings. Japan Housing Corporation was founded in 1955 in order to develop housing land and provide housing systematically in urban areas. With the objective of housing supply, this corporation also made efforts to improve housing living environment-high and medium-rise building, fireproof, and study of floor plans designed for rationalization of household matters such as improved kitchen facilities and introduction of guarantee of 4-hour sunshine.

The prefabricated housing components play a significant role when the development of light gauge steel structure and dry board panels (named new building materials "shin-ken-zai") contributed to standardization and mass production. Newly developed building materials and construction methods helped initiated movements to review housing (sound insulation, heat insulation, and fireproof). The government made efforts for standardization and created the Industrialized Housing Performance Certification System in 1973(Housing Divison 1988). After the oil crisis in 1973, Japan Housing Corporation was incorporated into Housing and Urban Development Corporation. With diversifying and high-level needs of consumers, the priority of housing policy shifted from "quantity to quality'. The outstanding program was two basic housing standards - the Minimum Housing Standard and Average Housing Standard - designed to upgrade housing quality on the housing size. Systems of standard designing for collective housing were also developed to accommodate various plans, not the former standardized planning of the precast concrete panel construction method alone.

In the late 1970s and early 1980s, the mass housing supplied during the previous decade was criticized as expensive, inconveniently located, and small. Within the context of efforts to add the new appeal of homes, various new design policies/trends were presented, quality, and diversity (small-lot production of diverse products). The sophistication of design, custom-made design per housing block, per building, per unit, integrated private and public vehicular flows, the formation of valuable corporate assets, etc., demonstrating that the decade was an era of transition form standards designs to diversification. As a result, the development of unique and appealing housing complexes such as townhouses, densely mid-rise buildings, etc. became famous in this period (UR Agencies 2007).

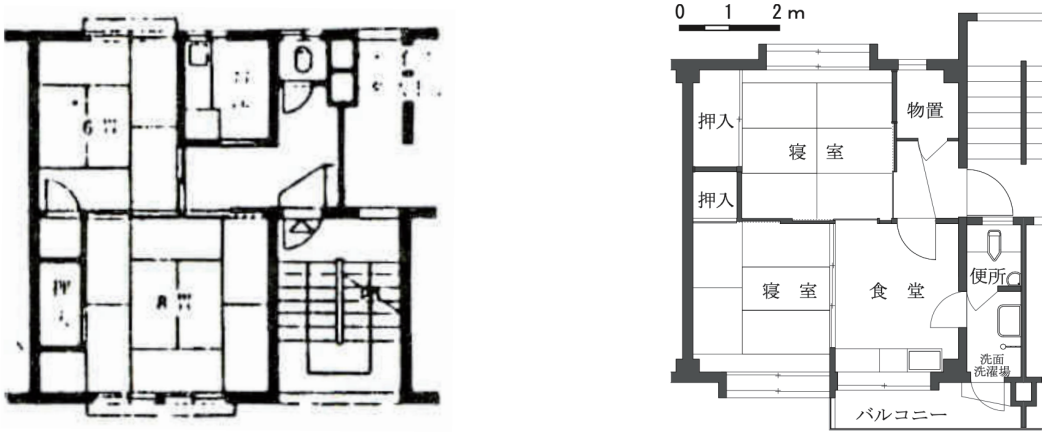


Figure 4.10 First public housing in Tokyo, 1947 and housing standard type 51C, 1951

(from AIJ 1989, 190)

In 1951, the Publicly Operated Housing Law was enforced to established the legal system for publicly operated housing - housing constructed by the local government with government subsidies. In 1951, the Publicly Operated Housing Law was enforced to established the legal system for publicly operated housing - housing constructed by the local government with government subsidies. This mass supply of public housing is using diffused technology of medium-rise fireproof apartment houses and DK (Dining Kitchen) floor plans called 51C-type (35.3m^2) (figure 4.10).

The 51 standing for 1951 and C, meaning it was the third of 3 standard designs. It was the smallest of the three, built for the poorest classes. However, this small housing unit, which was not even 40 square meters, would greatly impact Japanese housing henceforth, according to Suzuki Fumihiko, who was involved in the development of 51C.

At the time in what was called the Housing Research Group, Nishiyama Umitsu proposed a similar plan that would consider the "separation of sleep and meals" (the separation of

the spaces for sleeping and eating). Moreover, "segregated sleeping" (the separation of the sleeping spaces for parents and children) provides each of these functions in separate rooms of the same size. It was using these ideas the floor plan 51C was created. This proposal was a kitchen where meals can be taken hereafter referred to as the modern Dining Kitchen (DK).

It is not well known but what was really important in 51 C was to provide two rooms and dining and kitchen functions within a small area. If they had three rooms in addition to the kitchen, one would be a dining room, one the child's bedroom, and one the parent's bedroom, achieving the separation of meals and sleep and segregated sleeping. In actuality, the 51 A and B types did not have a dining kitchen.

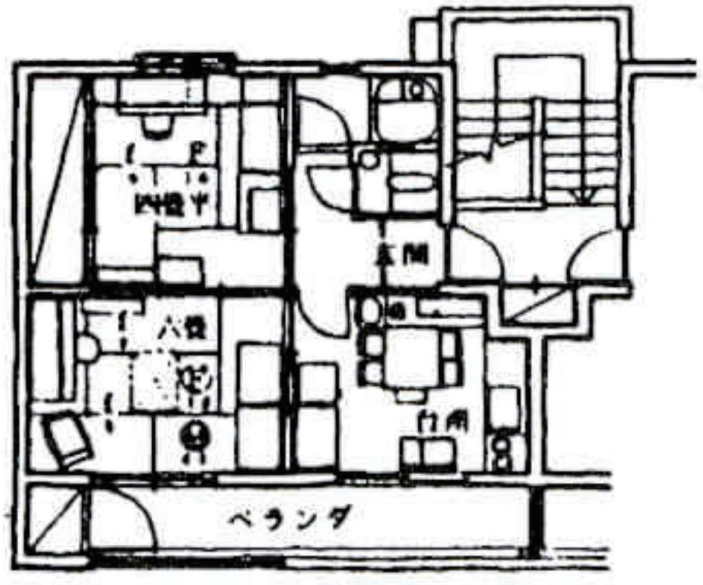


Figure 4.11 Housing Corporation Rental Housing 2DK in Tokyo, 1959

(from AIJ 1989, 191)

However, at the time, poverty would not allow such luxury. The only way to fit a housing unit into less than 40 square meters was to make the kitchen large enough to include the dining table. This was the well-thought-out background of proposal C. Furthermore, the other rooms' dimensions were also cutback. It brought forth the small "Danchi [団地] size" apartment unit. This floor plan was launched in the Public housing Agency's 2DK (two rooms and a dining Kitchen) floor plan.00 Through the Public Housing Agency design section, it claims they did not know about 51 C and that the 2DK was the natural succession coming from the realities of the dormitories for civil servants and public housing.

In 1955 the Public Housing Agency was established. It was to relieve the post-war housing

shortage. In addition to this, the government created a Housing Trust to provide funds to support housing creation by the general public. However, this leads to high rent. So as a strategy to lower rent, the Dining Kitchen was created. It was a way to get around the size of the housing. The Public Housing Agency finished the room with a stainless steel sink and made it a space for tables and chairs, modernizing it. The dining room merger with the kitchen soon became known as the Dining Kitchen and was shortened to DK (figure 4.11).

At the time, a stainless steel sink was a luxury; to make them cheaper, the Housing Agency pushed for their mass production sprouting factories in small towns, lowering their cost to a quarter of the original price, making the stainless sink a standard in modern housing. To make “Chair-style living” a standard, the apartments were rented with tables and chairs. However, these would disappear when renters moved, to the point where they had to be fixed to the floor. It shows how pleased the residents were with this progress in modernization. The Dining Kitchen made the housewife much easier.

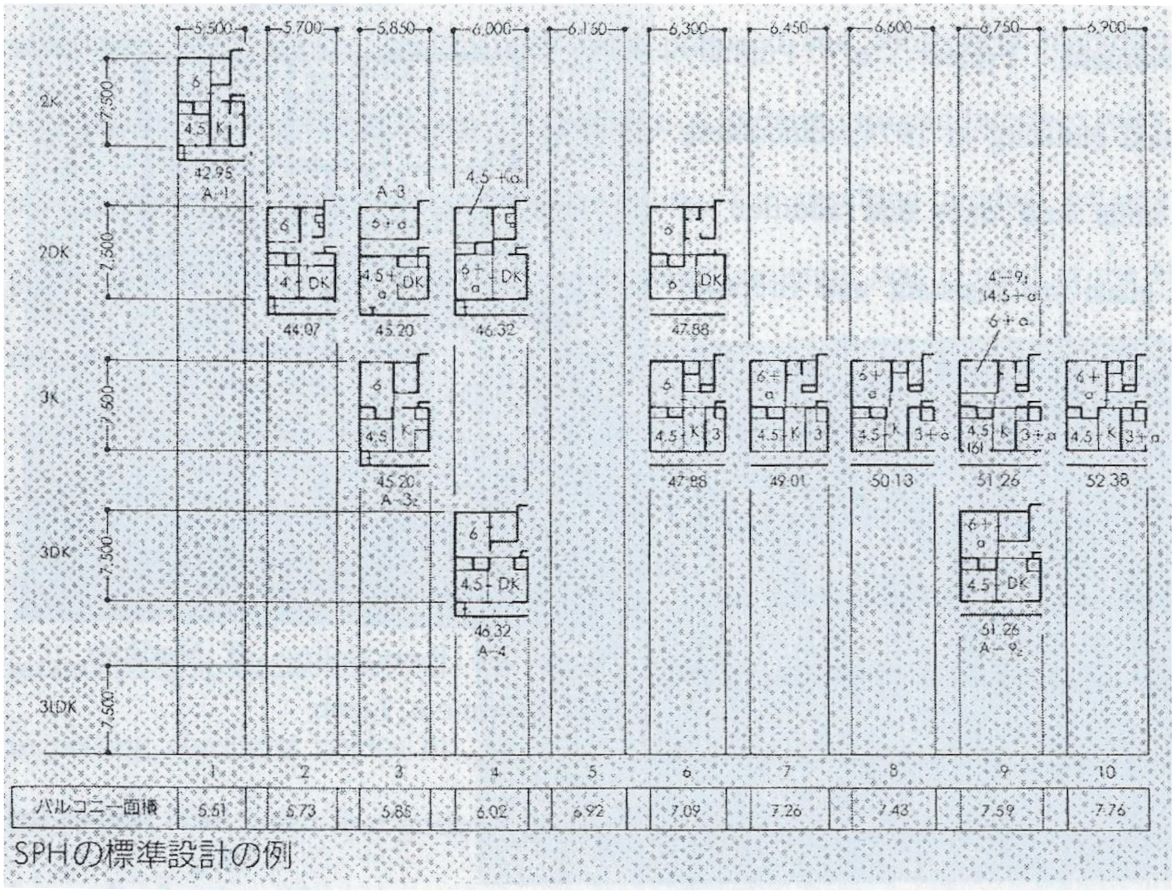


Figure 4.12 Standard of Public Housing Systematic Plan

(from Housing Division 1988)

The DK was favorably placed in a south-facing room, which led to the three great appliances, the television, the washing machine, and the refrigerator was placed there. The Dining Kitchen became the aspiration of the housewife of the time. These apartments were such popular applicants were presently unimaginable tens and hundreds of times more than the supply of apartments.

The post-war housing improvement themes of “chair-style living,” moving the living area to the south side of the home, and reducing housework were realized. As housing got bigger, we began to see 3DK and 4DK being built. After the foundation of JHC, publicly operated housing assumed the role of providing housing for low-income earners. The JHC also planned mass components, such as steel door and steel sashes. In 1960 industrialization of housing is promoted while the private sector-led technological development. Later in 1969, this law is with its emphasis on the product, rationalizations, SHP (Standard of Public Housing) could not satisfy consumers' demand. The Ministry of Construction created two systems designed to develop housing components by the private sector. Then in Inhe ‘Fine Quality Housing Parts (Better Living parts) Certification System’ was founded. Under the system, the Minister of Construction designated parts developed by private firms as ‘Better Living parts in terms of design, performance, and supply systems (figure 4.12).

Centre for Better Living, an independent organization chartered by the Ministry of Construction, has supported the development of building components such as cladding systems, mechanical systems, interior components such as bathrooms, and fixtures and finishes. In order to meet the changing and diversifying need of consumers, it becomes all the more important to improve production and supply systems featuring free revised with a view to the rebuilding of old public housing, full use of land, the closeness of house and workplaces, and improvement of a living environment. The initial collective housing using concrete block (CB) and reinforced concrete (RC) technology also become outworn with poor facilities. Under the Improvement Project of Publicly Operated Housing in 1974, remodeling (two units into one) and addition of these quasi-fire resistant and fireproof housing were carried out with government subsidies.

After the more flexible system was introduced in 1976, the construction of the Excellent Model Housing Complex is implemented to upgrade designing, promotion of wooden publicly operated housing units using the local timber for their revitalization of the regional economy construction of housing for the area. Until new, remodeling and rebuilding of worn-out existing are continuing.

4.1.4 The concept of "Omote" and "Ura," "Mae" and "Oku"

In the samurai housing, the principle of specific spatial composition existed in the Edo period. The space for reception was placed prior to the family living space, and there was no space for individuals. So the spaces cannot be divided into individual and family spaces; instead, they can be understood using the divisions of the principle of “Hare” (bright) and “Ke” (shade), “Omote” (front) and “Ura” (back), “Shallow” and “deep.” This comes from the notion that the family and the home were not static as it would have different appearances and uses dependent on when it was being used is the idea behind “Hare” (brightness) and “Ke” (shade). Hare is related to the bright clothing worn on special occasions, and Ke is the return to daily life. If Ke continues for too long, the community becomes too dark, so bright activities (such as a festival) occur within the community to reset the space and atmosphere. For samurai, one of these bright activities was the visit of someone important.At the time, it was widespread to do excellent cleaning or Ikebana to welcome a guest. In this way, at a funeral, new years, or festival, the house was refreshed. In this continuous circle of Hare and Ke, daily life was continually reset and refreshed. It’s important to understand that “Hare” and “Ke” only refers to a change in the mode of the space with time and not a permanent mode of space. For example, now the zashiki has become the sleeping space of the grandparents, so it must be used traditionally also for Ke activities. So it is essential to look at the physical principles of the space, not just the time-based principles. These are “Omote” and “Ura”, Shallowness and Depth.

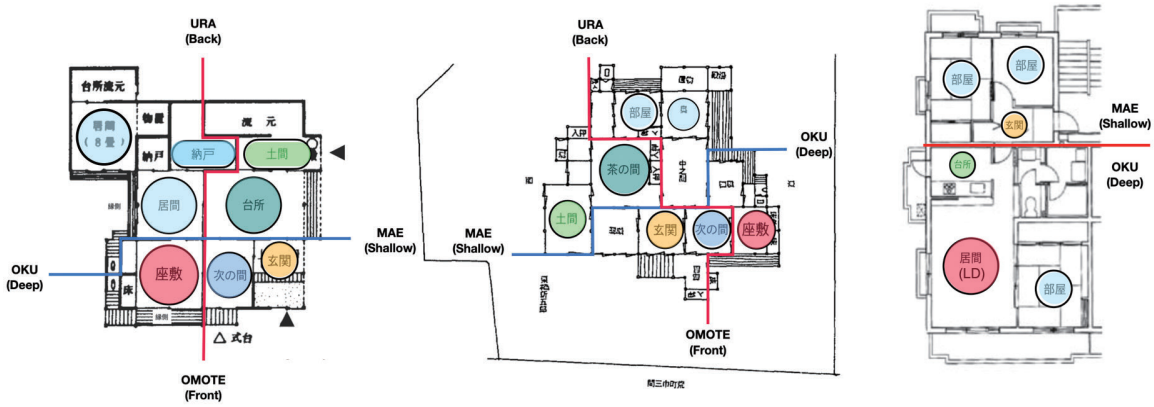


Figure 4.13 The concept of "Omote - Ura," and "Mae - Oku"

(left plan: reproduced from Aoki 1986, 14, middle: reproduced from Ooka and Aoki 1994, 40, right plan: reproduced from Housing and Urban Development Corporation 2000, 82)

4.2 Evolution of Domestic Space in Japan

4.2.1 Introduction : from the old and new

From the Second World War to the present, Japanese housing has undergone many changes due to urbanization, structural changes in families, and changes in construction technology and lifestyle. Before World War II, Japan's population was mostly rural, and rural housing was mainstream. However, this study aims to examine the transition process of urban housing, and even before the war, the research focuses on urban housing. Urban housing in Japan differs according to class and region. Machiya (町屋), where more traditional elements remain, and commercial residential buildings that have been transformed after the modern era are still widely distributed.

However, these types of houses are on a path of decline as the period of high economic growth passes. Meanwhile, there are middle-class houses derived from Samurai houses in the residence-only housing domain, and among them, interior corridor-type houses are representative (Suzuki 1988, 31). After World War II, Japan began supplying housing in the public sector, and supply to the private sector increased rapidly after 1970. In general, it is divided into three periods. Period 1 is a postwar revival (1945~1955), period 2 is high economic growth (1955-1972), and period 3 is low growth (1973~new) (Suzuki 1994, 9).

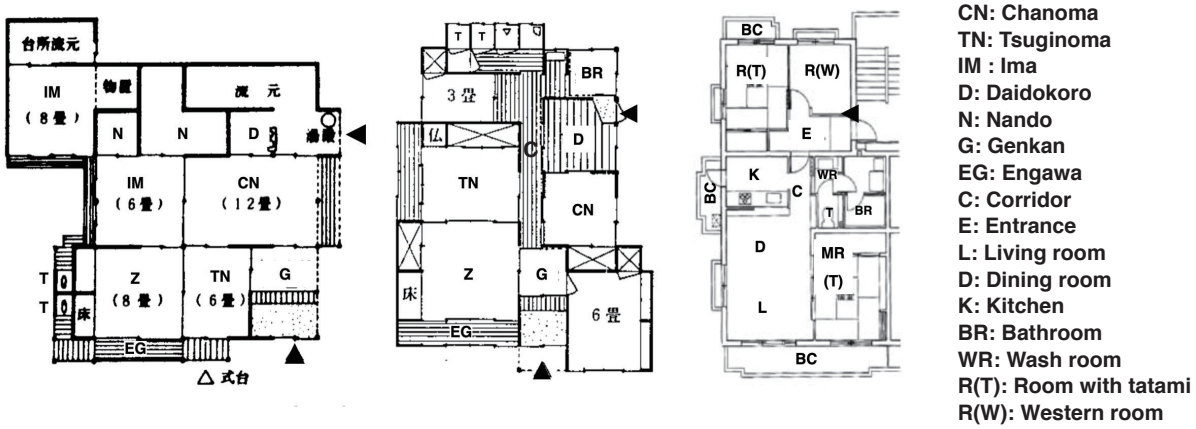
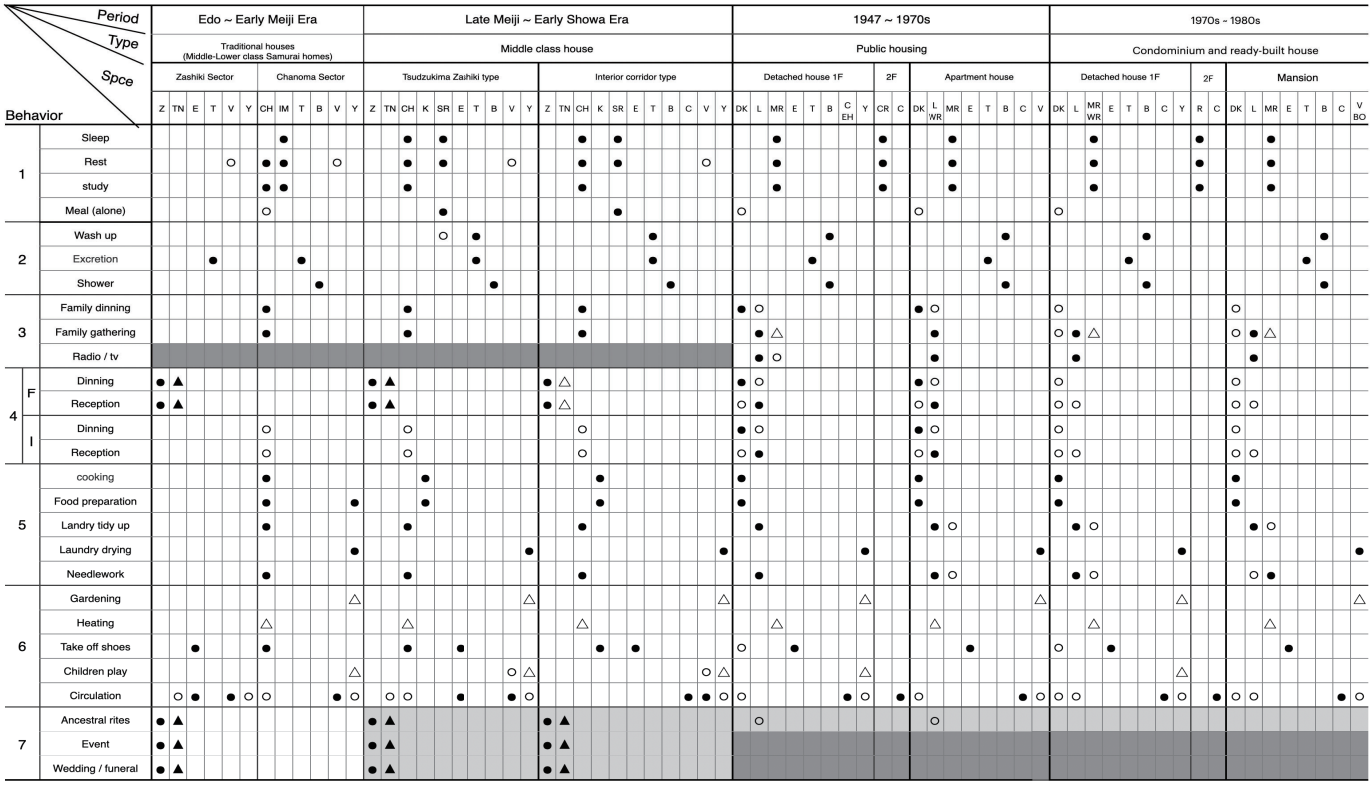


Figure 4.14 Middle class samurai houses in edo period and Inner corridor type houses in 1933, and Universal 88-5N-3LDK type apartment houses in 1988
(left plan: from Aoki 1986, 14, middle: Aoki 1983, 34, right plan: from Housing and Urban Development Corporation 2000, 82)



1: Personal behavior, 2: Hygiene behavior, 3: Family behavior, 4: Reception, 5: Housework, 6: Service, 7: Non-everyday life behavior, F: Formal, I: Informal.

Z: Zashiki, TN: Tsuginoma, CN: Chanoma(Daidokoro), V: Veranda (Engwa), HY(B): bedroom IM: Bedroom(Ima), SR: Servant's room, E : Entrance(Genkan), T :Toliet B: Bathroom K: Kitchen(Daidokoro) , C: corridor WR: Tatami room

●: Main behavior, ○ : Sub behavior, △ : Seasonal behavior ▲ : Temporary behavior,

Table 4.1 The transition of resident's Behaviours in Japan

The characteristics of each period are as follows. During the postwar revival period, many housing complexes were built to solve the problem of housing supply in large cities. The RC-structured multi-family housing began in earnest in the public domain, and the Japan Housing Corporation's standard housing design was applied. The standard design was a solution to supply a large number of houses while maintaining a certain level of housing quality across the country. In order to lead the modernization, it also possessed the character of the textbook of modern life. During the period of rapid growth, the city's concentration in the city was accelerated due to economic growth, and the problem of urban housing was intensified. In 1955, the establishment of the Japan Housing Corporation and standard designs became the driving force to construct a large-scale housing complex. The house plan inherited the standard design and established dwelling units such as nK type or nDK type as a "type system." From the late 1960s, urban redevelopment projects were actively promoted, and high-rise houses, internal corridor units, and prominent buildings with north and south axes were primarily adopted. Besides, since the mid-1960s, awareness of housing industrialization has increased, and the SPH (Standard for Pubilc Housing) system has been developed. During the period of low growth, the housing environment's quality was improved based on stable economic growth. The project was converted to small-scale development, and the scale of the low-rise building and the format to support a variety of living were changed. In order to meet various dwelling needs, we tried to develop units targeting locality and various classes. In 1975, the New Planning System (NPS), which can support the diversity of life while reflecting on the rigid standard design, was launched in 1975. In other words, since the late 1970s, Japanese urban apartment complexes have changed in response to various needs, and it has become difficult to define as a typical plan. On the surface, morphologically, those three types are entirely different, From figure 4.f4, one can see the samuri house, which is inward-looking, has now turned into the self-contained modern apartment house, which is outward-looking. What has been changed is not only the overall form. Some spaces like the Zashiki have disappeared, and some have emerged; those multi-functional rooms like Ima and Chanoma of old house have been endowed with new names, main bedroom and living room, due to their more specialized functions in the modern period (figure 4.14). The same analysis method as in Chapter 4.1 Korea is applied. The " Behavior-space" interactions; how the behaviors om each partition space are preserved, migrate, and finally re-group to form new spatial frameworks. Based on previous studies, functional spaces were classified according to residents' behavior, from traditional Samurai houses in the Edo era to apartments in the public sector in the 1980s. Residents' behaviors were divided into seven categories: personal behavior, hygiene behavior, family behavior, reception, housekeeping, service behavior, and non-daily behavior(table 4.1).

4.2.2 Traditional code and its transfer to the early houses

Traditional Japanese culture was created through the long ***Buke***(武家) period, and Buke's history spans 800 years. Look at Buke's history; it was a sort of vigilante consisting of landowners and peasants. Several manor house groups were united to create a nationwide power structure based on each land. Assuming this as a class, this class was the actual class of leaders in Japan until the Meiji era, and it affected a ruler.

The Edo period's samurai controlled the organization with strict formalities and complex positions, ranging from the ***Daimyo*** to the samurai servants of the lower classes in the upper class. Class means qualification, and privileges and authority have changed according to class. In the Edo period, the machiya where ordinary people lived and the samurai residence where samurai lived were separated, and samurai were not allowed to live in machiya. The higher the class, the closer the house was to the palace, and the samurai built houses on land designated by the clan's owner and changed their location and size to build houses according to their status. The size of the land is determined by status, and there are many restrictions, such as the size of the dwelling or the composition of the genkan.

There were no interior corridors, and wooden doors, and fusuma sliding doors separated rooms. As such, voices would carry throughout the house, and people would pass from room to room to room. The rooms were not individualized. The most walled and deepest room, the Nema or Nando, could be said to be the couple's sleeping room, but the reality is it was used more for their nighttime activities; keeping and changing clothes; giving birth; housing the sick. Though it was a segregated room, it cannot be strictly called the master bedroom. This house type did not correspond to the individualized rooms for individual use and the modern house's family-based living areas. Looking at the samurai family through territoriality, we see that the family members had rank, and the family was a hierarchical collective. Only the father had his room, as what was important was the unity of the group, and there was no importance placed on the space of the wife or children.

So the spaces cannot be divided into individual and family spaces; instead, they can be understood using the divisions of the principle of "Hare" (bright) and "Ke" (shade), "Omote" (front) and "Ura" (back), "Shallow" and "deep." This comes from the notion that the family and the home were not static as it would have different appearances and uses dependent on when it was being used is the idea behind "Hare" (brightness) and "Ke" (shade). Hare is

related to the bright clothing worn on special occasions, and Ke is the return to daily life. If Ke continues for too long, the community becomes too dark, so bright activities (such as a festival) occur within the community to reset the space and atmosphere. For samurai, one of these bright activities was the visit of someone important. At the time, it was widespread to do excellent cleaning or Ikebana to welcome a guest. In this way, at a funeral, new years, or festival, the house was refreshed. In this continuous circle of Hare and Ke, daily life was continually reset and refreshed. It's important to understand that "Hare" and "Ke" only refers to a change in the mode of the space with time and not a permanent mode of space. For example, now the zashiki has become the sleeping space of the grandparents, so it must be used traditionally also for Ke activities. So it is essential to look at the physical principles of the space, not just the time-based principles. These are "Omote" and "Ura", Shallowness and Depth (figure 4.15).

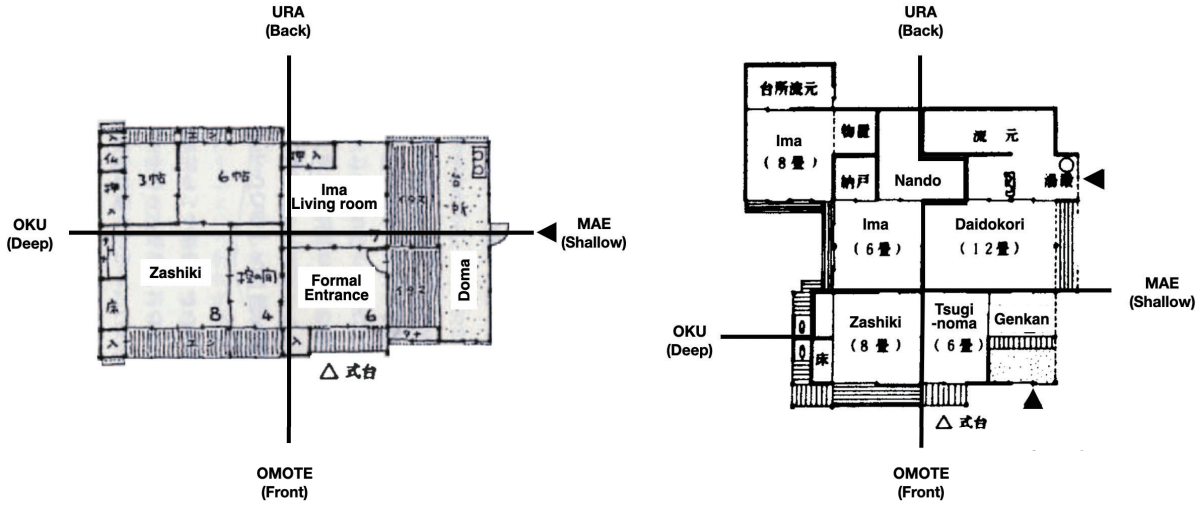


Figure 4.15 Omote and Ura, Mae and Oku

(left plan: reproduced from Kobayasi 2010, right plan: reproduced from Aoki 1986, 14)

The diagram linking the six spaces, Genkan, Tsuginoma, Zashiki and Daidokoro, Chanoma, Ima, can epitomise the spatial characteristics as well as the topology of these spaces. Besides, two sub-spaces be linkined to the main space, engawa and toilets are located in each area of Omote and Ura. The three spaces at the top are the family life sector, and the character of the space is defined according to entering the outside. The Doma or Daidokoro is a low-level ground floor with a function of cooking at the same time as the entrance to the family. Chanoma is the family's main living space and is the space where most activities occur inside the house, such as dining, rest, housework, and circulation. Heya and Nando have the character of a family bedroom. However, as previously stated, Traditional Japanese houses do not have individual rooms, and families sleep together. The three spaces lo-

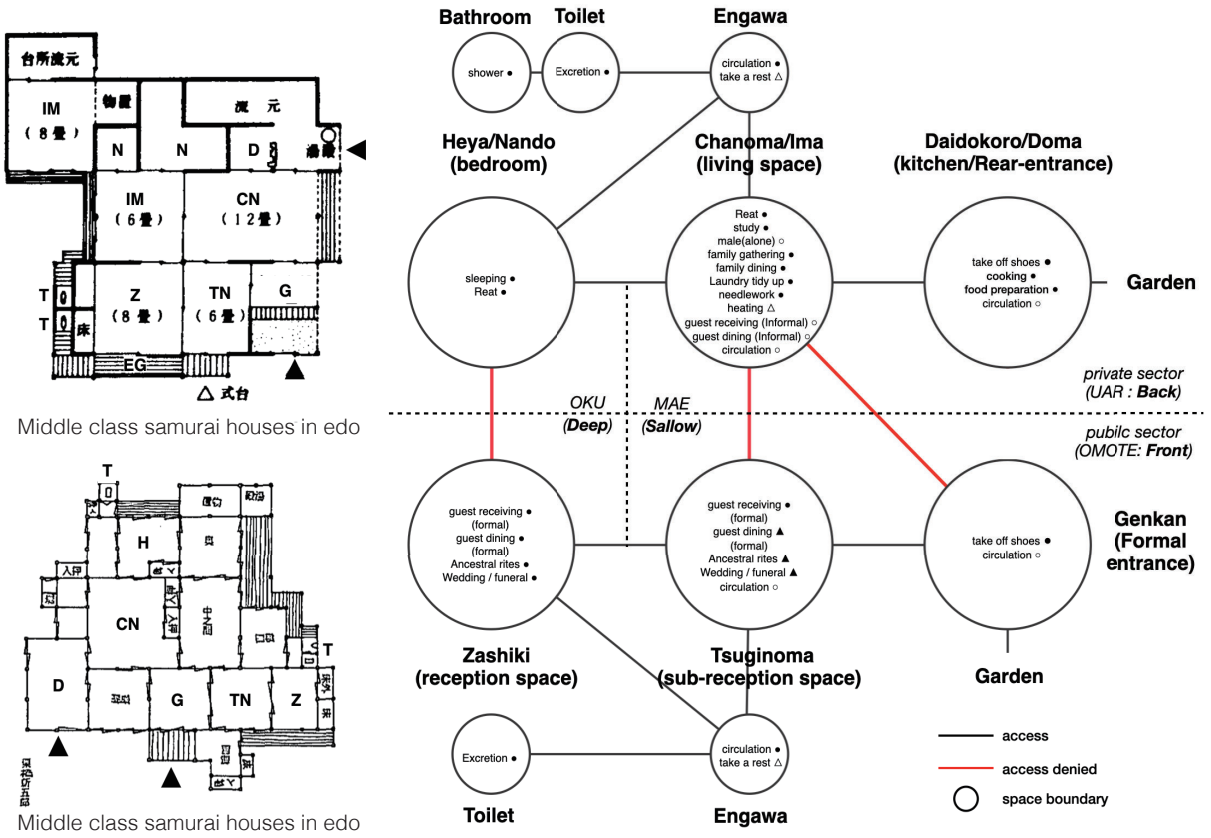


Figure 4.16 Traditional domestic code < 0 >

cated at the bottom have the essential meaning in samurai housing. The Zashiki is the most formal in the house and is used organically with the Tsuginoma. Following the strict reception method, the method of use varies depending on the relationship of status, the number of people, and the formall event's characteristic. If the guest's class is lower than the owner, the guest reaches Tsuginoma through the entrance and waits. If the guest's class is higher than the owner, the guest enters the entrance-Tsuginoma-Zashiki, and the owner enters to Tsuginoma.(Aoki 1983, 88-89).

The top and bottom spaces are physically linked, but they do not invade each other's space in principle. Besides, the space that makes this difference more pronounced is the bathroom. Restrooms are placed in each area to ensure separation of the family space and reception space, and fundamentally preventing them from reaching each other (figure 4.46). In other words, Japanese samurai housing has a physical circulation structure. However, in terms of recognizing and using space, it has a tree structure similar to traditional Chinese and Korean houses.

The modernization of Japanese housing began in earnest as it entered the Meiji era. In the

Meiji late 20s, a new class (white-collar workers) was established: civil servants, soldiers, and teachers. For this class, dormitories and employee houses or rental houses were built in large quantities, and houses were also built for independent household houses. Most of the new classes were of samurai descent, and their homes expressed their high social status with regular main gates and formal entrance. This perception has extended to not only urban housing but also rural housing. The main gate and the formal entrance were fixed in people's perception as symbolic spaces representing social status. From the Meiji period to the Taisho period and the early Showa period, middle-class housing was established and formed based on these social customs(Aoki 1983, 85).

Aoki(1983; 1984; 1985) theorized that the Interior corridor type housing plan developed out of the Zashiki direct entry type housing plan. As mentioned above, the Zashiki and Tsushinoma functions are clearly defined by the reception method. However, in the modernization period, the reception processes were simplified, and most of the reception activities took place in Zashiki. The meaning of Tsuginoma was lost in the reception method. In other words, Tsuginoma has a two-sided characteristic that supports flexible reception and family living spaces. However, in unexpected situations such as the case of an unscheduled reception, the unstable living space served as a factor in raising the family's tension. In the modern era, residents recognized the irrationality of the composition of Tsudzukiai zashiki (zashiki-tsuginoma structure) and inevitably had to change the form. Tsuginoma has also changed the multifunctional sector that simultaneously supports large numbers of guests and space for family living. A Zashiki direct entry type plan appeared to complete this residential configuration, which connects the zashiki directly from the entrance.

The Zashiki direct entry type inherits five spaces from the main six spaces of a samurai housing. The location of Tsuginoma is exchanged for the existing Heya, and it exists as a buffer zone between the Omote sector and the Ura sector. However, the separation between Omote and Ura is still maintained. The entrance is used as a space for formal receptions, and it is common for families to enter and exit Daidoko. However, when the reception event occurs, the restroom is located in the Zashiki area, restricting families' movement. As a result, the spatial depth of the Omote sector has physically decreased. However, conceptually it inherits the spatial composition of the previous era. Although family structure changes and receptions were simplified in modernization, reception methods still exist strongly in people's consciousness (figure 4.17). Tadao Aoki theorized that the Inner corridor type plan developed out of the Zashiki direct entry type plan. The principal reasoning for this is developing a separate route to the bathroom for guests from the family spaces

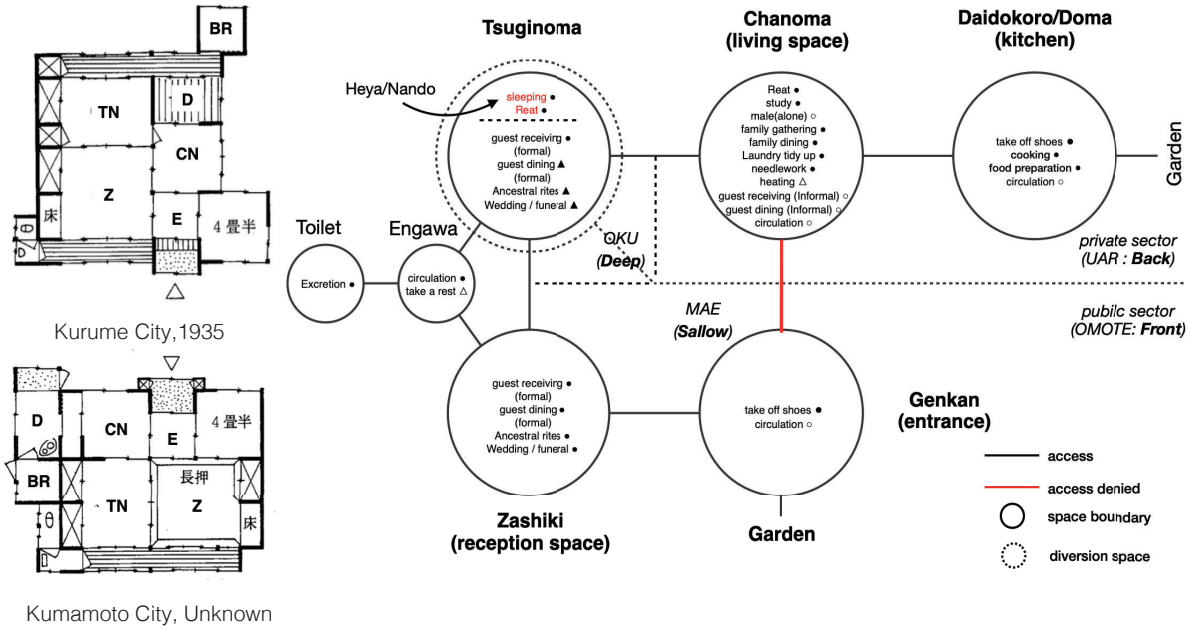


Figure 4.17 Zashiki direct-entry type and domestic code < 1 >

and the separation of the maid's quarters from the family quarters. Looking at the last step Interior Corridor type plan, the zashiki is located close to the entrance (figure 4.18). The corridor eliminated the need to go from room to room as such, destroying the need for shallow and depth principles. However, the main issue from the principle of Shallowness and Depth is eliminating the previously established hierarchy in receiving guests in the home as the Salaryman assumes the highest status in society.

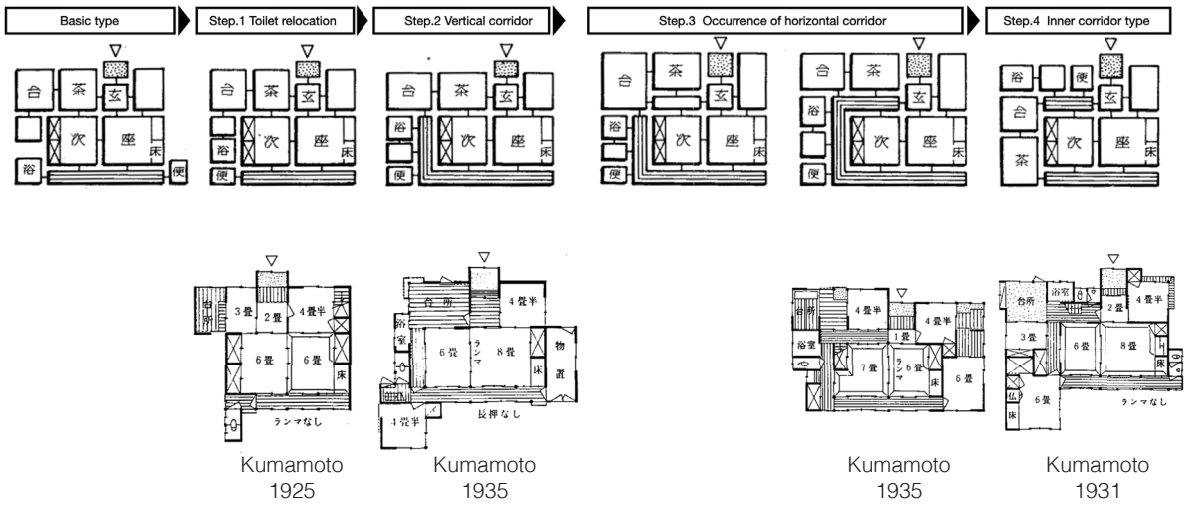


Figure 4.18 North entry-horizontal inner corridor type plan formation process model

(source: reproduced from Aoki 1983, 91)

With no need for the principle of shallow and depth and the elimination of the need to go through rooms to access others, the Inner corridor type house becomes the most appropriate layout for stable family life.

The inner corridor type plan proposes a physical solution to the circulation structure that the occupants consciously control. Traditionally, it has changed from a conscious separation method that the reception space and family living space do not invade each other according to the reception method, to physically separate the space by placing a corridor between the two sectors. Looking at the spatial configuration diagram, while sharing the basic configuration with the Zashiki direct entry type, the existing irrationality has been removed through the corridor in the center (figure 4.19).

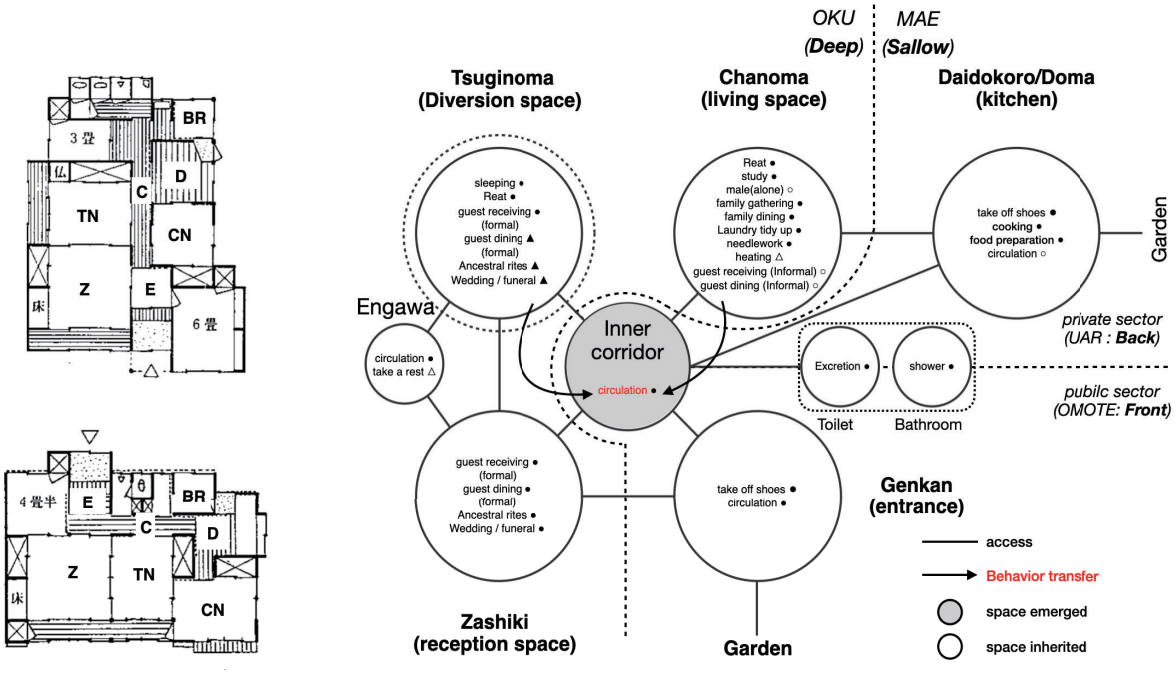


Figure 4.19 Inner corridor type and domestic code < 2 >

The Pacific war pushed the general recognition of the new urban housing movement. In the war, the widespread destruction of housing allowed for housing redevelopment, starting with the lower classes. During the war, the working class's economic structure was dealt a devastating blow, so what led the housing modernization movement was government provided public rental apartment buildings.

The government's stance was to replace the burnt homes in the war with fireproof concrete apartment buildings. In 1951, the standard type for public housing was the Public Housing 51C type in which there was a dining kitchen (DK). The 51 standing for 1951 and C,

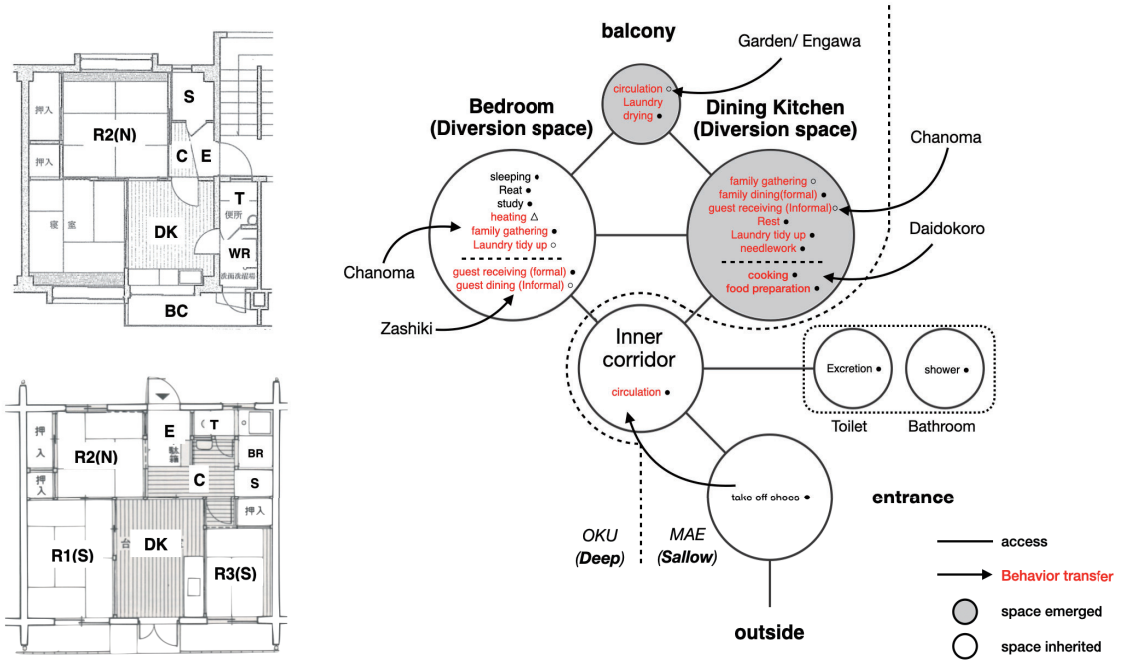


Figure 4.20 Standard design 1950s and domestic code < 3 >

meaning it was the third of 3 standard designs. It was the smallest of the three, built for the lowest classes. However, this small housing unit, which was not even 40 square meters, would significantly impact Japanese housing henceforth. The 51C plan was designed for three essential purposes: First, securing two bedrooms, especially one-bedroom, is clearly separated. Secon, The kitchen plan for dining and at least the size of the breakfast room is divided. Third, watering and draining system planning. Construct a pipe system for washing or drainage, and install a pantry (Suzuki 1988, 35).

The Omote space has been officially removed from the Code 4 diagram. It was a new social phenomenon caused by the collapse of traditional society and the urban population's concentration. On the other hand, it is the housing plan's direction in the modern era to rationalize the lifestyle. The distinction between the Omote and Ura sectors, which had been maintained up to Code 3, has disappeared, but Mae and Oku, which represent the housing depth, are inherited. As the Chanoma area was incorporated into Okuro in Code 3, it was divided into service space and housing living space. This consciousness structure affected even the apartment plan in the early modern period (figure 4.20). Entrance-Corridor-The toilet and bathroom are grouped into the Mae sector, and the DK and two bedrooms are composed of the Oku sector. The behaviors that were distributed in Omote and Ura were mixed and transferred to DK and the bedroom (south). According to Suzuki's (1961) survey, the south bedroom and DK often used integrated space by removing the middle door,

and the north bedroom was often used as a child's room or reception space. The entrance space was simplified, and the circulation function was transferred to the corridor. Some functions of the Engawa garden that existed in the previous codes were transferred to the balcony.

Condominium housing in the public sector was generally planned for larger units than rental housing. The private sector also developed a unique type of plan that was narrow and deep due to site conditions and density constraints, following the trend of public housing in the 1960s~70s. In the 1960s~70s, condominium housing in the public sector increased the number of bedrooms, and the 3bay type was typical. There was no significant change in domestic code 4. In the basic structure, a front bedroom was added, and the service space was differentiated. The toilet and bathroom are physically separated, and a washroom or laundry (changing room) is overlapped between them. (figure 4.21). Since the 1960s, houses have been fixed in a narrow and deep form due to site conditions and density constraints. However, the lifestyle of the resident went in almost the same direction as the detached house. In the 1960s, the plan was to concentrate on plumbing facilities such as the kitchen, bathroom, and kitchen into one place and place it in the middle of the long dwelling unit from north to south. In the south and north, the bedroom and the rest of the living room, dining, and kitchen were divided into divisions, and an inner corridor connecting all spaces is placed to handle movement.

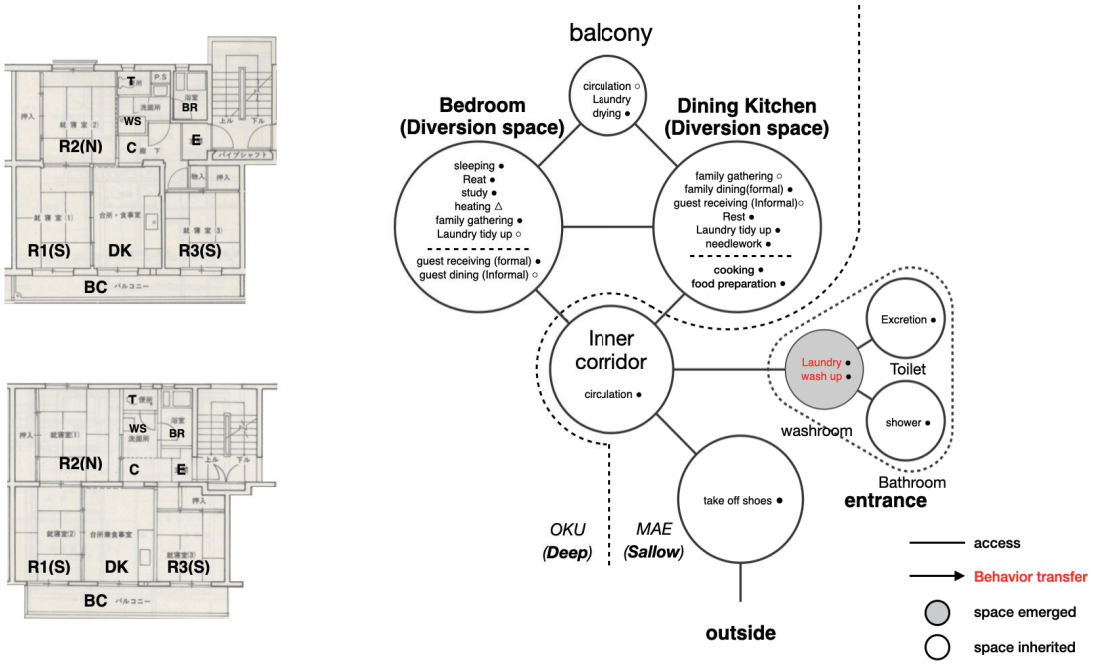


Figure 4.21 Standard design 1960s~70s and domestic code < 4 >

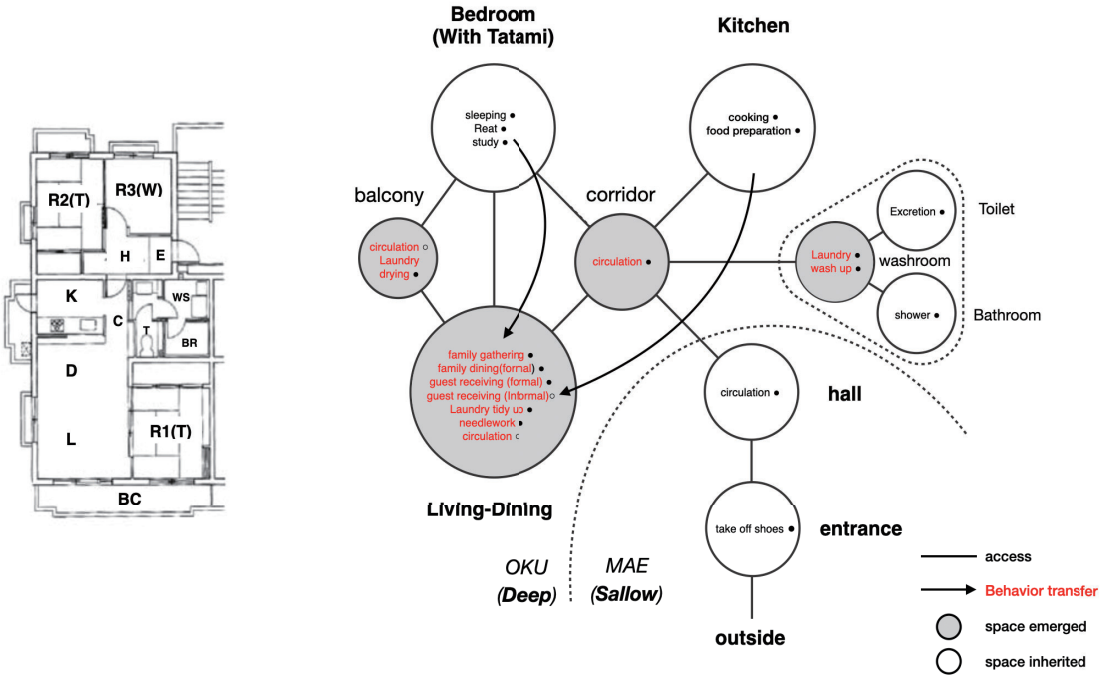


Figure 4.22 Standard design 1980s and domestic code < 5 >

A modern living room does not settle until it reaches the narrow and deep inner corridor type. Although there was a living room (Ima) or DK before, it had a characteristic close to a chanoma that works organically with the parent's bedroom. The kitchen became independent from DK, and dining, family gatherings, and social functions were transferred to living-dining. This phenomenon also occurred in the parents' bedroom. The depth of entering the house's interior increases and the segmentation between the Mae and Oku sectors is further emphasized. In particular, toilets, bathrooms, and laundry rooms, which are service spaces, were moved to the Oku sector, and the sub-bedroom was relocated from the Oku sector to the Mae sector (Figure 4.22).

The separation of public-private spaces, sleeping-dining spaces that Japanese modern houses advocate are expressed as spaces. Compared with domestic code six and samurai housing, the zashiki sector was lost. Some of the remaining sectors and the activities of the chanoma sector were concentrated in living-dining. Besides, the increase in individual bedrooms clarifies the spatial separation of parent and child generations. However, the house's spatial depth inherits the structure of Mae-Oku, which controls the movement of residents through. It controls the service space by adopting the modern heritage of securing privacy by introducing an inner corridor.

4.2.3 Topological paths in evolution

Over-viewing the whole process, some import points can be summarized. The traditional link of the six essential spaces and one sud space was still preserved in the Middle-class housing of the late Edo period to the early Showa periods. However, when it comes to the public sector apartment houses in the 1950s, all relationships are rearranged, and the yard disappears, leaving small fragmented spaces to preserve some of its behaviors. The significant indication that suggests the initial code structure is the adjacency between the zashiki sector(Genkan, Tsuginoma, Zashiki) and the chanoma sector(Daidokoro, Chanoma, Nando, Heya) , which a like a rule, appears in every typical plan. The living room was settled in the condominium house in Japan, by combining the circulation function to the inner corrido and it links the remaining essential spaces. The function of circulation, therefore, has been transposed from the each room to the corridor and the the living room.

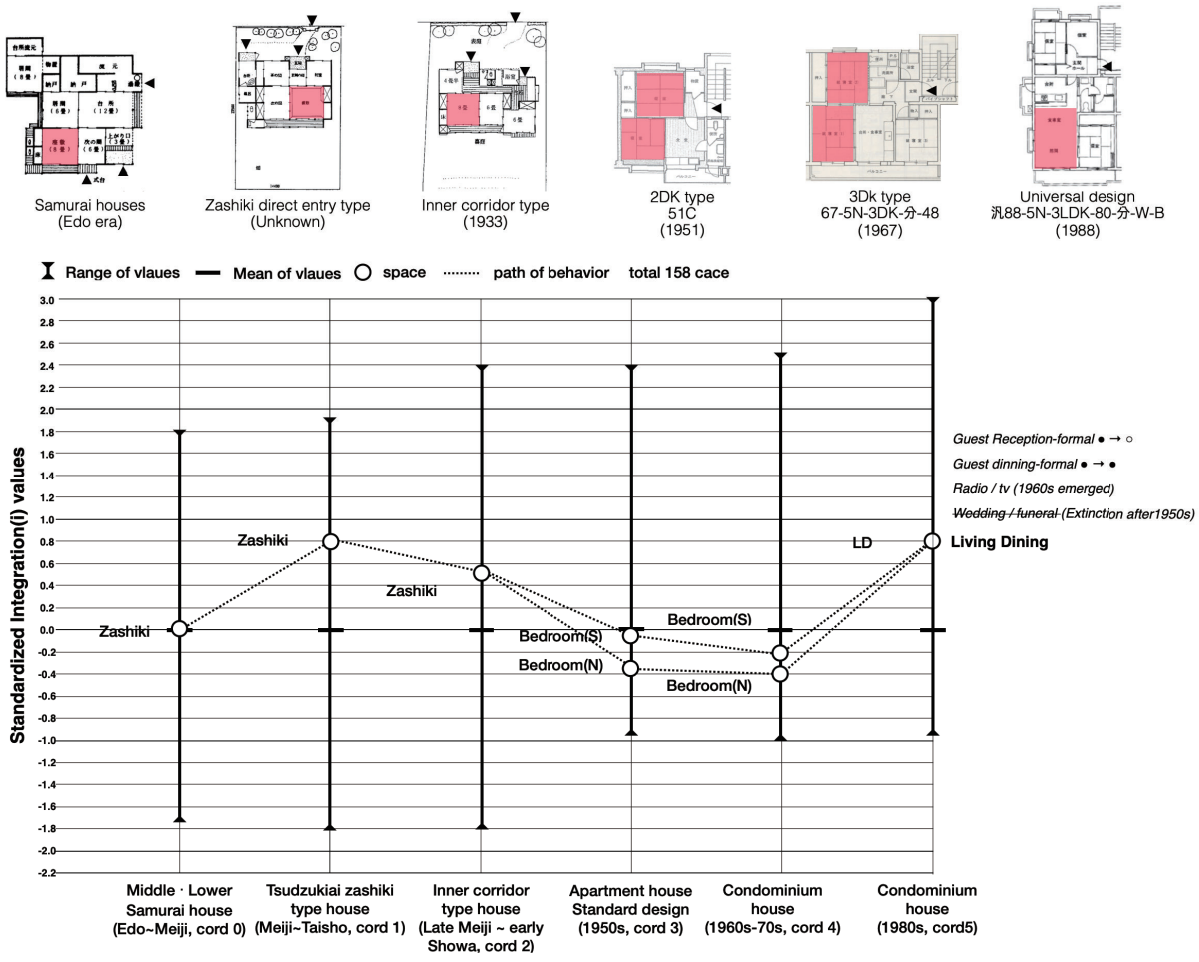


Figure 4.23 Topological paths of behavior of the Zashiki

The next seven graphs illustrate the topological paths of the behaviors by means of Standardized Integration(i) values (from figure 4.23 to figure 4.28). Each graph shows the traces of behaviors that came from one of the four keyspace.

Using Standardized Integration(i) values which show the degree of integration, precisely how these activities are assigned their topological position in each phase of the housing evolution can be revealed. First, figure 4.53 shows the diachronic movement of the behaviors that once belonged to the Zashiki, the counterpart of the modern living-dining space. The old Zashiki in the traditional house was the space for reception, and only allowed to head of the household. All the way through their migration, these behaviors are kept higher than the mean Standardized Integration(i) values before public sector planning in the 1950s. Officially, the name Zashiki disappeared from the apartment complex, and the behavior of reception moved to the southern or northern bedroom adjacent to DK. This change lasted until 1970, and it settled an independent space as living-dining in 1980.

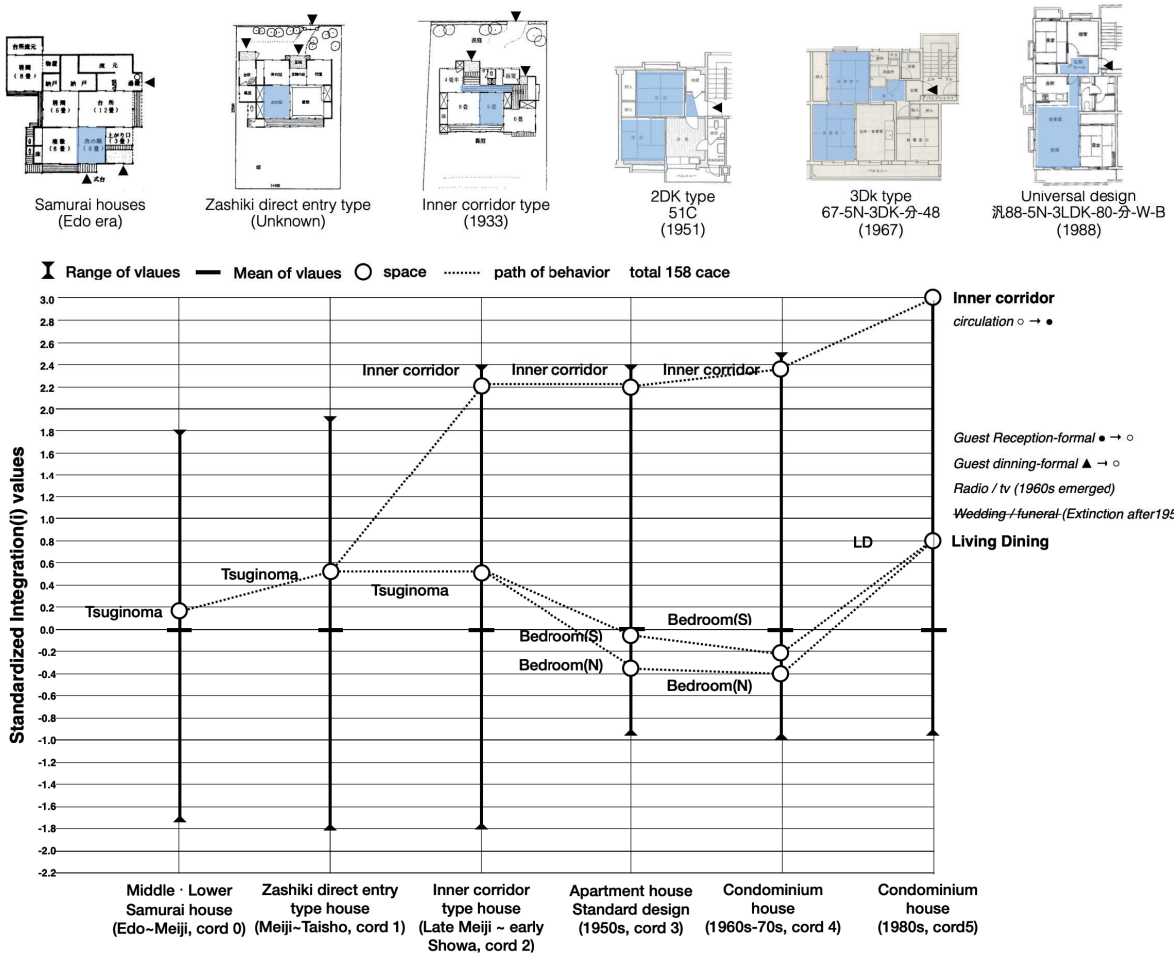


Figure 4.24 Topological paths of behavior of the Tsuginoma

However, the modern living-dining space does not have the same properties as the old Zashiki, and the original characteristics of Zashiki have weakened. In particular, in the first phase, Zashiki is located almost in the center of Standardized Integration(i) values, which means that Zashiki is at the periphery of the whole house's spatial composition.In other words, Zashiki is located in a deep spatial location with low accessibility. These characteristics are the result of contrasting the characteristics of Korean and Chinese spaces previously discussed. Even in traditional Korean houses, "Sadang," which puts the ancestral Wipae, is located in the deepest spatially and has low accessibility. However, Sadang is a place where the spirit of ancestors is enshrined and is not a space for living people. Korea's Madang and Maru and China's Ting and Fang are organically intertwined spaces in the realm of life. However, the Japanese Zashiki is separated from the living space and is only responsible for consciousness and social functions. As Zashiki is located in the south front of the house as an Omote sector, its visual accessibility tends to be higher than that of the Ura sector.

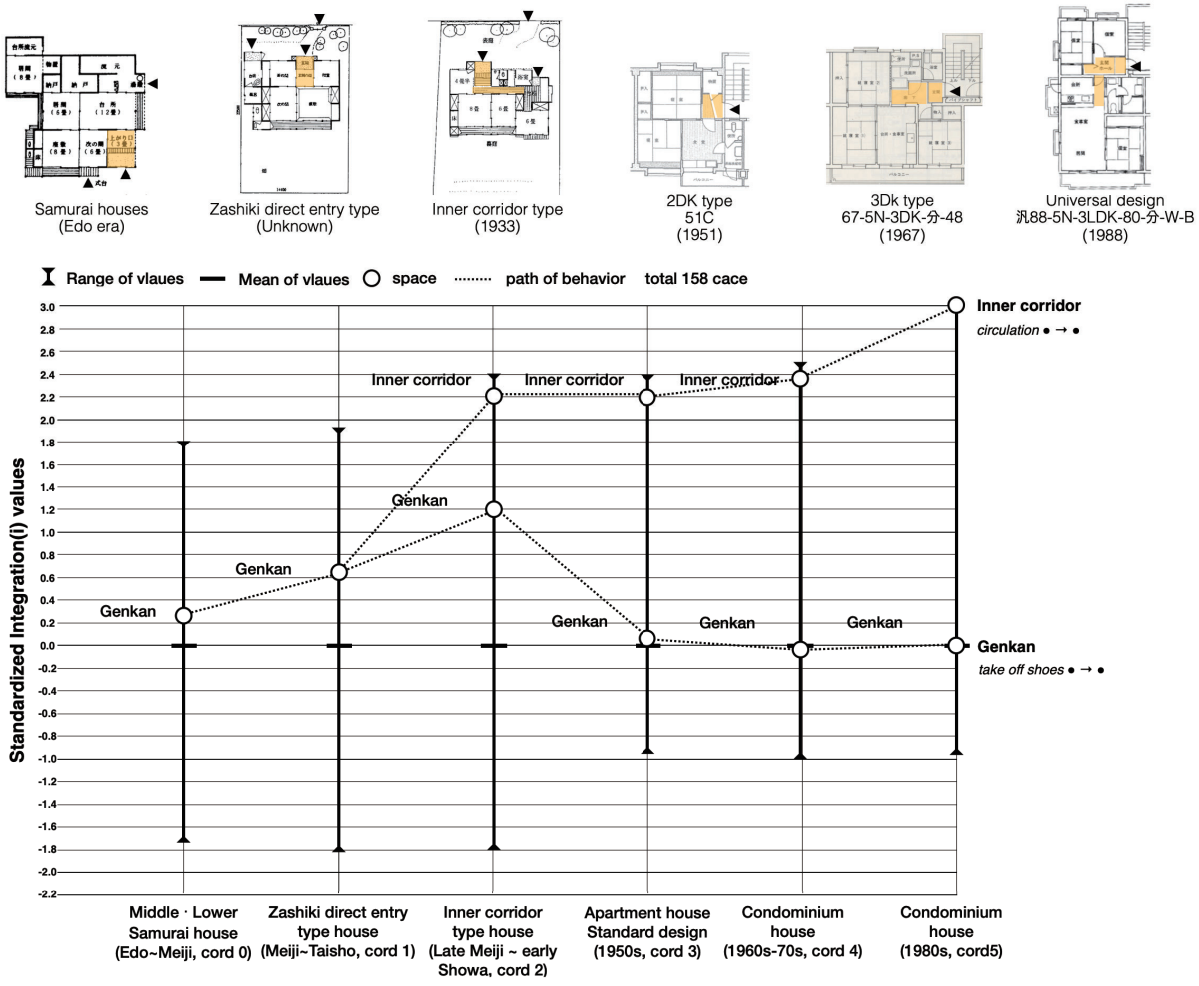


Figure 4.25 Topological paths of behavior of the Genkan

However, Zashiki has a deep spatial depth as it can only be accessed through the entrance and Tsuginoma. In other words, it implies both high visual accessibility and low physical accessibility. The position and phase of the old Zashiki were readjusted during the modernization period, resulting in large fluctuations in Standardized Integration(i) values and weakened behavioral aspects. Thus, it is not easy to judge that the current living-dining ultimately inherited the old Zashiki's behavior.In the traditional samurai house, the Tsuginoma was the space for sub reception and the intermediate space linked to Zashiki. As soon as the inner corridor type house was equipped with a corridor, the behavior of circulation was separated from Tsuginoma (figure 4.24). In the fourth phase, Tsuginoma officially disappeared from the house, and in the second phase, the traits that support both reception and family living spaces are inherited through the third phase. After that, the phase changed to the same pattern as Zashiki, and in the 1980s, the meaning and physical form were simplified.Genkan is the formal entrance to the Zashiki sector and is the first space to rise to the high interior space.

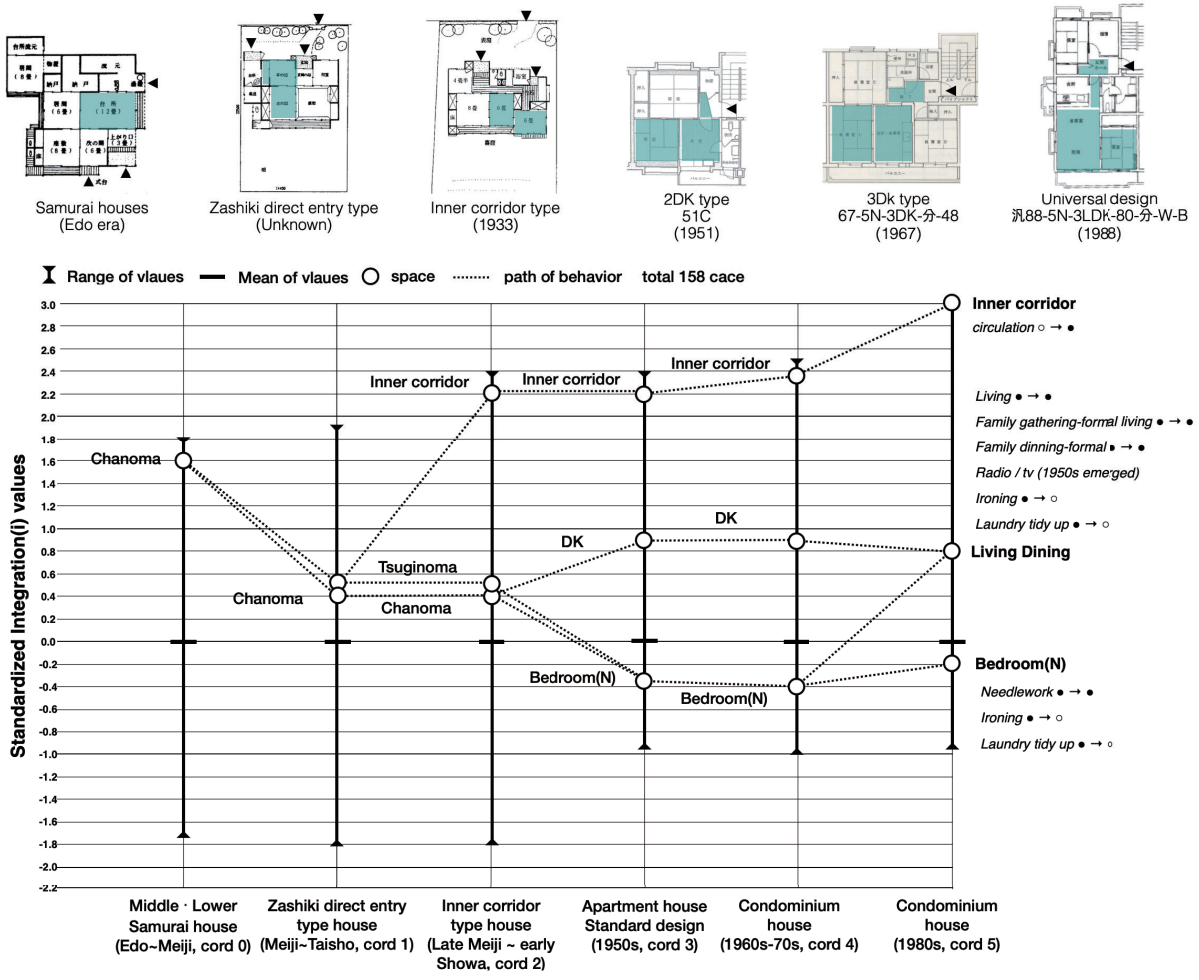


Figure 4.26 Topological paths of behavior of the Chanoma

Genkan migrates the circulation form to the Inner corridor in the third phase, preserving only the behavior of taking off shoes (figure 4.25). In the early modern era, Genkan has above-average Standardized Integration(i) values combined with Engawa or a female maid's room located in the front of the house. However, it maintains a constant number after the third phase in which the circulation behavior migrates.

The most startling change of all is the transformation of the Chanoma. This center of family living space's multiple roles has been successfully re-distributed into the three newly emerged spaces in the modern nLDK type houses, as previously illustrated in the domestic code diagram (figure 4.26). The living-dining, the inner corridor, the South bedroom have inherited its behaviors, and the inner corridor is supporting its function as a circulation core. The old Chanoma is a central space that supports family living and shows the highest Standardized Integration(i) values among whole houses' spatial composition. Here we can find essential differences from the current views.

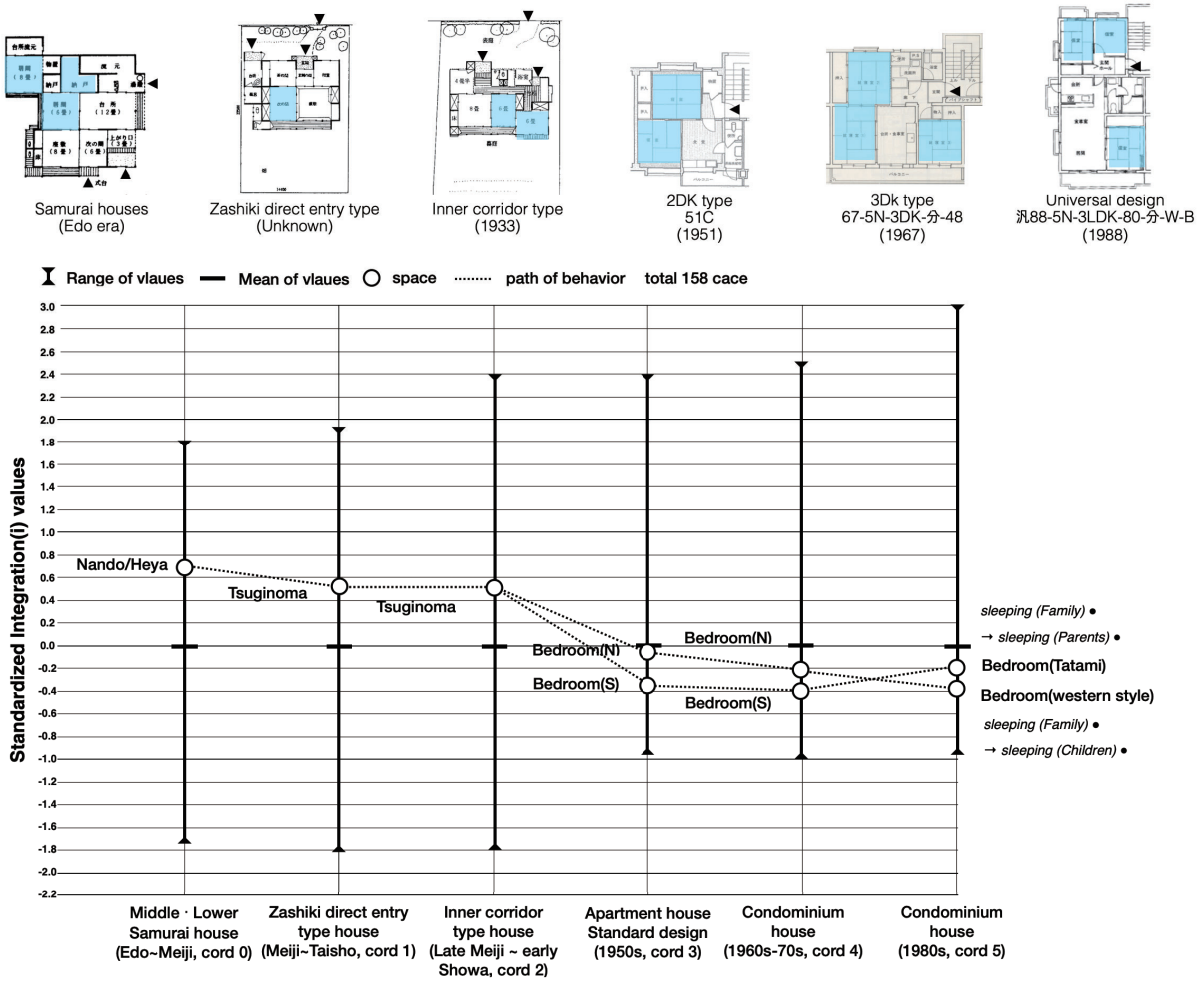


Figure 4.27 Topological paths of behavior of the bedroom

Traditionally, the Zashki sector has a higher meaning than the Chanoma sector and is considered a more critical space. However, in the Standardized Integration(i) values, Chanoma was higher than that of Zashiki. From a spatial topological point of view, these results imply that the topological centrality of the Chanoma space is high and that it is more likely to have important functions than other spaces. In other words, there is a difference between a space recognized as necessary socially and culturally and a topological center space. In traditional Korean houses, men's spaces are higher than women's spaces and have a strong decorative character. However, looking at 18c Hanok in Korea, the Anmadang where a female space, has the highest integration value. Traditionally, there were no individual bedrooms in Japanese houses. It is common for families to gather together and go to bed. This space is located in the deepest part of the Chanoma sector, and it is often connected to the backyard. In some cases, "Nanda," "Heya," or the room's name is not specified. In a samurai house, Nando was a closed space with no outward-facing windows and was used for a bedroom or newlyweds to becoming pregnant.

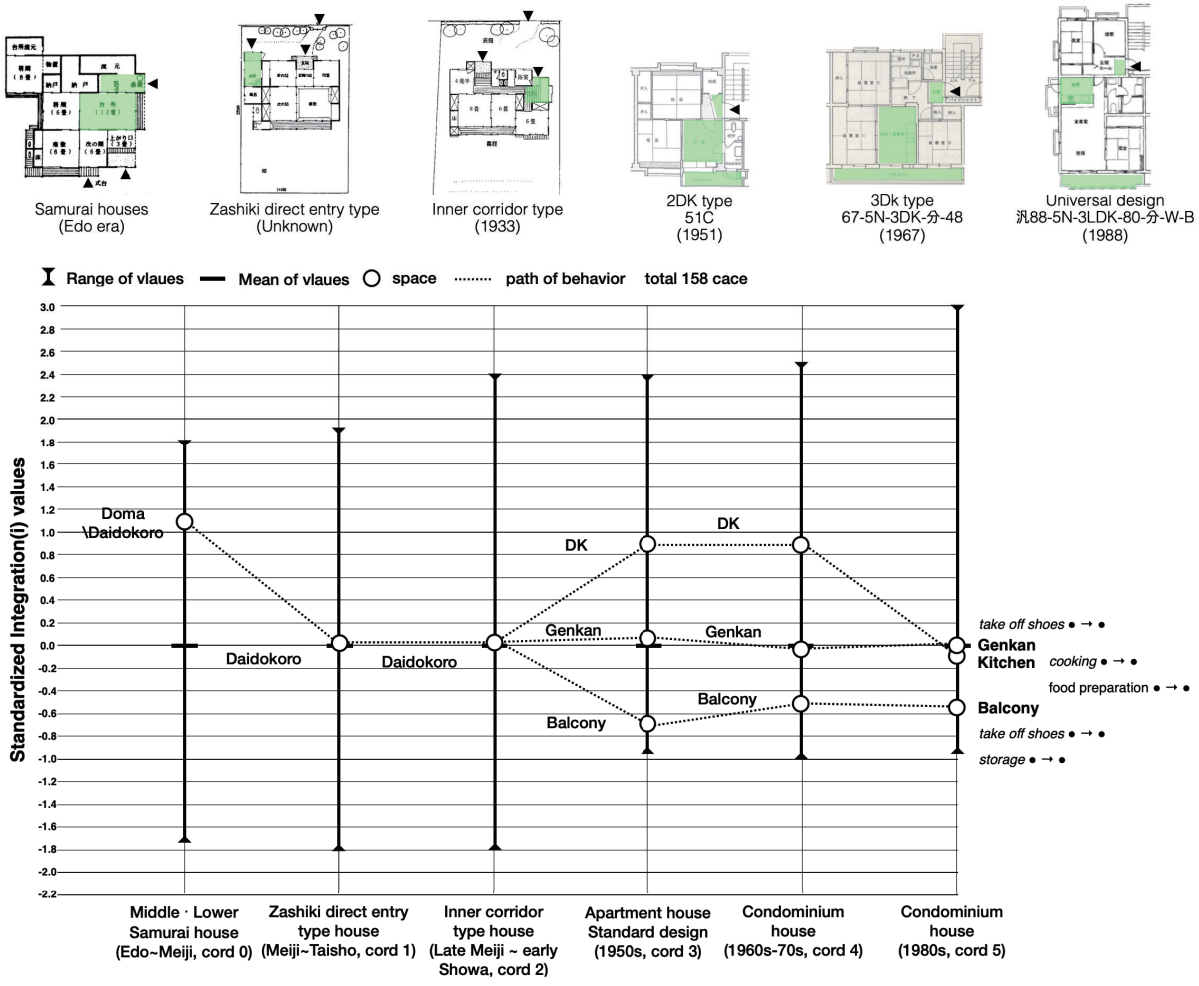


Figure 4.28 Topological paths of behavior of the kitchen

In today's Japanese housing, Nando has switched to the meaning of storage space. Figure 4.27 has a level of Standardized Integration(i) values above average and even higher than Zashiki. It is located close to the center by linking to Chanoma at a low depth and has a physically closed form. However, it has high accessibility when considering the spatial composition of the whole house. Until the third phase, these characteristics were preserved, and in the 1950s, standard design houses were converted into separate bedrooms. After the third phase, the bedroom Standardized Integration(i) values remain below average, and in the 1980 plan, the north bedroom values decrease, and the southern bedroom is increased. The spatial separation of the parent and child generations, the LDK, and the connected southern room (with Tatami) increase the centrality due to the spatial composition. The centrality of the bedrooms of the children's generation separated from the primary living sector decreases. Doma is a ground floor-level space that connects to Chanoma and is a multifunctional space that supports life, such as an informal entrance and cooking, storage, and food preparation.

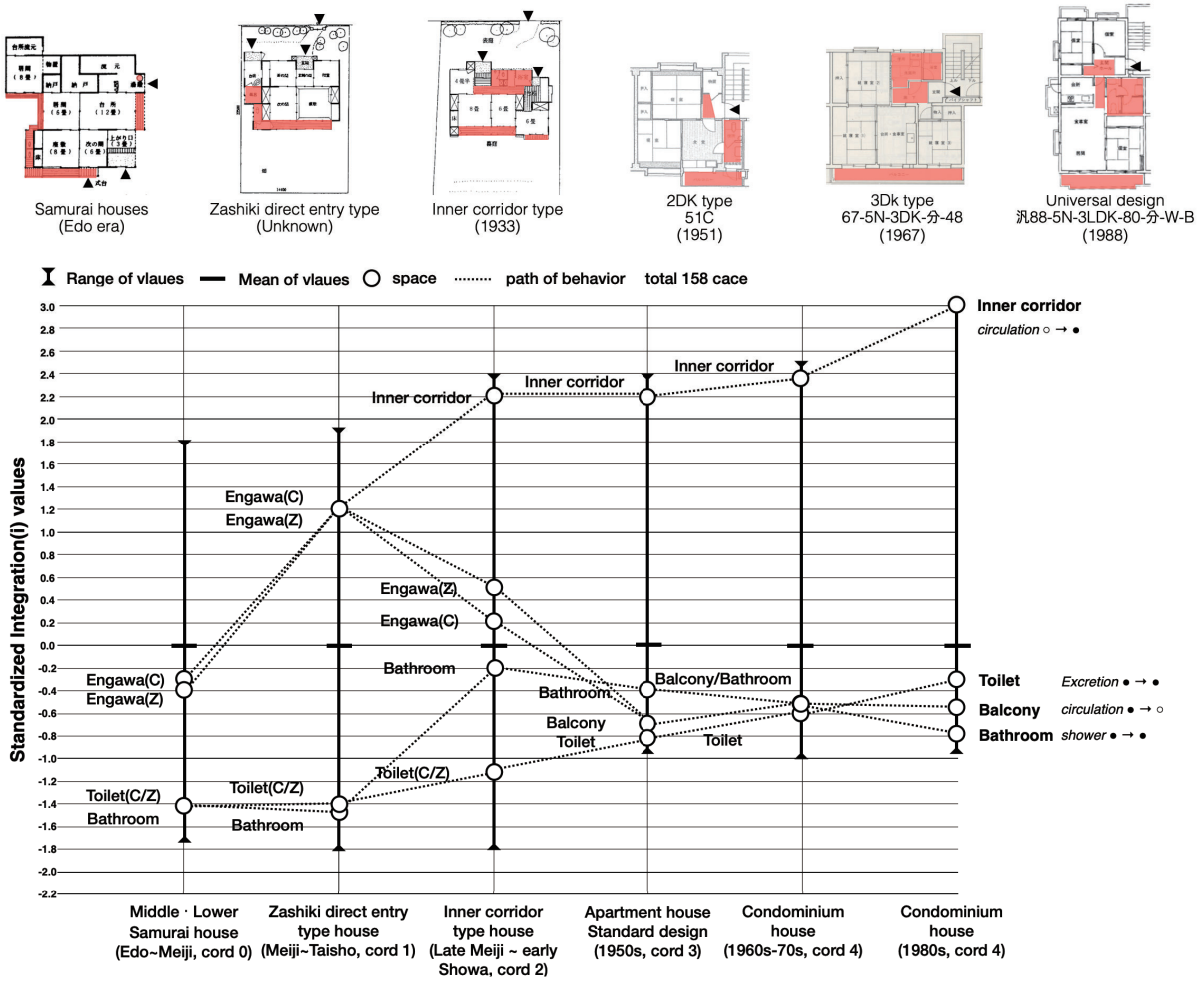


Figure 4.29 Topological paths of behavior of the Engawa and toilet

In the second phase, Doma physically and functionally merges with Daidokoro. In other words, the behavior of “taking off shoes” is added to Daidokoro in a way that Genkan’s floor level changes. Besides, Daidokoro’s Standardized Integration(i) values are maintained as mean because of the spatial scale of early modern houses decreases, and the number of spaces connected to Chanoma decreases.

In the fourth phase, the behavior is inherited to the dining-kitchen, the entrance, and the balcony, and the centrality rises because DK inherits the behavior of Chanoma. In the 1980’s nLDK type units, the kitchen is separated from the DK and relocated to an independent space (figure 4.28).Engawa attaches to each sector and functions as a passage to the toilet, where it has a temporary break at the boundary between the interior and exterior spaces. In the Edo era, toilets were installed in the Zashiki sector and the Chanoma sector, respectively, but in the second phase, they were integrated into the Zashiki sector. Therefore, Engawa’s Standardized Integration(i) values increase significantly and decrease again in the third phase because all service areas are connected to the inner corridor.

In the third phase, Engawas is an intermediary space that circulates outward, and in the fourth phase, this space has officially disappeared. Although the old Engawa layout is similar to the nLKD type unit’s balcony in the 1980s, it is not easy to judge that it does inherit its characteristics. After the 1950s, when connectivity to the outside space was lacking, balconies have been kept below average. Toilets and bathrooms are the deepest levels in the house and maintain the lowest value in all phases (figure 4.29).

The behaviors derived from each space migrate through the different routes and spread across the domestic field. It is evident from the graph that the behaviors that once belonged together in the on in each space are diverging gradually towards the other end. It is a natural result caused by the revered characteristics of the old and new house configurations.

4.2.4 “Mae - Oku” and “Omote - Ura” as underlying force in evolution

The principle of composing samurai housing, which is based on modern middle-class housing, is concise and strict. As described in the previous chapter, opposing concepts of Omote-Ura and Mae-Oku greatly influence the spatial composition of samurai housing. In the Middle Ages of Japan, the class system was established, high and low status was formed, and reception behavior was considered important. Omote is a reception area, and Zashiki and Tsunoma occupy the space, depending on the owner’s status and the guest, Oku (deep: high), and Mae (shallow: low).

Ura is the family’s living space, while Chanoma and Nando/Heya occupy the space according to the functional differences, Oku (deep: night behaviors) and Mae (shallow: day behaviors). Interestingly, in the Justified graph of Figure 4.30, all spaces are physically linked, but the Zashiki sector and the Chanima sector cannot enter each other’s space. The Zashiki sector is located at a low spatial depth level and is the first space to be reached when entering from the outside.

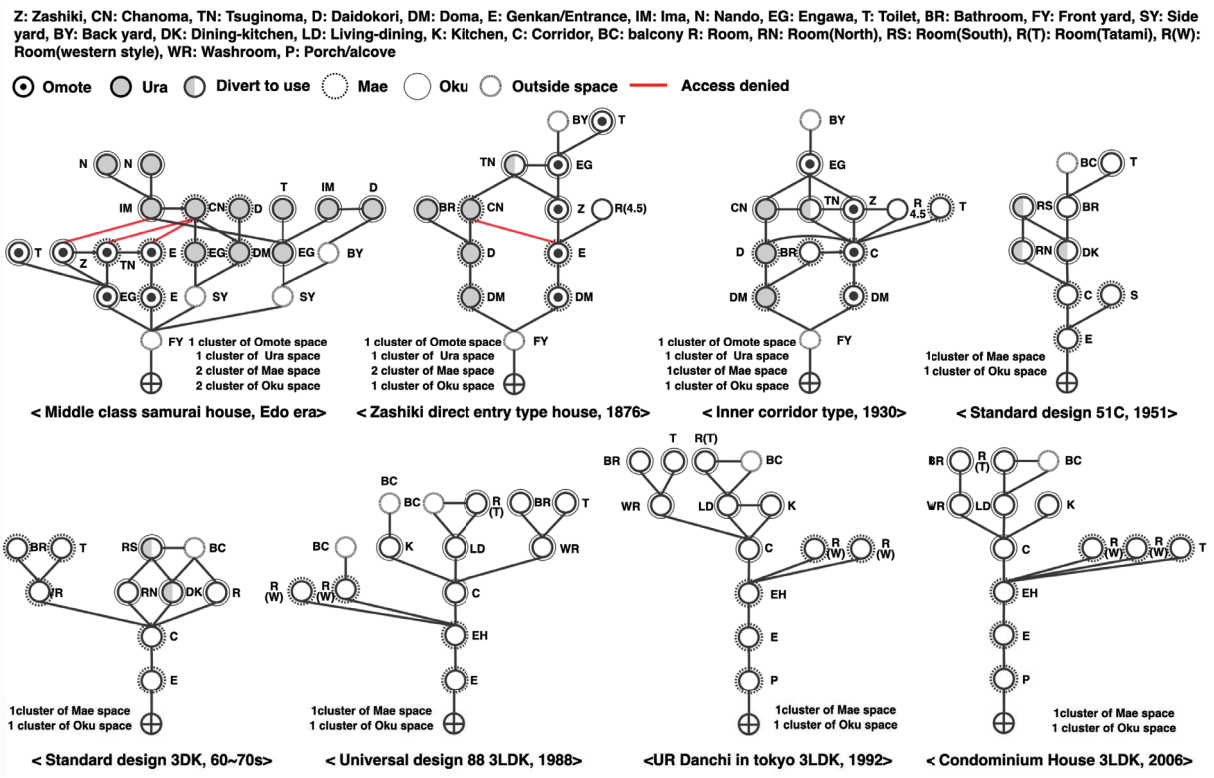


Figure 4.30 Justified graphs of the houses in China from late 19c to 2000s

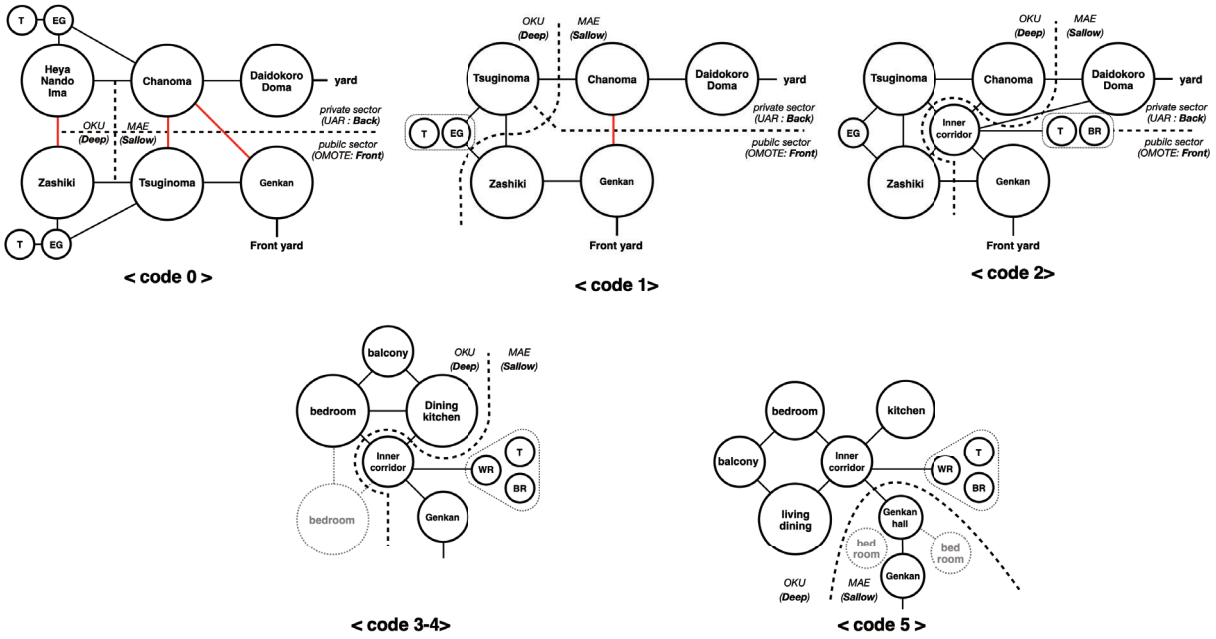
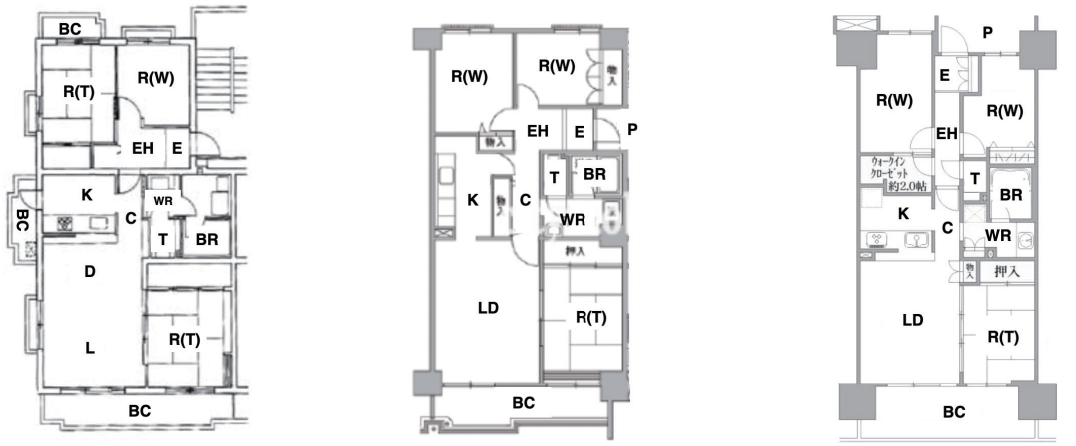


Figure 4.31 Transition of the boundary depth distinction

By marking the spaces that cannot enter each other with red lines, the separation between the two sectors is more clearly revealed (figure 4.30). Figure 4.30 shows that the eight plans from the previous figures are converted into the justified graph format with each sector legend of each sector. Two more graphs were added on each row's far-right side; they are from the Urban Renaissance Agency to the 3LDK type unit(1992 and 2006) in Tokyo (figure 4.32). In the first graph of the middle-class samurai houses, the Omote sector is placed on the low-depth and separate into one cluster, and it is divided into one Mae cluster and one Oku cluster. The Ura sector is placed on the deep-depth and separates into one cluster, and it is divided into one Mae cluster and one Oku cluster.



Universal design 3LDK, 1988 UR danchi in Tokyo, 1993 UR danchi in Tokyo, 2006

Figure 4.32 nLDK type dwelling unit since 1980s

The next graph represents the Zashiki direct entry-type houses of 1876 with one cluster, Omote, Ura, Oku, and two Mae sector clusters. The Zashiki direct entry-type houses inherit the sector of samurai housing as it is, but the spatial depth of Tsuginoma deepens and transforms into a complex space that supports reception and family life. Ura's Oku space merges into one Oku cluster as it merges into Tsuginoma.

The inner corridor houses of 1930 also maintain, with a similar arrangement, the four clusters. All moving lines are concentrated into the inner corridor and integrated into one Mae cluster. The first apartment type plan of 1951 has been rapid changes, with a different arrangement, the two clusters. Considering the configurational restrictions in apartment unit design, however, this earliest attempt to the different characteristic sectors as Zashiki and Chanoma in one cluster seems entirely intentional; there before could be interpreted as a conscious effort to separate the two zones. The three graphs of the 1951 and 1988 standard design units have two clusters. The difference between them lies in the living-dining space newly emerged after the 1980s and sanitary spaces transformation. After the 1988 graph, the circulating spatial structure has disappeared, and the toilet and bathroom are attached to the wash room and connected to the inner corridor. The entrance hall is also separated from the corridor to form a single Mae cluster of the entrance and the northern bedrooms. This phenomenon enhances the depth level of the entire house and acts as a cause of further separation into the main living area and the external area.

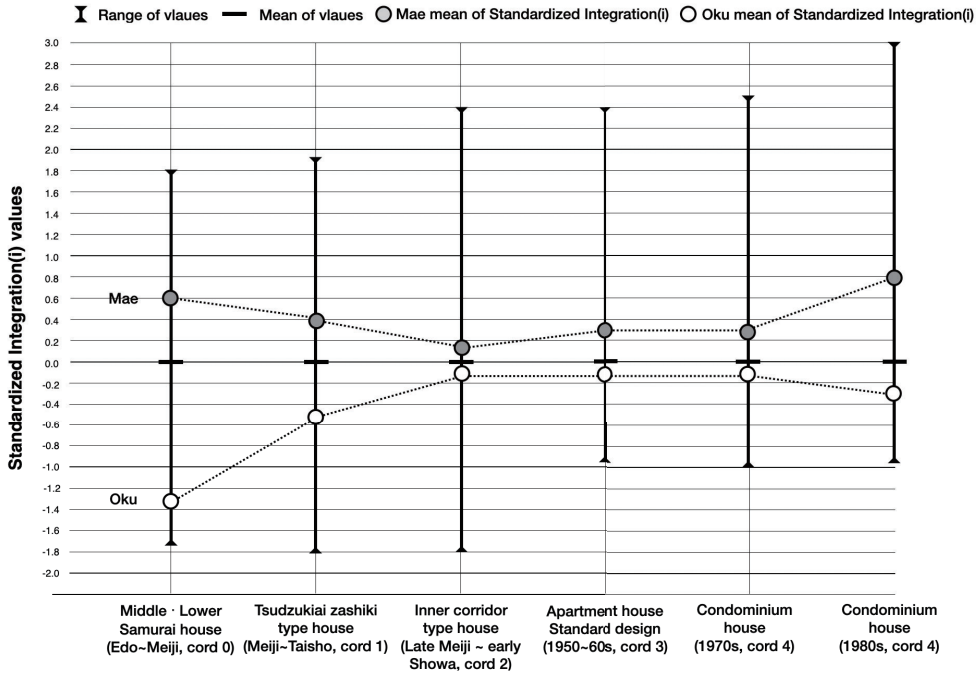


Figure 4.33 Transition of the mean Standardized Integration(i) values of Mae and Oku

The last three graphs, from the 1988 plan to the 2006 plan, should be pointed out in the on-going trend of separation degree - increasing; this has resulted from the unit's form that has been elongated north and south. This precisely reflects the general trend of unit planning in Japan's public sector, which has been pointed by many researchers; As there are more LDK types than DK types, spatial division increases, and LD/K types are more common than L/DK. Also, there is a strong tendency to separate the kitchen. Toilets and bathrooms are planned separately, and recently, there are many cases where the washroom is combined with a utility room. A door is installed between the entrance hall and the inner corridor to separate the space in some cases. (Sugiyama 1990, 138). Looking at the changes in the graph, some transitional patterns can be easily recognized. The number of clusters is decreasing, while the number of spaces in each cluster is increasing. In the samurai house, the Zashiki space is connected to the shallowest part, and the Chanoma space is connected to the deepest part of the graph.

However, from the apartment plan of 1951, those spaces begin to be merged, making another cluster. The number of isolated clusters on the Oku spaces and Mae spaces is getting bigger through time, and finally, Mae's spatial depth is deepened by the entrance hall and porch. If the first and last house plans are compared again, the necessary procedure for traditional housing to arrive at the inherited from the current apartment configuration can be realized.It is possible to convert these justified graphs to Standardized Integration(i) values (figure 4.33). In the graph, the dark dots represent the mean of Mae spaces and the white dots that Oku spaces. As expected from the justified graph, the mean standardized Integration(i) values of Mae spaces in the samurai houses are higher than those of Oku spaces. In the inner corridor type house, narrow the distance as the inner corridor integrating into the whole space. From the first apartment house in 1951, the two heterogeneous values are gradually diverging from each other while the mean of Standardized Integration(i) values are attempting to recover the fundamental gap. This polarisation precisely reflects what has been observed from the justified graphs. The Mae space intentionally increases the spatial depth between the outside and the Oku space, and the Oku space is located deep in the house, showing the intentional intention to secure the stability of the residence.

An indigenous concept of territory-distinction that was actively involved in this process. Guided by these underlying forces, the evolution of the housing in Japan has followed certain topological paths to adapt the old genotypical properties to the new physical environment, and the user's reaction described above shows that these values do persist through the formal changes.

4.3 Respect of Spatial Structure on Gender and status

4.3.1 Introduce

A house is not a simple physical structure containing a family's life, but a cultural space that reflects various aspects of the culture. Aamose Rapopot (1969) emphasizes the relationship between housing form and culture according to human behavior and social institutions. Traditional housing is a space that reflects the unique social structure, institution, and natural environment of each culture. The form and spatial composition of the dwelling are not caused by accidental requirements but is formed by the family relations, social structure, and values of a specific range of groups that share culture and values. Besides, the process of occurrence - extinction - repeat according to the changes and demands of life trends.

Family groups, according to all social structures and cultures, have characteristic practices in spatial use. The house's spatial composition and the behavior of the residents change according to the age, gender, position, and role of each family member. The order in which we live is divided into living spaces according to families' and individuals' positions and roles. Exploring how to recognize the spatial structure and give meaning provides the basis for understanding the time-series transition of houses more quickly. In this chapter, we start from the premise that there will be differences in the concept of traditional residential spaces depending on the characteristics of family relationships (gender) and status (age, class, visitors).

As described in the previous chapter, cultural characteristics of Japan develops unique characteristics during development, and its social characteristics are strongly reflected in traditional housing. Besides, throughout modernization, the introduction of Western-style housing, lifestyle changes, improvement of women's human rights, changes in family structure, and urbanization weakened traditional notions and influenced houses' perception. However, the Japanese concept of spatial depth (Mae-Oku) highlight the differences as they inherit it into modern houses.

Research on the Japanese traditional housing can be found easily, and through various approaches, differences and commonalities are expressed. However, there are many approaches to analyzing cultural characteristics from psychology, anthropology, history, and social science. Although attempts can be found from a topological and spatial point of view,

the validity is judged to be low due to errors in the analysis sample or errors arising from a lack of understanding of traditional houses in a specific country. Cheong (2016) describes the “Nando” as the center of the Japanese samurai house, with having the highest integrated value, and is set as a space for a female owner. Besides, Kim (2011) analyzes the Ninomaru Goten in Japan, but there is a gap in class and spatial scale between traditional houses in Korea and China.

Existing studies have a limitation of grasping each space of traditional housing individually and fragmentarily. Therefore, in this chapter, the spatial topological properties and structure of the overall house and the overall residence behavior are interpreted in connection with each space’s meaning.

This chapter aims to understand the correlation between traditional houses’ spatial composition in Japan and the family structure. There is a sub-purpose to interpret the typical traditional housing of each country. The study’s subject is set from the 17th to 18th centuries, which established the cultural value of each country. The study’s scope is to Select traditional houses from the Edo Period in Japan. The research data collection is based on each country’s official publication date, and the typical type is selected by referring to the papers published by the AIJ(Architectural Institute of Japan),

The analysis method of the spatial composition of a house uses spatial syntax to derive the topological centrality of a specific space quantitatively. Classifying the spaces according to gender and status and using the T-test analysis method, one of the statistical verification methods, each space is judged for the difference in the integration value (i).

4.3.2 Family structure and housing spatial composition

Japan has a decentralized social structure due to its geographical influence, and local communities and social organizations have established a robust system like religion. Communities and social organizations bound with strong cohesion start from a strict hierarchical relationship, and individuals always adhere to the order within the organization and group and remain in their position. Individual norms of order affect the family and linguistic aspects and are expressed differently according to gender, generation, and age. The family system in Japan is dominated by the small family type in which only one household resides in

one house (Kim, 1997). The family is a direct family structure that focuses on inheriting the family's name, taking the form of inheriting the name, not blood ties. "*ie* (家)" refers to the living community of all residents, including non-kinship, and is a system that guarantees the group's permanence. Even if they are related by blood, transfer to another family through branch out or adoption is excluded from the same family member. Family members are not related to blood but refer to members who share the same living space. In Japan, the family means a living community and presupposes a conscious sharing of the group.

Besides, heirs have the right, including the management and management of all property belonging to the family's name, and designating the next generation of heirs. Japan is an independent succession system that inherits all powers from the successor. Depending on the region, it may be inherited by the husband of the eldest daughter or the adopted child.In other words, it inherits everything to the successor designated by the head of the household and even designates others as successors. In Japan, the head of the household is more important than the age of blood ties and siblings. The successor inherits all the rights and property of their ancestors. Also, since the influence of blood ties in the inheritance system is insignificant, the head of the household and successor have the same master-slave relationship as the owner and the employee and have strong loyalty characteristics.

Space		Behavior (daily)	Behavior (non-daily)	Primary user	Sub-user	Gender	Floor type	Floor level
Zashiki sector	Genkan	-	circulation	head of the household, visitor	-	male	Tatami earthen floor	Up Down
	Tsuginoma	-	reception, ritual ceremony, funeral	head of the household, visitor	-	male	Tatami	Up
	Zashiki	-	reception, ritual ceremony, funeral	head of the household, visitor	-	male	Tatami	Up
	Engawa	-	circulation	head of the household, visitor	-	male	wood floor	Up
	Toilet	-	excretion	head of the household, visitor	-	male	wood floor	Up
	Front yard		Gardening	head of the household, visitor	-	male	earthen floor	Down
Chanoma sector	Doma Daidokori	cooking, food preparation, circulation	-	whole family	-	both	earthen floor wood floor	Down Up
	Chanoma	livinfg, circulation, Housework meal,	-	whole family	-	both	Tatami	Up
	Nando Heya	sleeping, storage	-	whole family	-	both	wood floor Tatami	Up
	Engawa	circulation,	-	whole family	-	both	wood floor	Up
	Toilet	excretion	-	whole family	-	both	wood floor	Up
	bathroom	body wash	-	whole family	-	both	earthen floor wood floor	Down
	Back yard	경작, 건조, 휴식	-	whole family	-	both	earthen floor	Down

Table 4.2 Family structure and spatial composition in Japan

A branch family is distributed land from the head house, is provided with production tools and household goods, and relies on many important family events. Therefore, the head house's dependence is high, and the same clan forms a living community and seeks to endure.

In Japan, In the immediate family relationship, the wife is highly dependent on the husband and has a vertical hierarchy. In the Japanese family, all power is monopolized by the household's head and demands unconditional obedience to all family members. They also have a master-slave relationship in marital relationships. Korea demands the separation of men and women based on Confucian ideology. Still, Japan has a structure to obey the household's absolute power in feudal society.

Japan has a form of direct family, but the household's head designates the successor. Any person designated by the head of the household can be a successor. Therefore, in Japan's father-son relationship, paternal rights are insignificant, and only the rights of a patriarch are emphasized. The sense of duty as the head of the household is more important than a father's role. For the succession of a patriarch's rights, a father-son relationship of a non-blood relation is formed. In some provinces, the eldest daughter inherits the rights of a patriarch. Japan's father-son relationship does not keep the filial duty but emphasizes loyalty to strengthen the master-slave relationship.

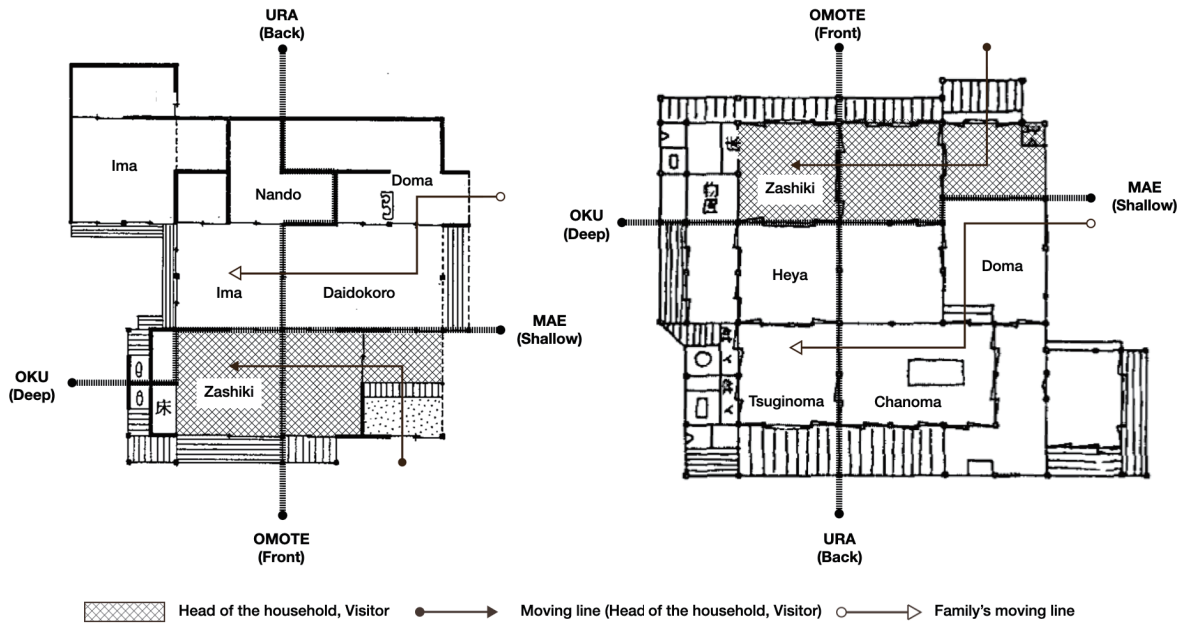


Figure 4.34 Family structure and spatial arrangement of traditional housing in Japan

Japan's sibling relationship is more different than that of Korea. The relationship between the successor and other siblings specified by the head of the household is as diverse as that of the father-son. The single inheritance system for successors provides more authority than the eldest son in Korea and is treated similarly to the household's head. The other brothers have a vertical relationship of obedience to their successors. Since other siblings are separated from the existing family after marriage, there is no spatial composition according to sibling relationships in traditional Japanese houses.

This section examines the socio-cultural system of family and the spatial composition of housing. The previous section confirmed that the Edo era's family structure definitely existed in spatial differences between heads and family members. Besides, although the reception and family life sectors are arranged independently without invading each other, all spaces are physically linked. Due to this characteristic, Japanese samurai houses have characteristics different from those of Korean and Chinese traditional houses; There is no single integrated core.

The high phase degree of a specific space in any spatial configuration means that space is at the topological center of the overall spatial configuration. It means that access from that space to all other spaces is easy.

As seen in the previous section, in the Samurai houses (figures 4.23 and 4.26), the Chanoma sector shows a relatively high integration value than the Zashiki sector. It means that the family living space is more accessible from all spaces than the reception space and has a lower spatial depth.

Comparing the Zashiki space and Chanoma space					
sector -1					
Variable		Zashiki sector (n=108)	Chanoma sector (n=128)	*t*-value	prob
Integration value	M SD	1.000151396 (0.076)	1.12640651 (0.118)	2.20	0.029
sector -2					
Variable		Zashiki (n=22)	Nando(bedroom) (n=24)	*t*-value	prob
Integration value	M SD	1.08053028 (0.089)	1.191176331 (0.064)	0.85	0.401
Gender -1					
Variable		Z-T-G (male) (n=38)	Daidokoro-Doma (female) (n=22)	*t*-value	prob
Integration value	M SD	1.1711455 (0.043)	1.444830525 (0.052)	3.02	0.002

Table 4.3 Family structure and spatial arrangement of traditional housing in Japan

To verify these results in detail, the average (T-test) is compared by extracting the sector and status of each space. As a result, it was confirmed that the Chanoma sector average was higher than that of the Zashiki sector ($p<0.02$)(table 4.3). These results show contradictory views from previous studies. Zashiki is the core space in traditional Japanese houses, and it is designed with the decorative elements and arrangement as the top priority compared to other spaces (Aoki 1983, 88; Suzuki 1988, 29).

This phenomenon can also be found in traditional Korean houses. In the previous section, the topological centrality of women's space tends to increase as the spatial composition of traditional houses comes to the latter part of the article. Choi (2003) interprets this phenomenon as a result to construct a rational movement for women's social status change and housework. From a socio-cultural point of view, male have a higher position than female, but from a common human point of view, housing plans an integrated core with low depth in the space that supports family life. In addition, Ooka (1999) found that Zashiki's area ratio and decorative elements were not significantly different from family living spaces.

4.4 Conclusion : genotypicial property of space

In this chapter, we have considered the transition process of Japan's domestic space. The conclusion from the Spacel-Behavior dimension is as follows; a)In the samurai house, Zashiki has a low integration value because it is located with deep spatial depth. Ironically, Zashiki is placed in the front of the samurai house but can be accessed through the Genkan-Tsuginoma space. In the case of China, public spaces have higher integration values than other living spaces. However, Zashiki maintains an average level of integration values, and modern living rooms inherit only a fraction of the traditional Zashiki behavior. b) Chanoma is a space that supports the family's daily life and has the highest integration value in samurai housing. Zashiki Sector is a space that supports formal receptions or non-daily life behaviors, and Chanoma is a multi-purpose space that supports the everyday life of families. It is a general view that the composition of living room + bedroom (tatami), which is commonly found in Japanese apartment houses, inherits the traditional zashiki composition. However, in terms of behavior-spatial dimensions, it can be interpreted that the modern Japanese living room inherits the attributes of Chanoma. c) There was no individual space in traditional Japanese houses, and other families except the head of household lived in the same space. It reflects the spatial properties of traditional houses where all spaces are connected. The

integration value in bedrooms is declining. It can be interpreted that the bedroom of a modern house is isolated from that of a traditional house.

In symbolic dimension, the depth distinction was leading the evolution of domestic space in Japan. From the beginning of the 50s, the new apartment housing development in urban areas was to modernize and enhance the people's living. For some planners, the old domestic culture was regarded as superannuated and unhealthy, thus not suitable for modern living. They thought the apartment house that came from the West should enclose the western living style. They merged dining's behavior into the kitchen in some earlier apartment plans and excluded space for reception only.

There is a clear way of separating areas in traditional Japanese houses based on the relationship between "Omote-Ura" and "Mae-Oku." "Omote-Ura" does not invade each other's sectors. However, in the 1951 apartment plan, the Zashiki sector was deleted. But. Mae-Oku's distinction concept, which controls the movement of residents with the depth of space, persists in modern public housing. In a medium-sized house, the inner corridor is processed to separate the spaces such as Chanoma, Zashiki, and Tsuginoma into the Oku sector. In the previous house, there were independent Mae-Oku in Zashiki and Chanoma, but in the inner corridor type, they were integrated into one sector. The redundancy of the entrance hall and the separation of the Mae space's main living space, including the toilet and bathroom, became apparent. This phenomenon can be confirmed by looking at the Universal Design of 1988. Following the entrance hall, the entrance hall space and the two bedrooms on the north side are separated from Oku's main living space by the Mae sector. After 1990, a porch or alcove was planned in front of the front door, so it can be seen that the depth of the village is deepened.

The transformation process of the domestic code described in this chapter is to show that it is not simply the changing arrangement of rooms but the interaction between the space and its activities within the domestic field that can precisely define the new space, and there is an indigenous concept of depth-distinction that was actively involved in this process. Guided by these underlying forces, the evolution of the housing in Japan has followed certain topological paths to adapt the old genotypical properties to the new physical environment, and the user's reaction described above shows that these values do persist through the formal changes.

Chapter 5

Syntactic comparison of urban housing in South korea, China and Japan

5.1 Introduction

In the previous chapter, the transition process of urban housing in South Korea, China, and Japan was traced, and the core elements leading to spatial evolution were examined. In previous studies (Kim, 2011; Cheong, S., Choi, Y., Song, H., 2016), it was found that the spatial composition of traditional houses in each country gives priority to securing privacy and prioritizing the space of the head. Besides, it is described that there are differences in the way women control space. Another study (Shim, W., Kang, S., Cho, J., 2000) compared the area ratio of apartment complexes built in the 90s and argued that there were differences in the type of housing and the area of the main bedroom. Based on these results, it was argued that Korean houses have the largest main bedroom area and have the highest hierarchical independence by planning a separate bathroom in the main bedroom.

There is a shortcoming in that previous studies deal with traditional houses or multi-family houses in fragments. Some studies (Cheong, S., Choi, Y., Song, H., 2016) incorrectly set the spatial function, resulting in errors in the interpretation of the results as follows; In Japanese samurai houses, "Nando" was set as a felmae's space, and external space was omitted.

Relative spatial depth in a house is a measure of how deep (or isolated) space is located from all other spaces in the house, taking into account the connectivity through each space's openings.The fact that one space is located deeply from another space means that it is difficult to access this space, which indicates that this space is relatively isolated from other spaces in the same house. When one space is linked to a shallow depth from another space, this space is centered relatively topologically from the other space. The index of integration value represents each space's relative position in the house to all other spaces. It means the possibility of social encounters (exchange between family members or residents and visitors) determined according to the overall spatial composition.

For example, the living room has a relatively low spatial depth that is easily accessible from other spaces because the living room is directly linked to another space or a door. On the contrary, the bedroom is a private space at the end of the spatial composition and is planned with low accessibility from all other spaces.

Relative spatial depth is designed differently according to socio-cultural constraints. For example, in the Joseon Dynasty's traditional house, Sadang (the space of rituals) and females'

space (Anbang of Anchae) show the lowest integration value. The female space was placed inside the house to restrict access from the outside, and Sadang is a space for ancestors, deliberately separating it from the everyday living area and giving it a formality.

In Japan's case, Zashiki has a public character as a space for reception, but it has a similar level of integration value with the bedroom (Nando). It can be interpreted as the intention to form the formality of space by separating it from life, like Sadang in Korea. It has a different spatial composition showing high integration values in Korea and China's public spaces.

As such, the relative spatial depth is designed differently according to socio-cultural constraints and affects modern houses. However, the basis for judging whether the result derived by using the standardized integration values in the previous chapter is a general characteristic arising from the general-purpose culture in East Asia or the characteristic of each country's own culture is still weak.

Therefore, in this chapter, the difference in each country's spatial composition is explained through objective indicators using the integration value calculated in the previous chapter. The floor plan composition of the house is divided into public areas (Maru, Ting, Zashiki, Livingroom), private areas (Anbang, Pang, Woshi, Nando, Heya, mainbedroom), and semi-public areas (kitchen, DK), and analyzed by time series of integrated values. Compare and analyze changes in each country. Also, to observe each country's characteristics in detail, the correlation between the three spaces and the t-test is examined. This chapter aims to compare the transition process of urban housing in South Korea, China, and Japan to a spatial topology perspective and discover differences in commonalities.

5.2 Comparative analysis of urban housing spatial composition transition

To understand the trend of housing floor plan change, we compared the integrated values of significant spaces. The main spaces were considered private spaces (bedrooms), public spaces, and semi-public spaces. However, in Korea and Japan, two types of kitchens and dining rooms are integrated into one space and separate (LD-K) types. In this case, the value of the kitchen's spatial integration is included in the analysis. Since the number of bedrooms varies according to the times and types of houses, this analysis analyzes and compares all bedrooms' average value. Also, the average value of public spaces is calcu-

lated and used for analysis. Changes over time were analyzed using a t-test. In the figure, a circle with a solid line means that the error probability of the amount of change placed on the circle represents a statistically significant change within the limit of 0.05. The dotted circle represents the limit of the error probability of 0.01.

Comparing changes in floor plans year by year from the 16th century to the 1980s is inefficient in several respects. First, floor plans of traditional houses and urban detached houses in the early modern period were not continuously developed differently from public domain houses. Second, the spatial arrangement of the public sector's standard design did not change significantly every year. For this reason, the collected data is divided into five phases and analyzed as follows. Phase 1: Hanok, Siheyuan, Samurai House, Phase 2: Urban Hanok, Early Lilong house, Zashiki Direct-entry type, Phase 3: General Detached House, Late Lilong house, Inner Corridor type, Phase 4: 1945 ~ 1969, Standard Design Apartment House, Phase 5: 1970 ~ 1980s Standard Design Apartment Housing.

Figure 5.1 shows the change of the integration value of bedrooms in each country. In phase 1, Japan shows a higher integration value than South Korea and China. It is a phenomenon that occurs because the samurai house's main spaces are physically linked and reflect the spatial composition of the individual spaces that were not separately divided. The change from phase 1 to phase 2 shows a statistically significant change ($p < 0.02$) in the process.

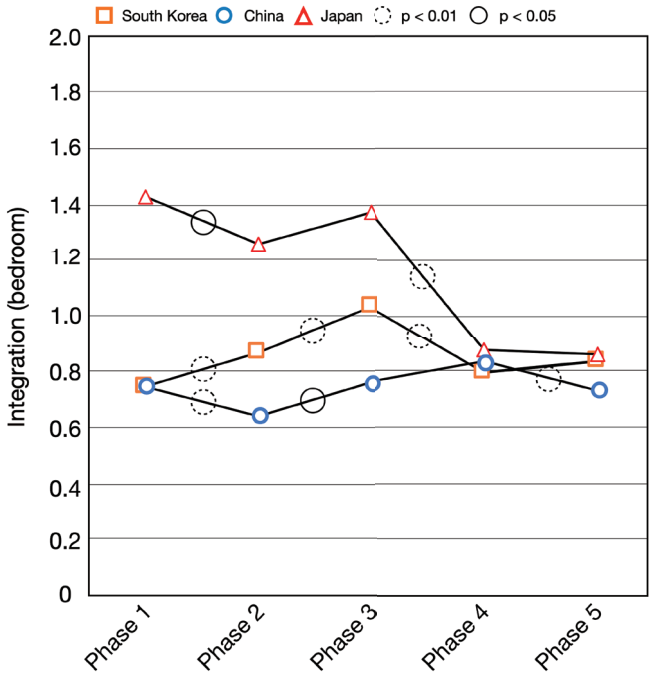


Figure 5.1 Change of integration value of private space (bedroom)

Due to three changes: the difference in the space size of the samurai and samurai houses, the change in the process of entering Zashiki, and the multipurpose use of Tsuginoma. However, even in middle-class housing, it was common for all family members to live together, showing high integration values in the bedroom. In phase 4, the bedroom's integration value decreases sharply and tends to be maintained in phase 5. in the standard design (2DK, 3DK). After the war, the trend of the partisan division of public and private spaces was formed in earnest under the influence of modern housing planning. Separate rooms were planned for children, and the couple's bedroom was linked to DK to use the center of the living space. In the case of 3DK, a bedroom linked at the entrance is planned (3-bay) based on 3DK, showing a lower integration value than the previous phase bedroom. This trend is intensifying as the parents' bedroom (south side), and the bedroom of children (north side) are further separated in modern 3LDK houses.

In South Korean bedrooms, the integration value tends to increase ($p < 0.00$) as it changes from phase 1 to phase 3 and decreases again ($p < 0.00$) as it enters phase 4 from phase 3. The Integration value is maintained after phase 4. It is a phenomenon that occurs when Maru is incorporated into the interior space in phase 3 and is connected to all bedrooms. In particular, Anbang has a higher integration value than traditional Hanok and urban Hanok because it forms a loop structure that circulates with the kitchen. It is also judged that the bedroom in South Korea reflects the characteristics of both public and private characteristics, such as the daily life of the family being Anbang.

In Chinese bedrooms, the integration value tends to decrease ($p < 0.00$) as it changes from phase 1 to phase 2 and increases again ($p < 0.03$) as it enters phase 3 from phase 2. Interestingly, the bedroom's integration value decreased ($p < 0.00$) during the transition from phase 4 to phase 5. As a result, it shows similar figures to the bedrooms of traditional houses. It can be judged that the floor plan was influenced by various influences (Western, Soviet Union) in the process of modernization.

However, it is settling into a spatial composition suitable for the lives of Chinese people. Chapter 3 was reconfirmed that the traditional spatial composition of securing private living spaces for each household in China appears as a phenomenon that intentionally increases the spatial depth of bedrooms in modern houses. Analyzing the change of bedroom space in South Korea and Japan, the integration value decreased in phase 4 (apartment house). In conclusion, the integration values of private spaces in the three countries converge to a similar level, which is judged to be due to the physical constraints and functional standardization of apartment houses.

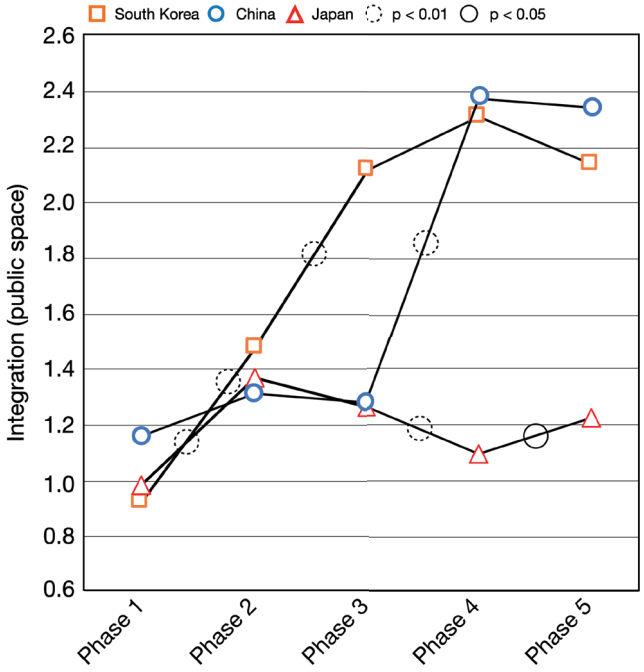


Figure 5.2 Change of integration value of public space

Figure 5.2 shows the change in the public space. Compared to other spaces, the integration value of the public space was much higher. It means that public spaces are the most easily accessible spaces and where families can quickly gather. It is also located in the center compared to other spaces from a topological point of view.

In the case of Japan, the integration value tends to increase ($p < 0.00$) as it changes from phase 1 to phase 2 and decreases ($p < 0.00$) as it enters from phase 3 to phase 4. As it changes from phase 4 to phase 5, it tends to increase again ($p < 0.03$). The reason is that phase 2 (Zashiki Direct-entry type) changes to the spatial composition of "Genkan-Zashiki" and links to a level where the Zashiki spatial depth is low.In phase 4 (2DK, 3DK), Zashiki officially disappeared, and the northern room was often used as a parlor (Zashiki 1963, 99). In phase 5 (LDK type), a modern living room has settled, and it has the role of a space for families, not a traditional public space (Zashiki). Compared to South Korea and China, public spaces' integration value remains low, and the range of changes is small.

In Chapter 4, the factors leading to the evolution of Japanese housing (Mae-Oku) were derived. As the house's spatial composition is rearranged, the main living space (Oku) and the superficial space (Mae) tend to separate, and the spatial structure in which the inner corridor links all other spaces appears with a low integration value. There is no single integration core in Japanese houses, and it has a "loose functional link structure" that uses space flexibly depending on the purpose. There is a gap between the Western ideology living room

and the traditional Ima in modern apartment houses. Formally, the Western living room is borrowed, but it is similar to traditional Ima in spatial composition.

In Korea's case, as it changes from phase 1 to phase 2, the integration value tends to increase rapidly ($p < 0.00$). In phase 2 (urban Hanok), the spatial scale decreased, resulting in an increase in the integration value of Maru, which was directly linked to one integration core (Madang). In phase 2 (detached house), Maru inherited the integration core's role linking to all other spaces, and the integration value rapidly increased. It inherits the function of circulating space, and it is not easy to judge that the role of the modern living room has been established. However, there was a little discomfort in the spatial composition centered on one space, so it was settled in the South Korean housing format after phase 3. This low resistance can be judged to be due to the spatial experience of traditional courtyard houses. However, as derived from Chapter 2, floor level distinction accelerated the establishment of public personality.

In China's case, there was no significant change in the integration value when changing from phase 1 to phase 3. In going from phase 3 to phase 4, the integration value increased rapidly ($p < 0.00$). Siheyuan has a structure in which the integration core (courtyard) expands and links in each sector. Lilong houses vertically expand the horizontal structure of traditional courtyard houses. In other words, from a topological point of view, Siheyuan and Lilong houses share a similar composition. Besides, it has a similarity in arranging public spaces because it has been changed to an apartment house with a similar spatial composition to South Korea. It can be interpreted as a factor in which the courtyard house's spatial experience can reduce the spatial composition's repulsion with one integration core.

Figure 5.3 shows the transformation of the semi-public space. The kitchen space has undergone the most physical changes. In Korea, it was raised from the lower floor level to the same level as the rest of the space. And the physical connection to the Anbang was cut off, and I was freed from a fixed position to some extent. In Japan's case, Daidokoro, Doma, and Chanoma were divided according to their roles, but they changed to DK with modern ideology. In China's case, the kitchen location is not fixed in traditional courtyard houses, but it is common to place it separately from the living space. This spatial composition is often inherited from modern houses and planned as a separate space. I

In China, the integration value tends to increase ($p < 0.00$) as it changes from phase 1 to phase 2. After phase 2, the integration value has been maintained at a constant level, and there was no statistically significant change. As previously stated, it is common in Chinese

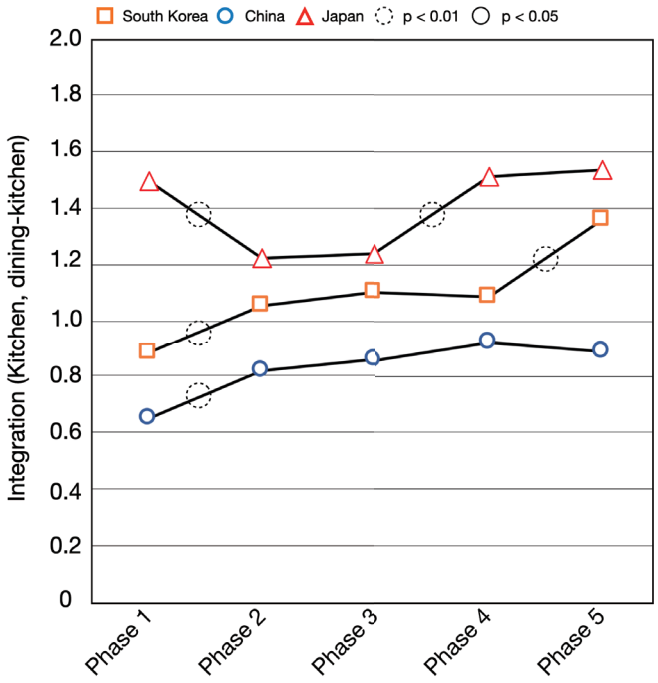


Figure 5.3 Change of integration value of semi-public space

houses to plan the kitchen space separately from the main living space. It is the result of efforts to resolve ventilation due to the food culture that uses much oil. In the case of Lilong housing, it was placed in a sub-building to the north. Furthermore, there were many cases in modern apartments where a door was attached to the entrance hall. The tendency to plan separately from other spaces is more evident when comparing different countries' integration values.

In Korea, the integration value tends to increase ($p < 0.00$) as it changes from phase 1 to phase 2. It is due to the spatial scale between the traditional courtyard house and the urban Hanok. Interestingly, the integration value tends to increase rapidly ($p < 0.00$) as it changes from phase 1 to phase 2. As previously described, it is a phenomenon that occurs as the floor level of the kitchen rises and is directly connected to the living room. Besides, early DK plans to deviate slightly from the living room, but in 1990, more and more cases are planned as a visually integrated space. In South Korea, DK establishes its role and status in apartment houses as a new space that did not exist in conventional houses.

In Japan's case, as it changes from phase 1 to phase 2, the integration value tends to decrease ($p < 0.00$). This phenomenon occurs when the house's spatial size difference and the spatial composition of "Daidokoro-Doma" of the samurai house are simplified to Daidokoro. From phase 2 to phase 3, no statistically significant change was found. As it changes from phase 3 to phase 4, the integration value tends to increase ($p < 0.00$). After phase 4, the In-

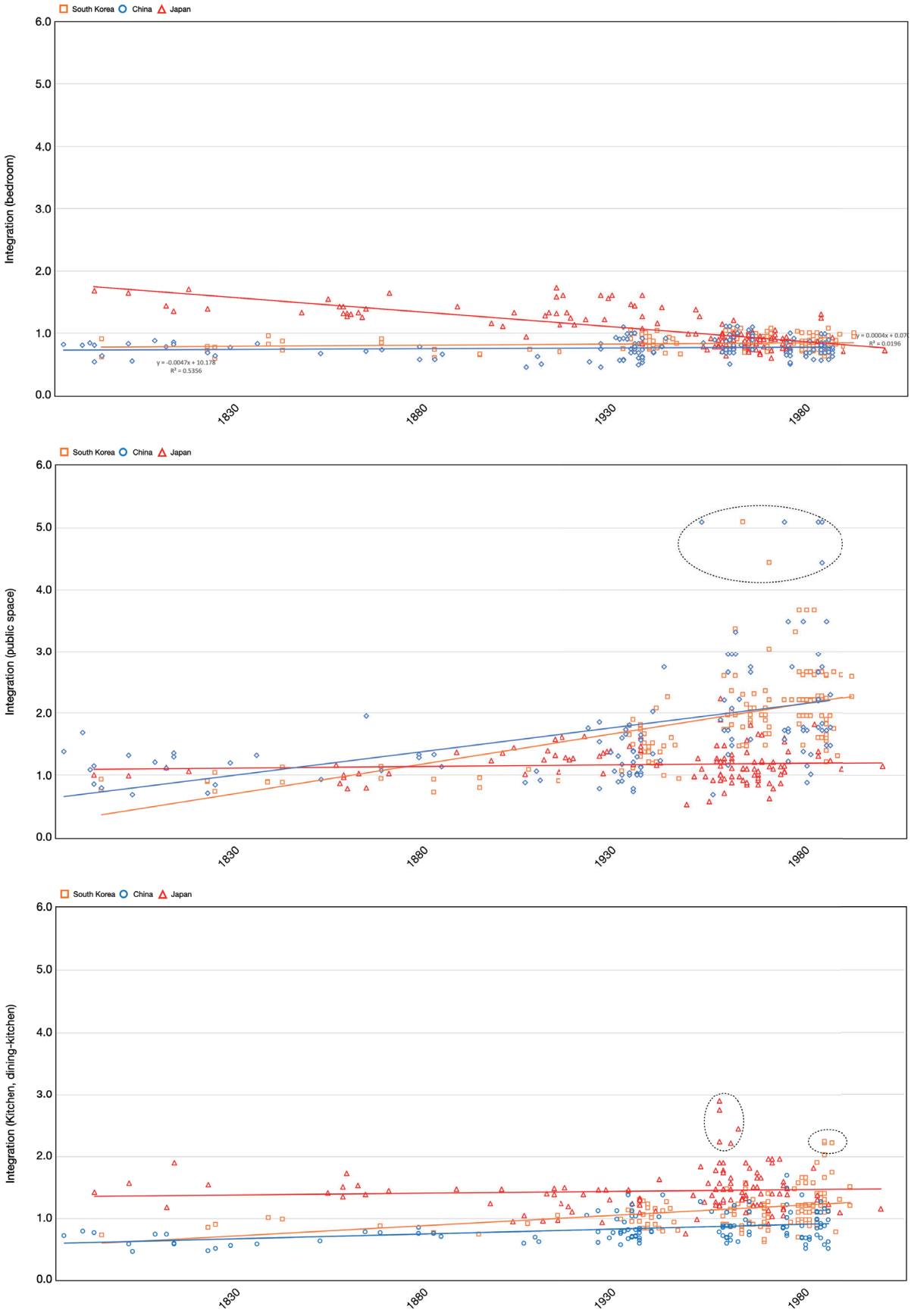


Figure 5.4 Temporal change of the integration value of the three main space

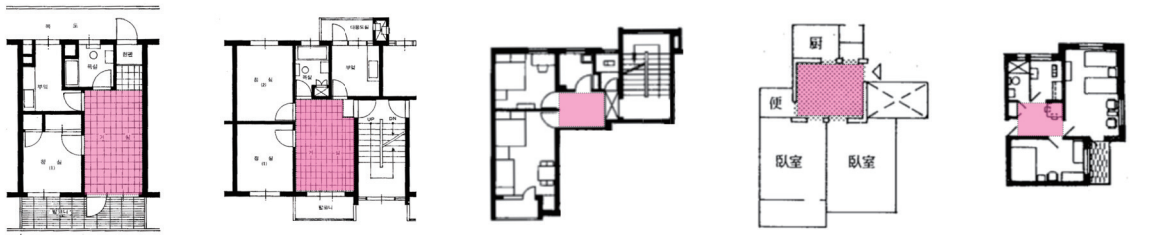
tegration value is maintained at a constant level. DK had a profound influence on Japanese housing after World War II. It was proposed to separate the sleeping and eating behaviors for modern life. In other words, it is a space that combines the traditional family living space (Chanoma) and kitchen space.

In the previous section, each country's significant spaces were compared and analyzed in terms of topology by dividing them into five phases. As a result of the analysis, as private spaces (bedrooms) changed to modern apartment houses, there was a decreasing integration value in all countries. Moreover, China was being planned while maintaining a lower level of topological centrality than in other countries.

Public space increased rapidly in Korea and China's apartment plans, and Japan did not show much change. Korea showed statistically significant changes in the semi-public space, and Japan showed high integration values on average. China continues to maintain low levels of integration, from traditional courtyard homes to modern apartments.

These three countries' changes appear more clearly when a graph is drawn up and analyzed in terms of time-integration values. Looking at the graph at the top of Figure 5.4, the integration value of private spaces of urban houses in Japan is continuously decreasing. In contrast, South Korea and China continue to maintain values below 1.0.

As described in the previous section, after the 1950s, all houses' integration values ranged between 0.8 and 1.1. It means a growing tendency to plan bedrooms in the three countries with the same spatial depth. In other words, it can be interpreted that the modern housing concept of "bedroom = private space" is accepted through apartment houses. In particular, in Japan, the depth of bedroom space has increased since 1950, showing a big difference from the previous era's houses.



Mapo Apartment Type-A (1972)

70 (5S) 17SB-1 in South Korea (1969, 1970)

Small living room type in Beijing (1973)

Shanghai faculty housing (1980)

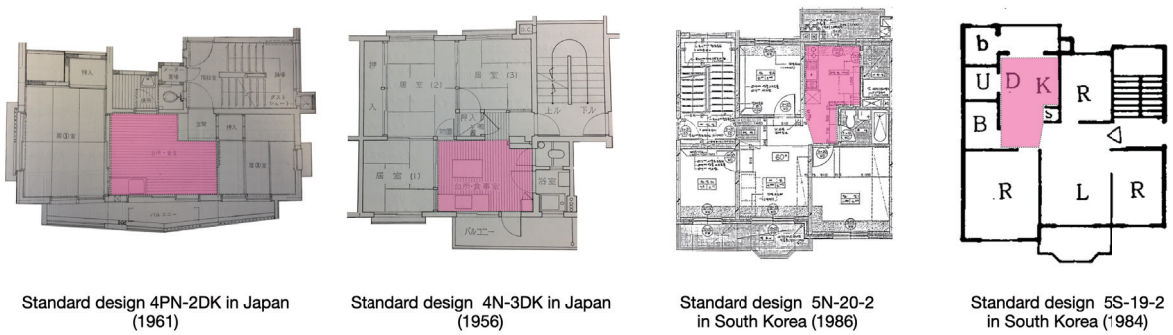
Standard design Tenjin-2 (1980)

Figure 5.5 Exception case with high integration value in living room

The graph in the middle represents the transition of public spaces. The integration value of public spaces shows the most significant change. The value of integration between Korea and China gradually increased after the 1930s and then increased rapidly after the 1950s. There are also extreme cases where the integration value exceeds 5.0 (figure 5.5). Cases with too high integration values appear mostly in small unit types. It is a phenomenon that occurs because all spaces directly link with public spaces. In other words, it easily appears in the spatial composition of depth 1 (public space) - depth 2(all other spaces).

The graph at the bottom shows the transition of the semi-public space. It is mostly distributed between 1.5 and 2.0 in terms of time series. It can be seen that Japan and China are maintaining the same style, from traditional houses to modern apartments. In Korea's case, the kitchen's integration value is continuously increasing, which is considered a factor that makes a difference from other countries' housing plans. Interestingly, in the 1960s, Figure 5.5 shows some cases where the integration value of Japanese housing DK is exceptionally high.Besides, in 1980 in South Korea, an apartment plan was also found with a very high integration value than the average. In Japanese standard design, the occupant's circulation is handled through a small corridor or an entrance hall that is usually linked directly from the entrance.

Exception cases show a phenomenon that increases the topological centrality because toilets and bathrooms are directly linked to DK. In Korea, the exception cases have a spatial composition in which the rear balcony, boiler room, laundry room, and bathroom are directly linked to DK. It can be interpreted as a tendency of planning to arrange spaces for supporting functions of life individually. Besides, in traditional courtyard houses, the kitchen supported housekeeping with a low-level floor (wet space).This cultural convention can be interpreted as an attempt to complement the function by attaching a space supporting water use to the DK while reorganizing it into an apartment house without a courtyard.



Standard design 4PN-2DK in Japan (1961)

Standard design 4N-3DK in Japan (1956)

Standard design 5N-20-2 in South Korea (1986)

Standard design 5S-19-2 in South Korea (1984)

Figure 5.6 Exception case with high integration value in DK

5.3 Comparison of distribution characteristics of spatial composition

The previous section analyzed the changes in integration values for three significant spaces from a time-series perspective. Korea and China have similarities in the way they organize public spaces. Changes in the bedroom showed the largest decrease in Japan's case, and it is different in China to maintain the low integration value on average. In the kitchen, changes in Korea are showing a tendency to increase the integration value continuously. In this section, the differences in each country's spatial composition are analyzed using the integration values of the three types of space analyzed in the previous section. Also, by creating a distribution map of integration values, each country's spatial characteristics are classified.

Figure 5.7 changes the relationship between "bedroom-public space" into a graph. The integration value of bedrooms in traditional housing to the detached urban house is distributed between 0.4 and 1.7. The integration values of Hangu and China are lower than that of Japan. In the case of public spaces, South Korea has the most considerable change (0.6-2.8), followed by China (0.6-2.1). In Japan's case, since all spaces have the spatial composition of the cyclic loops that are linked, it is characterized by having a lower level of integration compared to other countries. As the integration value of bedrooms in South Korea increases, the integration value of public spaces increases rapidly.

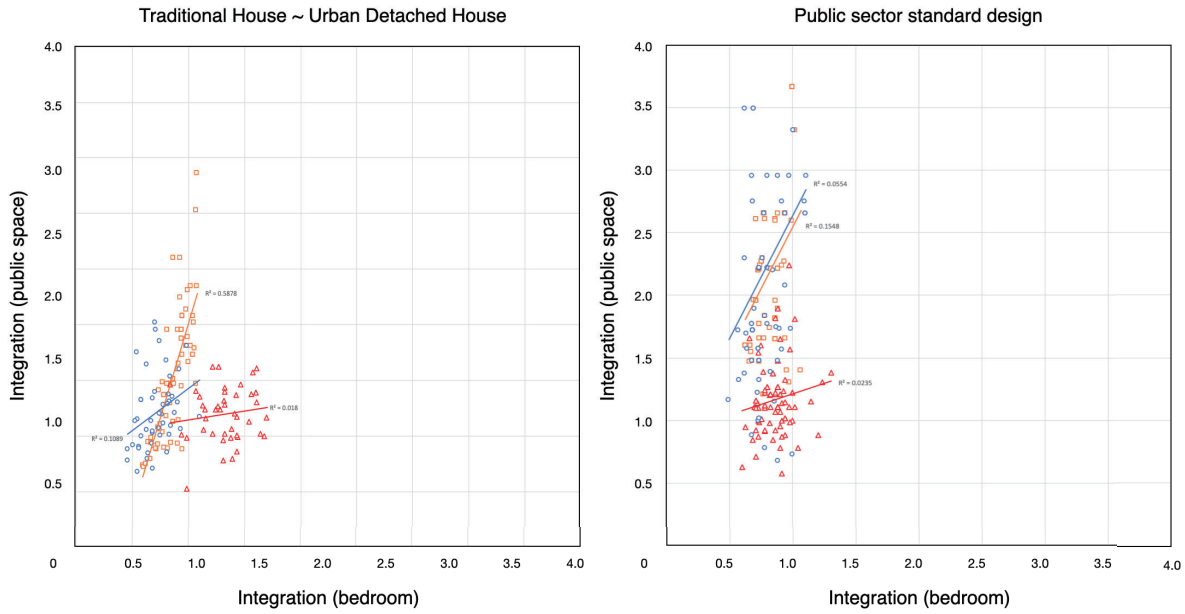


Figure 5.7 Distribution graph of correlation between bedroom and public space

As previously described, in Japan's case, since all spaces have a constant level of integration value, they exhibit different distribution characteristics.

In the graph of the public sector standard design, the integration value of bedrooms is distributed between 0.4 and 1.4, and Korea and China have lower integration values (less than 1.2). Japanese bedroom integration values have decreased slightly. The range of changes in the integration value of public spaces increased further. Compared to other countries in South Korea, the correlation between "bedroom and public space" was observed. Considering the public space-bedroom correlation distribution characteristics, Korea and China are distributed with similar patterns. In Japan, all types of houses have low public space integration values and tend to be distributed according to changes in bedrooms' integration values.

Figure 5.8 reproduces the relationship between "bedroom-public space" as a graph. The kitchen's integration value is distributed between 0.4 and 1.9 in the range of traditional housing to the detached urban house. The average integration value in Korea and China is lower than that of Japan. In the case of public spaces, South Korea has the most considerable change (0.6-2.8), followed by China (0.6-2.1). In Japan's case, since all spaces have the spatial composition of the cyclic loops that are linked, it is characterized by having a lower level of integration compared to other countries. Looking at the public sector standard design graph, the kitchen integration value is distributed between 0.5 and 3.0, and China has

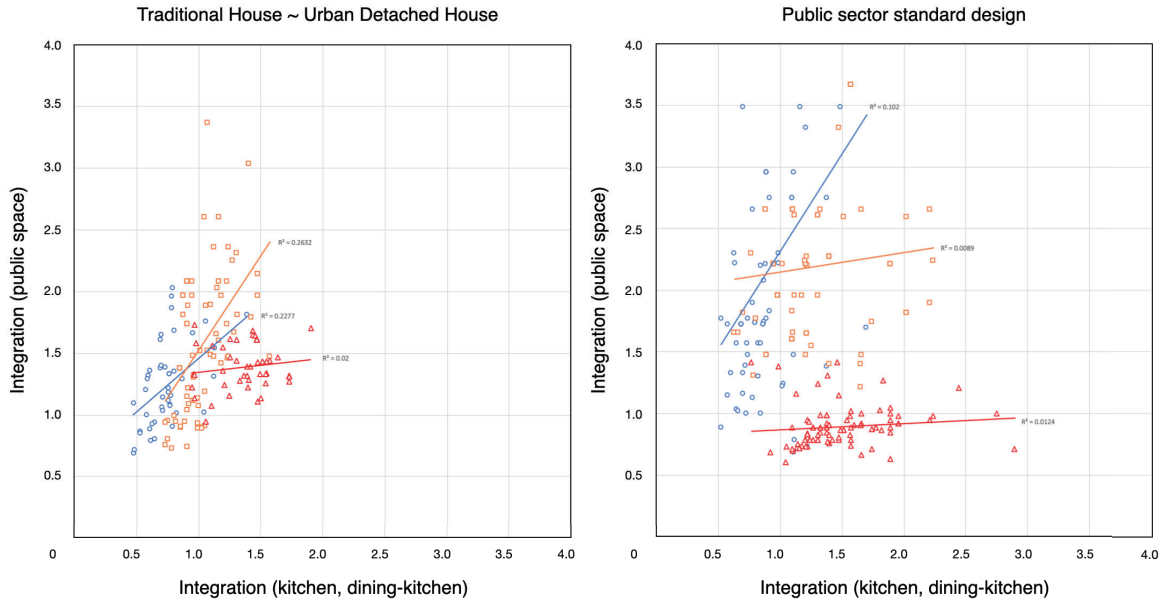


Figure 5.8 Distribution graph of correlation between kitchen and public space

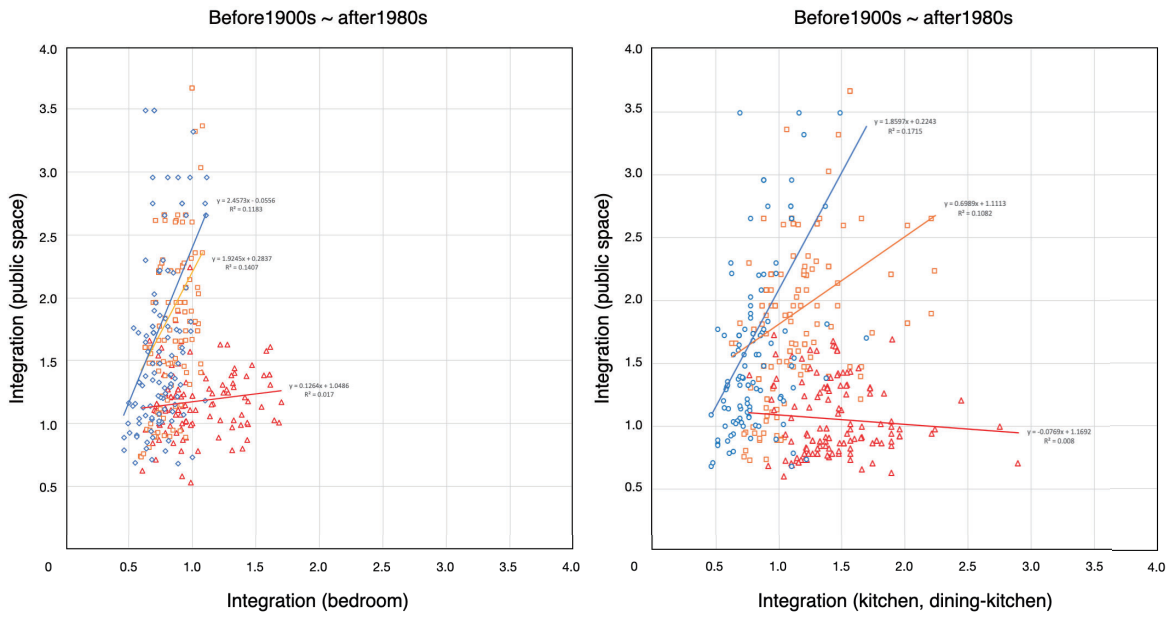


Figure 5.9 Correlation distribution graph

a lower integration value (less than 1.6). Japanese kitchen integration values are widely distributed compared to those of Korea and China. Compared to other countries in China, the correlation of "kitchen-public space" was high.

From the perspective of "bedroom-public space," China and South Korea have similar distribution characteristics and appear in contrast to those of Japan, which have a low integration level. About "kitchen-public space," South Korean and Chinese houses' spatial characteristics appear separately. It can be judged due to the cultural conventions shared by China and South Korea (spatial composition with one integration core). Besides, the characteristics of urban housing in South Korea are more clearly revealed through the difference arising from the kitchen's integration value.

In other words, China's urban housing has the property of intentionally separating the bedroom and the kitchen from the spatial composition centered on the public space. Also, it protects privacy by intentionally increasing the bedroom's spatial depth and aims for the comfort of inner life through the spatial separation of the kitchen. In South Korea's urban housing, the living room and the DK each play a complementary role, playing a central role in life. In urban housing in Japan, the integration value of bedrooms decreases to a level similar to that of other countries. After 1980, the integration value tends to decrease as kitchens were separately planned.

Chapter 6

Discussion and conclusion

6.1 **Overview :** Reminding the research questions

This thesis has examined the changing modern urban housing culture in Korea, China, and Japan with a question: ***how do old spatial values interact with a new domestic setting?*** Efforts have been made to answer this question; using the house transformation process that happened in the twentieth century each country, and two different approaches were made to illuminate the interaction between the old and the new. These three approaches were categorized as a spatial-behavior dimension, a symbolic dimension, and a syntactic comparison dimension. Each dimension has examined the question from the perspective of the space-behavior relation, housing culture-spatial relation. Space syntax theory has been chosen as the best channel through which the evolutionary process of change can be analytically and objectively measured and then interpreted.

For the investigation's efficiency, the main research question was divided into three sub-questions, each of which focuses on one of the three dimensions mentioned above. They are: first, how is an old spatial organization mapped onto a new setting that is formally and functionally different?; second, how is an old conceptual dimension in space transferred through a transformation process?; third, how is the difference in the spatial composition of the domestic setting in each country?

The first and second sub-questions were discussed in chapter 2, 3, 4. In the chapter, the diachronic analysis was made by tracking the historical development of each country's housing types, and this included the important types of houses that existed in the twentieth century, namely; Korea has included the traditional courtyard house, the public sector detached house, and the public sector apartment house, China is included the traditional courtyard house, the urban Row Houses, and the public sector apartment house, Japan is included the traditional samurai house, the middle-class houses, and the public sector apartment house.

The problem of mapping the two radically different physical settings of the houses was solved by replacing the basic unit of mapping from a partitioned space, i.e., a room, to a room's compositional element, i.e., a behavior. From this conceptual replacement, the evolutionary process of housing culture could be more precisely measured.

The third sub-question was tackled in chapter 5. In the chapter, amongst the housing types

examined in chapter 2, 3, 4. The morphological variations of a traditional house in the sample timing range in the 17th to 20th century each country were collected and analyzed. Since the sample plans were built over a long period, these plans are strongly influenced by social-cultural factors. For systematic analysis of the sample plan, space was classified according to spatial composition, and statistical comparison of the calculated integration value (i) was conducted. Each country has found that there is a typical trend of spatial composition.

6.2 Culture as a driving force for housing evolution

In chapter 2-4, to answer the first and second sub-question, it was suggested that a room-to-room mapping should not compare the old and new houses; instead, these two or more heterogeneous settings should be seen through the space-behavior interaction to understand the transformation process. Since, for each country's houses, the rooms in the old house are not equivalent to those in the new, each room as a spatial unit in domestic space was intentionally decomposed to become its compositional elements, i.e., behavior, which characterize the function of a room.

In fact, this translation of the house's physical structure to the non-physical domestic behaviors could be regarded as the actual mechanism in the human mind that facilitates the re-adaptation to a new dwelling environment. Even if the new environment is similar to the old one, people often re-arrange their domestic activities to make them fit better into a unique setting. For instance, if the bedroom of a new home is much smaller than the one in the old house, it may not be possible to use the tea table and chairs in it as before, and hence the old habit of having tea in the bedroom has to be transferred to another room. In this sense, adaptation to a new space requires re-assignment of activities, which happens more intensely when the spatial condition radically changes.

Using the space syntax methodology, these activities' movement could be measured in terms of topological values (Standardized Integration values). The topological paths they followed through the transformation process of housing showed dynamic movements. When the new housing type emerged, some activities that belonged together in a room were separated into different rooms, while some converged into the same locality from separated

rooms. When the traditional house's spatial structure in each country was renovated by the new design of the modern house in the middle of the twentieth century, most of the domestic activities had to become involved in this relocation process. This process was performed in two phases; first, by the modern designers and second, by the house's new users. The designers first reprogrammed rooms with an intention to redistribute the enclosed activities. By changing the function of each room, they tried to regulate a new way of living. In the second phase, when people moved in, they must have tried to 'read' or 'retrieve' from what the designers set up, an appropriate spatial structure for proper modern living.

The re-adaptation in this second phase, however, does not necessarily follow the designers' intention. Consciously or unconsciously, some people slightly modified the rooms' intended use by adding to or subtracting from each partitioned space some activities, while others radically modified the rooms by completely changing their functions. It can be said that these mismatches between the designers and users were mainly due to the different perspectives on the old spatial values. After the Korean War, the first generation of the modern designers in korea tried to change their architectural competence to fit to the new spatial language, most of the users' minds. However, most living in the traditional domestic environment.

This discrepancy in the idea of the new home can be exemplified by the fact that in many modern homes, people still called what designers are labeled as the main bedroom by the traditional name, anbang. This verifies that people were still using the room in the same way they did in the traditional spatial setting; thus, family gatherings and meals were still occurring in the room. In an extreme case, people actively modified the physical structure of their houses; in some of the early apartment houses, designers intentionally raised the bathroom floor up to the level of the adjacent living room to follow the western standard. Still, later the users had the floor rebuilt to make it lower, as mentioned at the end of chapter 2. In this case, the designers failed to notice the indigenous symbolism that is stronger than the evolutionary power. They disregarded the fact that activities are symbolically characterized by the two contrasted domestic environments, i.e., the raised floor area and the earthen floor area.

Since the house's raised floor side acquired symbolic meaning as a divine clean zone in the long process of evolution, activities performed in it were treated differently from those belonging to the other side. Thus the behavior of body washing, which used to be performed in the courtyard or kitchen in the traditional house, was a part of the activity group defined by the symbolic nature of the earthen floor area where dirty and wet jobs were allowed. During

the modern housing development, the designers could not see this inherent symbolism of level distinction and could not even expect that it is strong enough to make the inhabitants' act to reconstruct their houses. The inhabitants' need was to perform the activity of body washing 'in the old sense' in the new space of the bathroom, and therefore they wanted the floor of the room to be lowered.

From the justified graph analysis, it was recognized that there was a gradual movement of the low-level spaces from the center towards the edge as houses evolve from the traditional urban house to the detached house. Then to the several phases of apartment plans - this visual observation was corroborated by space syntax values.

Therefore, the following sequence of plan transformation can be characterized as a process where all the variables, including the level-distinction, are involved in finding the optimum solution that suits the modern dwellers in Korea. In this process, the high-level spaces are converging together in one cluster in the center of the plan, while the lower-level spaces are moving outwards towards the surrounding edges. Looking at the whole process beginning from the traditional urban house, it can be said that this was a topological movement where the two heterogeneous spaces are heading in two opposite directions, thus swapping their original positions. In this sense, even though the transformation process of housing culture in Seoul looks radical and disconnected on the surface, it can be said that there was a hidden, symbolic dimension in space, i.e., level distinction, that actively guided the course.

This discrepancy in the idea of the new home can be exemplified by the fact that in many modern homes, people still called what designers are labeled as the living space by the traditional name, Ting. After the establishment of the People's Republic of China, the first generation of modern designers provided a new spatial language, but users still live in a traditional domestic environment. It can be seen that, as "Ting", which was removed from the early apartments, was revived from the 80s plan, people prefer the same way they did with traditional space settings. Also, the eruption of dining rooms found in Chinese apartments is a very interesting discovery. It can be judged that it inherits the traditional spatial structure that separates the space of each household. Their behavior can be seen as symbolically characteristic of two contrasting domestic environments, bright and dark.

In Japan, This discrepancy in the idea of the new home can be exemplified by the fact that in many modern homes, people still called what designers are labeled as the living space by the traditional name, Zashiki. After World War II, the first generation of modern designers provided a new spatial language, but users still live in a traditional domestic environment. It

can be seen that, as "Zashiki," which was removed from the early apartments, was replaced from the 80s plan's livingroom+Zashiki(tatami), people prefer the same way they did with traditional space settings. Also, the eruption of Mae-Oku found in Chinese apartments is a very interesting discovery. It can be judged that it inherits the traditional spatial structure that separates the space of each household. Their behavior can be seen as symbolically characteristic of two contrasting domestic environments, shallow and deep.

In chapter 5, from the perspective of "bedroom-public space," China and South Korea have similar distribution characteristics and appear in contrast to those of Japan, which have a low integration level. About "kitchen-public space," South Korean and Chinese houses' spatial characteristics appear separately. It can be judged due to the cultural conventions shared by China and South Korea (spatial composition with one integration core). Besides, the characteristics of urban housing in South Korea are more clearly revealed through the difference arising from the kitchen's integration value.

In other words, China's urban housing has the property of intentionally separating the bedroom and the kitchen from the spatial composition centered on the public space. Also, it protects privacy by intentionally increasing the bedroom's spatial depth and aims for the comfort of inner life through the spatial separation of the kitchen. In South Korea's urban housing, the living room and the DK each play a complementary role, playing a central role in life. In urban housing in Japan, the integration value of bedrooms decreases to a level similar to that of other countries. After 1980, the integration value tends to decrease as kitchens were separately planned.

6.3 Conclusion

There have been many studies dealing with the housing culture in South Korea, China, and Japan. Some argued that the tradition had been disconnected in the twentieth century, and others tried to argue that the apartment house successfully replaced the old house's tradition. What is lacking in the former argument is the role of space in evaluating the architectural tradition; they only see the tradition from the surface value in a typological sense, and thus, to them, modern buildings are not counted as a part of the tradition. If tradition is seen only from the phenotypical standpoint, however, the consistency of tradition can always be broken by a new style at any time.

From the perspective of a symbolic dimension, it has been confirmed that the old symbolism persists through the turbulent time of change and even guides the process of change. Although it cannot be defined as a single activity or event, this hundred years old symbolism has been crystallized at the level of unconsciousness in people's minds. Without being noticed, it had been transmitted from generation to generation, and, in the time of change, it implicitly affected the intuition of the designers and dwellers who had to face a new housing culture. In this second part of the analysis, the symbolic concept of level distinction, of which no proper research has been ever executed, was illuminated in the light of the space syntax theory.

The results of these two analyses strongly suggested that, even in a fast-changing society, the new house is not completely disconnected from the heritage of the old house. In a sense, their existences are only separate at the physical or rather material level, not at the behavioral and spatial level.

For instance, it has been argued that the living room in the apartment South Korea in Korea is the functional substitute for the courtyard in the traditional house because the former succeed in the role of the latter as a central hub for the movement flow(Choi, 1990). As verified in this thesis, it merely thinks that modern rooms can find their matches in the old house; rooms are continually reinvented with its changing activities as the house evolves. The modern living room inherits Anbang's behavior. In a similar case, it has been argued that the living room of a Chinese apartment house is a functional replacement for Ting in a traditional house because it inherits the role of the central hub of movement flow. However, in a survey of residents in the 1970s (Tomokiya, 1994),

Ting functions as a buffer space or entrance hall among different generations. It is also difficult to interpret that living rooms, which have spread since the 1980s, directly inherit traditional public spaces. Besides, in the study of Uekita (1995), although the bedroom linked from the corridor or the front chamber has an advantage in securing privacy, it is pointed out as the cause of the collapse of the traditional spatial structure. However, as a result of this study, the integration value of bedrooms is recovering from the traditional housing level, and the spatial code inherited from Chinese housing clearly separates public and private spaces.

The modernization of housing in Japan began with criticism of the Zashiki sector (Suzuki, 1988; Aoki, 1986). The importance of zashiki in housing was overemphasized, and the living space for families was pushed to the north, resulting in a low quality of the residential environment. Early planners suggested plans to place the family space in the south or the Ima (living room) in the house's center.

However, the results of a series of studies by Ooka (1994; 1996; 1997; 1998a; 1998b; 1999a; 1999b) analyzed the difference between the Zashiki sector and the Chanoma sector, which were pointed out as the cause of criticism in the existing housing modernization process. The conclusion of the analysis is as follows; a) In at least half of the houses, the Chanoma sector was located in the south. b) There was no significant difference in the area of zashiki compared to the area of family living space. c) Zashiki's interior decoration and quality did not differ significantly from that of the family living space.

The results of this study support Ooka's research and provide a contradictory view that the Chanoma sector (family living space) is located at the topological center of the housing space. Choi (2003) analyzed the phenomenon that the topological centrality of the female's space (Anmadang) is higher than that of the male's space (Sarangmadang) in the late Joseon Dynasty. He interprets it as a combination of the two factors, females' social status and the improvement of housework efficiency. From this point of view, it can be interpreted that the spatial composition of Japanese samurai housing is expressing a consciousness to efficiently support the reception space by placing the family living space at the topological center. Besides, although there is a strict spatial structure based on gender and social status, which can be confirmed in traditional houses in each country, it can be confirmed once again that the most basic nature of a house is a space for residents' living.

Rapoport (1976;1990) suggested that the broad concept of ‘culture can be dismantled by investigating its lowest level of components, activities, in association with their architectural

settings. While he only portrayed the abstract outline of this conceptual frame without presenting the possible methodology for research, this thesis has formulated a model in chapter 2~4 in which the cultural mechanism between the space and activity could be measured and evaluated in the light of the space syntax theory. As its label or its representative function cannot define a room, this space-activity model has been a useful tool to precisely measure the changing process of housing in time. Moreover, this model has made it possible to tackle level distinction, which has been regarded as too abstract to deal with.

Therefore, this thesis's argument has been established on an analytical basis to reveal the relationship between culture and housing systematically. Adopting the new approaches in utilizing the graphs and mathematical values tried to avoid vague and ambiguous descriptions in interpreting houses' morphological characteristics.

While this study tried to cover the century's changing housing process, there are some limits to its methodology and argument. As there appeared a single dominant type of housing, apartment housing, in the latter part of the twentieth century, the housing culture in this period had to be represented by it. Consequently, its possible design interaction with other types, e.g., multi-family housing and detached houses, could not focus. Although these different accommodation types show a decreasing degree of importance in terms of their proportion of the housing stock, it would be meaningful to examine how the old spatial values have interacted with different types of domestic spaces. It is hoped to be the future work to combine the study of these other types with this thesis's findings to illuminate alternative paths of the spatial values.

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국문초록

한국 · 중국 · 일본 도시주택 변천에 대한 공간 위상학적 해석

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본 연구는 도시주택의 대표적인 유형으로 자리 잡은 공동주택의 물리적 환경에 대한 의문과 근대화 과정에서 새롭게 등장한 공동주택과 각 문화권 전통 주거공간 사이에 공유하는 속성의 존재 여부에 의문을 제기하면서 시작한다. 연구의 목적은 동아시가 3국의 도시주택의 변천과정을 추적하고 변하는 것과 변하지 않고 유지되는 것이 무엇인지 실증적인 분석에 기반을 두고 밝히는 것이다. 도시주택의 근저를 이루는 것으로 물리적 환경에 내재하는 질서, 즉 공간구조를 상속하는 유전적 속성이 존재하며, 그것은 각 문화권에 존재하는 전통 주거의 공간적 구성에 토대를 두고 있다는 전제 하에 연구를 진행한다. 유전적 속성은 물리적 환경의 근간을 이루고 있는 것으로 공간구조 상에서 시간적 변화에 따라 다른 모습으로 변모하고 있지만, 그 안에 담겨 있는 거주자의 삶의 방식으로 표출되고 있다. 이러한 속성이 다양한 변화를 통해 희석되거나 새로운 요소와 혼합하여 새로운 형태로 발현 될 수 있는 가능성도 가지고 있다. 따라서 도시 주택의 변천의 추적과 비교를 위해 위상학적 그래프 이론을 적용한다. 또한, 한국, 중국, 일본의 비교분석을 통해서 도시 주택을 구성하는 있는 각 공간과 주거 평면의 내적인 구성질서를 명확하게 밝힐 수 있을 것으로 기대한다.

전통적 공간구성이 새로운 주택에 어떻게 재배치 되는가에 대한 연구문제를 효과적으로 설명하기 위해 3개의 하위 문제로 구분하여 고찰한다. 공간에 따른 거주자의 행태를 추적하는 공간–행태적 차원, 전통주택의 공간 구조에서 발견 할 수 있는 바닥 높이 차이의 개념, 공사 공간의 차이의 개념, 공간 깊이 차이의 개념, 그리고 성별과 사회적 신분과 전통주택의 공간구성 사이의 상관성을 밝히는 상징적 차원, 3국의 도시주택의 시계열적 변천을 비교하는

비교적 차원, 이상 세가지의 하위 문제를 살펴보고 궁극적으로 도시주택의 공간적 변천 과정에 대하여 소명하고자 한다.

연구의 대상은 한국의 경우, 조선시대 한옥, 도시형 한옥, 주택 공사의 단독주택과 3실형 아파트 등 157개의 평면을 수집 하였고, 중국의 경우, 명·청 시대의 사합원, 이농주택, 표준설계 등 157개의 평면을 수집하였다. 일본의 경우, 에도시대 중하급 무가주택, 중류주택, 일본주택 공사의 표준설계 등 158개의 평면을 대상을 분석한다. 분석의 방법은 공간분석 기법 중 공간구문론을 활용하여 각각의 설계안을 정량화 한 후 시계열 분석을 시행한다.

과거의 공간이 새로운 공간으로 변화 하면서 그 특성을 그대로 유지하고 있다고 보기 어렵기 때문에, 공간-행위에 측면에서 하나의 공간에 일어나는 거주자의 행태를 분류하여 전통주택에서의 행위가 시계열에 따라 변화하는 과정을 추적하는 동시에, 공간조의 속성은 위상학적 중심성을 보여주는 통합도 지표를 통해서 해석한다. 상징적 차원에서는 각 나라의 전통 주택에서 발견 할 수 있는 공간적 차이를 변화 추이를 해석하고, 성별과 사회적 신분에 의한 점유공간을 분류하여 통합도의 평균을 t-test를 통해 해석한다. 비교적 차원에서는 공공공간, 사적 공간, 반사적 공간의 통합도의 평균 변화에 대하여 해석한다.

분석의 결과, 한국은 과거 얕은 공간 구조를 가지며 마당을 중심으로 통합된 구성을 갖는 전통 한옥에서 점차 공간이 깊이져 내밀화된 공간구조를 가지는 공동주택에 이르고 있는 것으로 보인다. 또한 안방, 침실, 욕실 등은 점차 깊은 공간 구조로 내밀화되는 특성을 보이고 있으나, 부엌과 거실은 점차 얕은 구조로 변화하면서 주택의 중심에 배치하는 경향을 보이고 있다. 특히, 안방은 공간 고유의 기능과 성격을 지속하고 있는 것을 알 수 있었고, 마당에서의 행위는 주택의 주변부의 낮은 공간으로 재배치 되어 존속하고 있다. 또한, 내부공간과 외부공간을 바닥 높이로 구분하는 한국의 전통주택의 구성이 근대화 과정을 거치면서 새롭게 재배치 되고 있는 과정을 명확하게 설명하고 있다. 이것은 기존의 연구들이 주장하는 중정과 마루의 거실화 및 공사 공간의 분화를 반박하는 결론을 보여 준다. 중국은 과거 가지형태의 깊은 공간을 가지고 있으며, 한국과는 다르게 마당을 중심으로 각 영역을 분리하는 구성을 가지고 있었다. 이러한 공간 깊이는 점점 얕아지고 근대 초기에는 하나의 침실에서 모든 행위가 이루어졌고, 1980년에 이르러서 전통주택과 비슷한 수준의 공간적 깊이과 구성을 회복하고 있다. 특히, 의도적으로 침실 공간을 중심공간에 분리하는 경향이 강하게 나타난다. 일본은 공간적 깊이를 통해 거주자 및 방문자의 이동을 컨트롤 하는 공간적 구성이 현대 공동주택에서 표출되고 있는 것을 알 수 있었다. 또한, 공간 위상학적 측면에서 가족생활 영역이 주택 공간의 중심에 배치하는 것과 공공공간을 의식적으로 주택의 깊은 공간에 배치하는 경

향이 현대 공동주택에 존속하고 있었다. 전통건축에서 근대이후 오늘날에 이르기까지 주택 공간구조는 과거 권위적, 과시적, 위계적 성격을 갖는 중심공간 위주의 통합된 공간구조에서 실용성과 독립 성을 추구하는 내밀화된 사적공간으로 분화되고 있는 경향을 보이고 있다. 동시에 공간 구성 즉 공간의 위상학적 관계에 있어서는 각 시대별 주택의 공간구조가 서로 상치하며(overlap) 다소의 변화 속에서 지속되는 경향을 보이고 있다. 따라서 과거 로부터 오늘에 이르는 우리의 주거는 형태적인 면에서는 단절과 변용, 그리고 새로 운 수용의 결과로 논할 수 있지만, 공간적인 측면에 있어서는 부분적인 변화의 수 용 과정을 거치면서 지속되어온 공간구조로 결과 지을 수 있다. 다시 말해 주택의 형태는 변하였으나 내재된 공간구조의 본질은 지속되고 있음을 고찰할 수 있었다.

각 나라의 도시주택에 존속하고 있는 속성은 물리적 환경을 재해석하는 관점으로 그 중요성과 가치가 있으며, 실제 거주자가 주거공간 계획을 수용하는 측면에서 상당한 의미를 지닌다. 본 연구는 도시 주택에 내재되어 있는 공간적 구성을 정량적 분석을 통해 변천과정을 객관적으로 고찰 하고 있다는 것에 큰 의의가 있다. 또한, 디자인 및 계획적 측면보다 더 근본적인 공간 배열의 문제 즉 공간구조에 대하여 논의 하였고, 기존 주거 문화적 측면에서 연구들과 다른 관점에서의 시도와 결론을 얻을 수 있었다는 것에 중요성을 가진다.

주제어: 공간구문론, 한국 도시주택, 중국 도시주택, 일본 도시주택, 공간구조 변천,

論文の要旨

韓国 · 中国 · 日本の近代都市住宅における空間位相的解析

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戦後の住宅難に対して韓国・中国・日本は、都市住宅を取り巻く社会の発展や変容等の中、1970 年代まで公共主導の住宅が大量供給され、1980年代は個性化・多様化される共通点を持っている。本研究は、韓国・中国・日本における各国の伝統的住宅から1980年代に至るまで都市住宅の空間的構成や住生活がどのように変容を遂げているのか、あるいは従来からの伝統性がどの程度継承されているのか、これらの空間位相的構造の変遷を明らかにすることを目的としている。都市住宅の根底を成すものとして物理的環境に内在する秩序、すなわち空間構造を相続する遺伝的属性が存在し、それは各文化圏に存在する伝統住居の空間的構成に基づいているという前提の上で研究を行う。遺伝的属性は物理的環境の根幹をなすものであり、空間構造上の時間的変化によって異なる姿へと変貌しつつあるが、その中に宿る居住者の生き方として表出されている。このような属性が様々な変化によって希釈されたり、新たな要素と混合して新たな形で発現したりする可能性も持っている。したがって、都市住宅の変遷の追跡と比較するため、位相学的グラフ理論を適用する。また、韓国、中国、日本の比較分析を通じて都市住宅を構成する各空間と住居平面の内的な構成秩序を明確にすることができるものと期待される。

まず1章では平面構成の変容をSpace - Behaviorの観点からSpace syntaxを用いて各国の都市住宅変遷過程を追跡し、住まい方による住宅の空間的構造変遷を解析する研究方法を設定する。1章では韓国・中国・日本において3期にわたり(近世・戦前期・戦後期) 472 件の住宅平面データから都市住宅の発展過程や変遷を概括する。2章では韓国都市住宅において床の高さレベル違いと暖房方式により位相的中心性が反転する特性、3章では中国都市住宅

において「暗-明」空間の位相的中心性、4章では日本都市住宅において「前-奥」空間の位相的中心性に着目して分析を行い、また各々章では伝統住宅における男女空間が位相的中心性についても分析を行った。5章では韓国・中国・日本の都市住宅都市住宅における空間的特性を比較し、Public-Private空間の関係特性を明らかにし、6章では本研究の結論などを総括し、今後の課題を示した。

韓国の結論は大きく3点に要約できる。1点目は、「床レベル」の差が近代都市住宅の空間構造変遷要因であること、2点目は、伝統的住宅においては男性の空間は女性の空間より位相的中心度が高い。 また、社会的な身分の視点からみると、親子の関係では中心度の差異が見られないが、使用人の中心度が高いことが検証できた。3点目は、既往研究との違う知見であり、Park（1997）は、Madangの機能消失と、Anbangの独立化、また、Choi（1990）は「MadangとMaru」がリビングルームに定着、していると論じているが、研究の分析によりと、Madangの機能は床下の空間に存続し、Anbangは多様な機能を持つことによって他の空間とのアクセシビリティが上昇している。また、現代的なリビングルームはAnbangの行為から分化したものと言える。中国の結論は大きく3点に要約できる。1点目は、「明」と「暗」の差が近代都市住宅の空間構造変遷要因であること、2点目は、伝統的住宅における男性の空間は女性の空間より位相的中心度が高いです。また、親世代の空間は子ども空間より高いですが、子ども世代の夫婦間の差はなかった。3点目は、既往研究との違う知見であり、私的空間のプライバシーの強化が統的な空間を阻害(そがい)する要因だと指摘しています。しかし、研究の研究では、むしろ現代集合住宅の部屋の中心度は伝統住宅のレベルに回復していると解釈できる。日本の結論は大きく3点に要約できる。1点目は、「前」と「奥」の差は日本近代都市住宅の空間構造の変遷要因であること、2点目は、伝統的住宅における茶の間領域は座敷領域より位相的中心度が高く、また、土間と台所の空間は座敷領域より、中心度が高い。3点目は、既往研究との違う知見であり、接客領域と、家族生活領域の間に、配置、面積、仕上がりにおいて大い差がないことを論じています。さらに、本研究の結果からみると、家族生活空間は座敷領域より中心に配置されている事が既往研究との違う知見である。

本研究は都市住宅に内在している空間的構成を定量的分析により変遷過程を客観的に考察していることに意義がある。また、デザインおよび計画的側面より根本的な空間配列の問題、すなわち空間構造について議論し、従来の住居文化的側面から研究とは異なる観点からの試みと結論を得ることができたことに重要性を持つ。

감사의 글

본 논문이 완성되기까지 많은 분들의 도움이 있었기에 이 지면을 빌어 고마운 마음을 전하고자 합니다.

우선 본 논문의 주제 선정부터 완성에 이르기까지 연구방향을 제시하고 지도하여 주신 곽동윤 지도교수님께 머리 숙여 감사를 드립니다. 일본 유학의 시작과 끝을 이끌어 주시고, 마음이 부서지지 않도록 바라봐 주신 애정과 스스로 결론에 도달하록 기다려주신 인내심에 감사드립니다.

아울러, 바쁘신 중에도 논문의 심사과정에서 많은 지도와, 자세한 조언을 아끼지 않으신 小林 秀樹 교수님, 村木 美貴 교수님, 森永 良丙 교수님, 塩田 茂雄 교수님, 佐藤 公信 교수님께도 진심으로 감사드립니다.

부모님, 배우지 못한 본인들의 삶이 너무나도 지치고 고달파서 다른 인생을 살아가라고 말해 주셨지만, 한번도 아버지 어머니가 부끄럽지 않았습니다. 지금도 큰 강처럼 흐르고 있는 부모님의 곁에서 바르게 성장해서, 지금 이렇게 무사히 인생의 큰 관문을 지나고 있습니다. 감사합니다. 그리고 사랑합니다.

박사과정은 제 자신을 크게 돌아보는 시간이었습니다. 졸렬한 마음을 보았고, 매 순간 포기하고 싶어했던 나약함, 모르는 것을 아는체 하는 것들, 방향을 잃고 표류하는 생각들, 뚜렷한 목적을 가지지 못한 것을 후회했습니다. 제 자신의 힘이 아니라 주변 사람들의 도움을 받아 가까스로 이 논문의 매듭을 지었습니다. 깜냥에 맞지 않는 일을 하기 위해 외로움과 좌절을 반복한 수많은 새벽을 견딘 스스로에게 작은 위로를 건넵니다. 그리고, 지나온 길을 같이 걸어준 王甯에게 감사함을 전하고 앞으로의 여정도 지금과 같이 서로를 지탱하며 걷기를 바랍니다.

2021년 2월

김 정 민