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Ecological design values of traditional urban courtyard dwellings:
a two phase study at 1st to 10th lanes, *Dongsi* neighbourhood, Beijing

A thesis submitted for the Degree of Doctor of Philosophy

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In the memory of my father

Ecological design values of the traditional courtyard living environment:
A two phase study of 1st to 10th lanes of *Dongsi* neighbourhood, Beijing

Abstract:

The dramatic development of the urban area of Beijing in the past five decades has imposed a great pressure on the natural, social cultural and economic resources in China's capital. This is in contrast with the traditional city where the traditional courtyard house living environment and its associated life were built in harmony with the local built environment. Shaped by Taoism and Confucianism, *Wangcheng* (ideal imperial city) and *Fenghsui* theory and traditional building regulations, each traditional courtyard building exemplified an understanding of the local built context. Could, therefore a detailed study of these traditional urban courtyard living environments create a basis for a potential vernacular/traditional approach of ecological housing development?

The study focuses on the area of 1st through to 10th lanes of the *Dongsi* neighbourhood. Further, 12 different courtyard building types from the neighbourhood were chosen for a two phase case study to explore the ecological (traditional/vernacular approach) values of the traditional courtyard living environment. Firstly, place studies led to the conclusions that traditionally there were four foci of social and cultural activity in the area, these were the *Dongsi* archways, temples and temple fairs, *hutong* (lanes) and also the courtyard entrance gates. Secondly, in the urban morphology aspect, the two dimensional figure ground studies of the area have highlighted the hierarchal urban grid and voids (inner yards and courtyards) patterns. At a more detailed level, the plot pattern studies explored the flexible use of a standard 8 *mu* (5336sqm) plot size, and the building types have been studied through three buildings parameters: the roof type; buildings width (number of bays); and the building height. The original uses of these buildings were mixed and included religious, imperial residential, ordinary residential, commercial, leisure and so on. The mixed use neighbourhood combined with the hierarchal street pattern (with appropriate street proportion) and so on has helped to created lively, pedestrian and liveable streets.

In the past the archways to the neighbourhood and main road, the front public yard of temple, the front entrance place of *hutong* and the courtyard entrance gate created a fluent and continuous urban spatial transition from the very public outside neighbourhood to the intensely private inside of the courtyard buildings. This hierarchy of privacy was continued in the dwellings themselves since the physical location of the buildings exactly matched the social identification of each family member and visitor. For a courtyard unit, the dwelling owner and also the religious/family worship function were always located inside the main building; then the next generation of male family members was located in the left wing buildings, females were located in the right wing buildings, and the visitors and service persons were located at the front buildings. When the residents had higher social/economic status or a large family, the courtyard unit axis could be expanded following either the north-south axis or the west-east axis. Secondary buildings and building elements such as a screen wall, decorative gate, the verandah and so on also helped to provide a smooth spatial transition inside the courtyard buildings, and these secondary buildings/buildings elements gave clear directions to each member of the family and the visitors.

Structural elements are also strictly controlled in traditional courtyard housing, for example with the 11 grades *doukou* (modular) system, this not only provides the basic scale and proportion of buildings, but also, for example, controls building standards. This timber structure system also has great flexibility for structural extension, repair, mass production, prefabrication, potential for transformation and so on. In detailed studies of how the courtyard buildings respond to the local climate we see this structural system also at work. Five microclimate types have been identified according to the location of the courtyard and yard inside a traditional courtyard buildings group at the 1st to 10th lanes of *Dongsi* neighbourhood in Beijing. Following the classification of the microclimate, the solar shadow index for the winter sun and the aspect ratio for the exposure to the external environment of each type of courtyard/yard was also studied and analyzed to pursue the physical characteristics of the courtyard microclimate. This was essential for the following comprehensive microclimate studies. The sunlight factor, the orientation factor, the building envelope factor, and the landscape factor from the traditional courtyards buildings in Beijing are discussed and analyzed to explore the *Qi* (energy) control strategies through individual buildings placement and also the buildings elements. The final part of the thesis is a study of the transformation undergone by this area as well as an examination of the shaping forces in 1st through 10th lanes of *Dongsi* neighbourhood,

This research has applied a systematic and rational research methodology to a traditional Chinese urban neighbourhood. The courtyard living environment studies have generated a comprehensive understanding of a vernacular/traditional building style that evolved over hundreds of years and therefore may have great potential to provide ecological design implications (vernacular/traditional approach) to cope with the current housing crisis in socio-cultural, environmental and economic (architectural structural design aspect) aspects. This type of study I believe to be unique and that it contributes to an understanding of these dwellings and a way of life which is under threat of disappearing.

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Part one: Introduction, research methodology and theoretical background

Chapter 1: Introduction

1.1 Origins of the research

Currently, hundreds of millions of people in China still live in a substandard living environment, particularly in urban areas, and most of the urban housing in China is overcrowded, poorly equipped and in a very bad condition. The typical urban household in China has 6.84sqm of living space per person, and over 30 percent of all urban households have less than 4sqm per person (World Bank, 1992). Crowded and substandard housing schemes have emerged in most of the major cities across China. In particularl, following the boost of the Chinese economy over the last twenty years, massive housing construction has been carried out to cope with the housing shortage problem. New massive high rise blocks have been built in every city. These tall buildings are mostly more than 20 storeys and located in large open spaces, mixed with some low-rise housing and surrounded by wide open streets, 'in a community for about 20, 000, there are few people to be seen, no children in the fields or street, no shoppers, no causal strollers, few signs of life... the new Beijing is a parody of American and Russian urban ideals of the 1960s: all buildings and motorways. The place is suffering not so much from paradigm shift (whereby general cultural values leap towards a new and creative consensus) but paradigm slip' (Rapanos, 2002: 215). Meanwhile, the historical neighbourhood in the inner city of Beijing, like other traditional cities, is overcrowded and badly degraded; most of these traditional neighbourhoods have experienced a dramatic transformation over the last fifty years, the good quality of courtyard dwellings has been transformed into overcrowded, substandard living compounds, particularly after the 1976 earthquake, therefore offering poor quality accommodation. As we can see, the newly built high rise buildings and the transformed traditional living quarters have all somehow failed to provide comfortable, affordable and sustainable urban living.

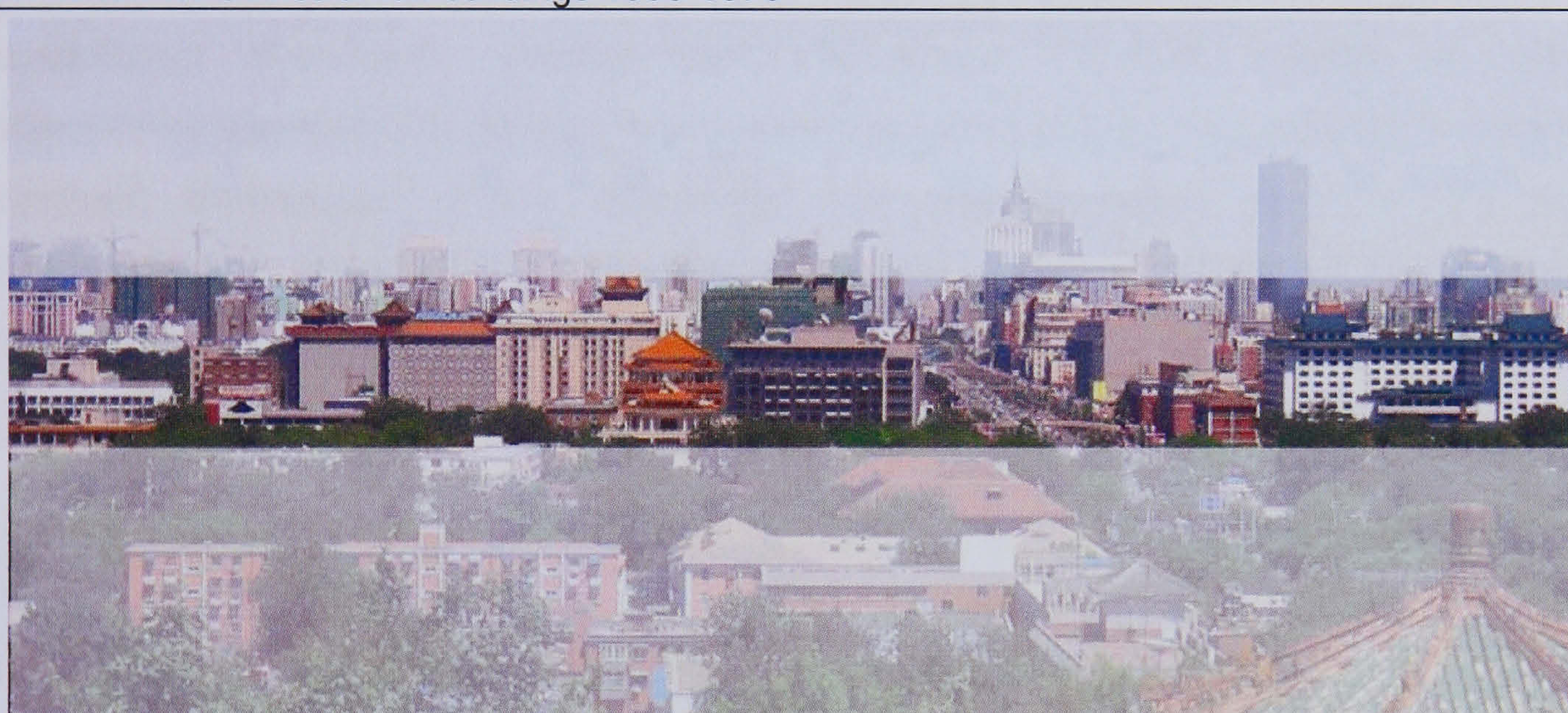
Following the development of the Chinese economy and the process of urbanization, the urban population in China in 2003 was 40.5 percent of the whole population, and it will reach 50% in 2015 (*Guojia Tongjiju*, 2004). Meanwhile, 'it is estimated by the United Nations that by the year 2015 the overall urban population will be 54.4 percent, while in more industrialized countries it will amount to 81.6 percent' (UNDP 1999). Therefore, more and more people will move into cities, more and more residential buildings will be constructed, more and more energy will be used, and the new development will create huge pressure on the natural and social cultural resources in China and even the world. Therefore, a sustainable solution to development is desperately needed to cope with this Chinese urban living transition.

1.2 **Housing solutions in Beijing:** from 1949 to present

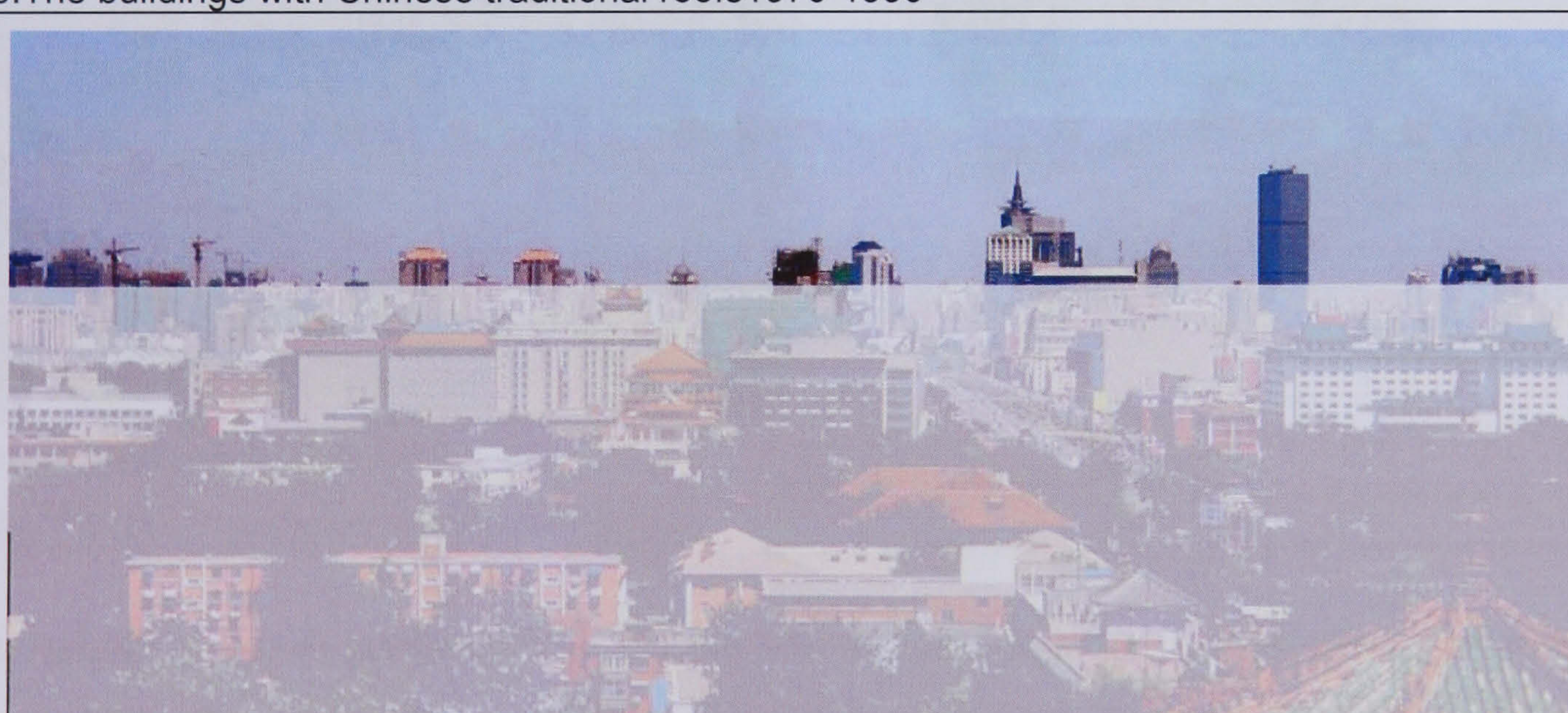
The search for a solution that can help to achieve comfortable urban living in Beijing has not ceased since the new country emerged in 1949. In early 1956, a report from the authorities revealed that 'most of the housing stock remained in the private sector in many cities in 1955; for example, 53.9% in Beijing... on the other hand, the majority of the working class lived in overcrowded or substandard conditions. Housing shortage and overcrowding were still the major problem which caused government concern' (Zhang, 1997:437-438). Therefore, the dominant character of the housing policy during this period was to provide dwellings for the working class who lived in the substandard urban slums. Following the socialist transformation in the 1950s, in Beijing, most of the existing private traditional courtyard buildings groups were divided into smaller units to hold the working class, and this approach worked well to meet the demands of the society.

From the mid 1950s to 1970s, most of the newly constructed housing schemes broadly borrowed the socialist design principles because of the influence from the former Soviet Union. Therefore, the north-south oriented low rise apartment buildings which linked up in parallel rows are one of the most important construction styles for housing; in such buildings only the detailing around window frames and doorways have traditional Chinese features. A lack of Chinese identity is the main character of this period of housing construction (Fig.1.1: a).

a:The former Soviet Union buildings 1950-1970



b:The buildings with Chinese traditional roofs1970-1990

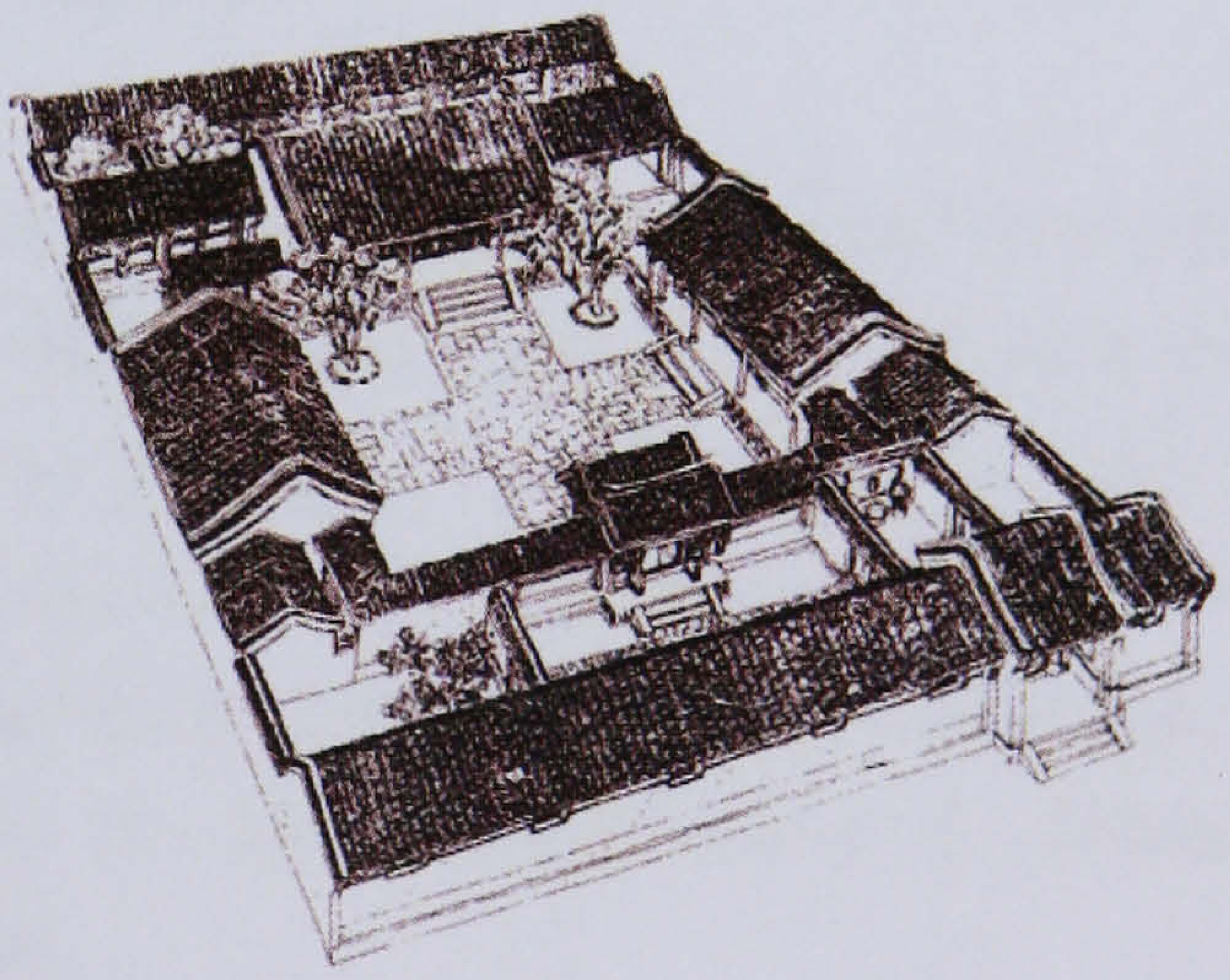


c:The modern high rise buildings 1990-

Fig. 1.1 A skyline view of *Chaoyangmen nei dajie*, Beijing
Source:http://grail.cs.washington.edu/projects/office/dewey/china/photos/beijing/city/skyline5.jpg

In the following 20 years, the borrowing of fragments of traditional Chinese architecture emerged as one of the major construction approaches, a mixture of traditional Chinese architecture as the 'head' and the modern architecture 'body' is characteristic of this period's construction (Fig.1.1: b), but the 'pagoda hats do nothing to make clumsy buildings either more graceful or more Chinese' (Davey, 1999:15). From the late 19th century following the Chinese open policy, international architectural styles were broadly adopted for most of the new projects, the high density and high rise superblock neighbourhood was constructed in Beijing, and most of these super-blocks consisted of clusters of mainly high-rise housing (Fig.1.1: c), with a north-south orientation. 'In Beijing, newspaper reports on the completion of inner-city redeployment projects are always entitled *Xiqianxinqu*, which means 'original residents happily moving back to newly redeveloped apartment'. Moving from dilapidated courtyard houses to newly redeveloped apartment buildings, the residents' physical living conditions were certainly improved dramatically (Fang, 2006:672). For this approach, most of the new constructions in the inner city of Beijing are based on the demolition of the traditional neighbourhood and the residents 'usually also remarked on the loss of closeness to friends and family, and of familiar surroundings' (Fig.1.2) (Rapanos, 2002:215).

The construction of the new tube station, and the courtyard buildings (centre left)



A courtyard house
Source: Knapp, 1999:33

Fig.1.2 The traditional courtyard house

Generally, housing architecture in Beijing has experienced dramatic development in the past 50 years, and many solutions and architectural elements have been brought into the construction site (Fig.1.1). Everything from the entirely new planned cities to a small living compound is new and also in pieces and the city has been cut off from its own rich social-cultural history and the specific built environment, the relatively comfortable living environment has to rely on an autonomous mechanical system. Furthermore, the residents of the newly constructed high-rise buildings are isolated from each other and also lack the social cultural context. Taken as a whole, none of the above solutions have successfully helped to achieve a socially, culturally and environmentally sustainable living environment in Beijing in the past 50 years. Meanwhile, in Beijing the good quality of the traditional urban courtyard living environment emerged and continued to develop for more than six hundred years after it was founded as the capital city in 14th century. Our ancestors survived, and 'often lived comfortably, for centuries under the same climatic conditions in dwellings of traditional design. They were able to do so because they made use of the energy available locally in the environment' (Shearer, 1986: xv). Meanwhile, these vernacular and traditional design strategies always grow in response to the actual need, fit into the local climate, geography, socio-culture and economic environment, designed by people who knew no more than their native feeling. Therefore, an exploration of the design values of this traditional courtyard environment will possibly provide a new ecological solution to cope with the current socio-cultural and environmental crisis in Beijing.

1.3 The definition of ecological architecture solutions

The terms 'ecological', 'sustainable', 'green', 'place-making', and 'vernacular' 'are often used to label environmentally responsive architecture. The meaning of each term and the values and approaches implicit within them depends almost entirely on who is speaking. Of concern to this study is the vagueness and ambiguity of the word 'ecological' which makes the term 'ecological architecture' equally vague and ambiguous. Therefore a criterion should be identified for a better understanding of different approaches of ecological solutions in architecture.

'Ecology' itself is easy enough to understand, 'the term 'ecology' derives from the ancient Greek words *oikos* and *logos*, and means 'the science of the habitat'. It was used by Haeckel in 1873, and then subsequently by biological scientists, to refer to the interrelations between organisms and their immediate environment' (Oliver, 1997: 31). The rise of environmental consciousness since 1970s has led to the creation of the term 'sustainable development' (Mazmanian & Kraft, 2002). At the same time Arne

Naess, the Norwegian philosopher, argued that Western philosophy traditionally separated out humans from the natural world and suggests that the new environmental concern recognised the inter-relationship between the two (Naess, 1989). Naess further separated the environmental movement into two key strands, 'shallow environmentalism' which was concerned with human welfare related to the exhaustion of natural resources, and 'deep environmentalism' which fundamentally questioned human relationships with the natural world (as will be discussed in section 1.3.2.1). This strand of environmentalism has much in common with traditional Daoist philosophy. It may have been new, to Western consciousness, but actually reflected very old ways of thinking practiced in China which followed the philosophy of Daoism. In the West the new environmental thinking has had just decades of development rather than centuries. 'The green movement which began to emerge in the mid 1980s may be characterized as a radicalized variant of the ecological sensibility of the 1960s, being more assertive on political issues such as industrial pollution' (Steele, 2003:8). Today three key strands of sustainability have emerged from the growing concern for environmental issues:

- **Natural**: emphasising the ' light touch'/follow natural rules approach, working with natural materials etc (Buckminster Fuller's geodesic dome and *Ken Yeang's* bioclimatic skyscrapers)
- **Cultural:** emphasising distinct and meaningful genius loci (the courtyard from Liangyong Wu in China and Charles Correa in India)
- **Technical:** emphasising technical innovation to cope with the environmental problems (Norman Foster and Richard Rogers's high technology buildings)

Within the three overarching approaches of natural, social and technical sustainability, however, there are many individual and complex approaches, often reflecting the researcher's own background. Sim Van der Ryn and Stuart Cowan (1995) define ecological architecture as any form of design that minimizes an environmentally destructive impact by integrating itself with the living process. Susan Maxman (1993) argues that 'sustainable architecture isn't a prescription. It's an approach, an attitude. It shouldn't really have a label. It should just be architecture'. Furthermore, some researchers have started to define and summarize the fragmented pieces of ecological principles in different disciplines. Yosef Jabareen (2004) presents a knowledge map of the fragmented and multidisciplinary literature on sustainable development. Seven metaphors have been provided from the contemporary sustainable literature. Each metaphor represents a specific domain in this map:

- the metaphor of ethical paradox signifies the ethical domain;
- the material domain is represented through the metaphor of natural capital;
- the social domain through the metaphor of fairness;
- the spatial domain through the eco-form metaphor;
- the political domain through the global discourse metaphor;
- the management domain through the integrative management metaphor;
- the visionary domain through the utopian metaphor;

Jabareen's studies are a multidisciplinary literature review of sustainable development, and the strength of this approach lies with its comprehensive representation of the complex sustainable development of the world. However, it is still very difficult to develop this approach within the context of the built environment. Guy and Farmer (2000, 2001) step closer to the field of architecture and provide another vision of the knowledge map on contemporary ecological architecture design. They identified six alternative logics of ecological design that have their roots in concepts of the environment. The six competing logics of sustainable architecture are:

- eco-technic; technology finds the solution for sustainable living
- eco-centric: nature knows best how to achieve ecological development
- eco-aesthetic; use of natural materials with little human modification
- eco-cultural; local ecology is central to developing a sense of place
- eco-medical; 'natural' buildings are healthier, less stressful etc
- eco-social; reconciliation of individual and community in socially cohesive manner through non-hierarchical and participatory communities.

Each competing concept of ecological architecture has an accompanying set of ideas, concepts and categorisations that are produced, reproduced and transformed into the resultant buildings.

These classifications are very helpful in understanding current trends in the built environment, but as criteria for the classification of architecture, they do not have universal acceptance and some terms contained within them are open to wide interpretation. Therefore, the aim of the following sections is to examine, deconstruct, and extract key principles from some of the multiplicity of texts which underpin ecological consciousness in architecture, then identify them according to the principles that human ecology is always concerned about, i.e., the relationship between man made space and nature, which can also be explained as how man made architecture responds to the local environment. Drawing on existing studies, three categorisations have been drawn up which are pertinent to this study and deserve detailed examination. They have been categorised as:

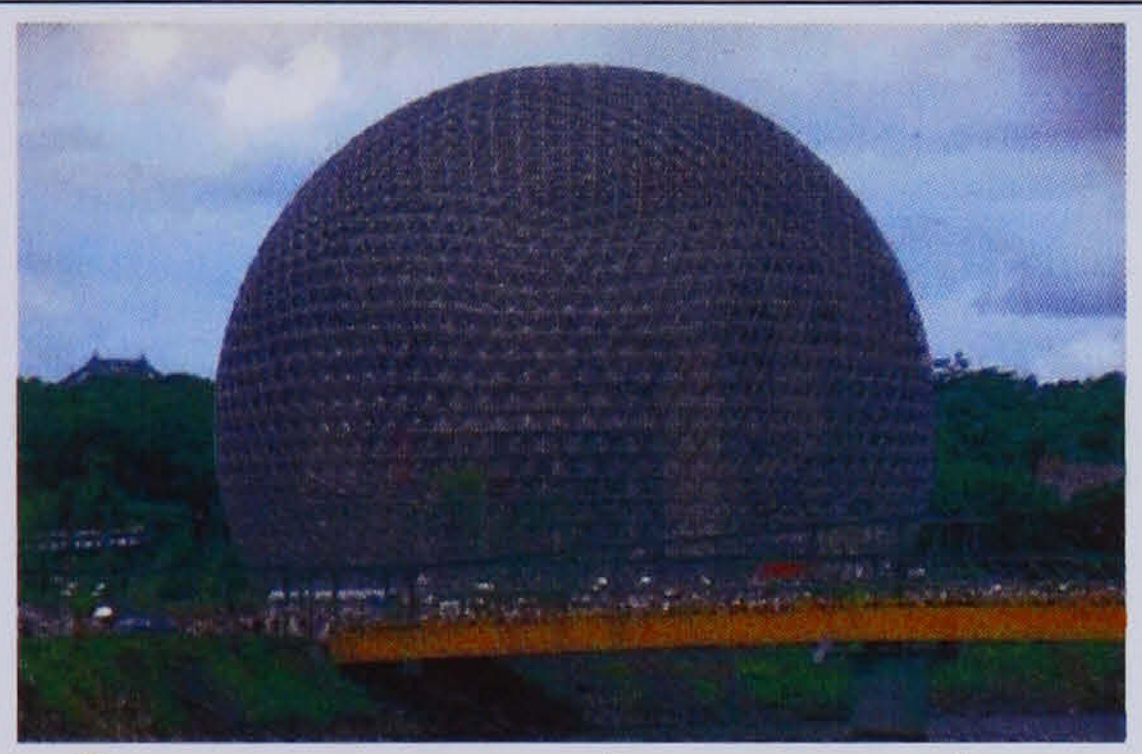
- Eco-centric architecture (man imitates nature)
- Eco-technical architecture (high technology solutions seeking to minimize use of nature resources)
- Eco-vernacular tradition (man works with nature and responds to locality – deep ecology approaches).

1.3.1 Eco-centric architecture solution and the Eco-technical architecture solution

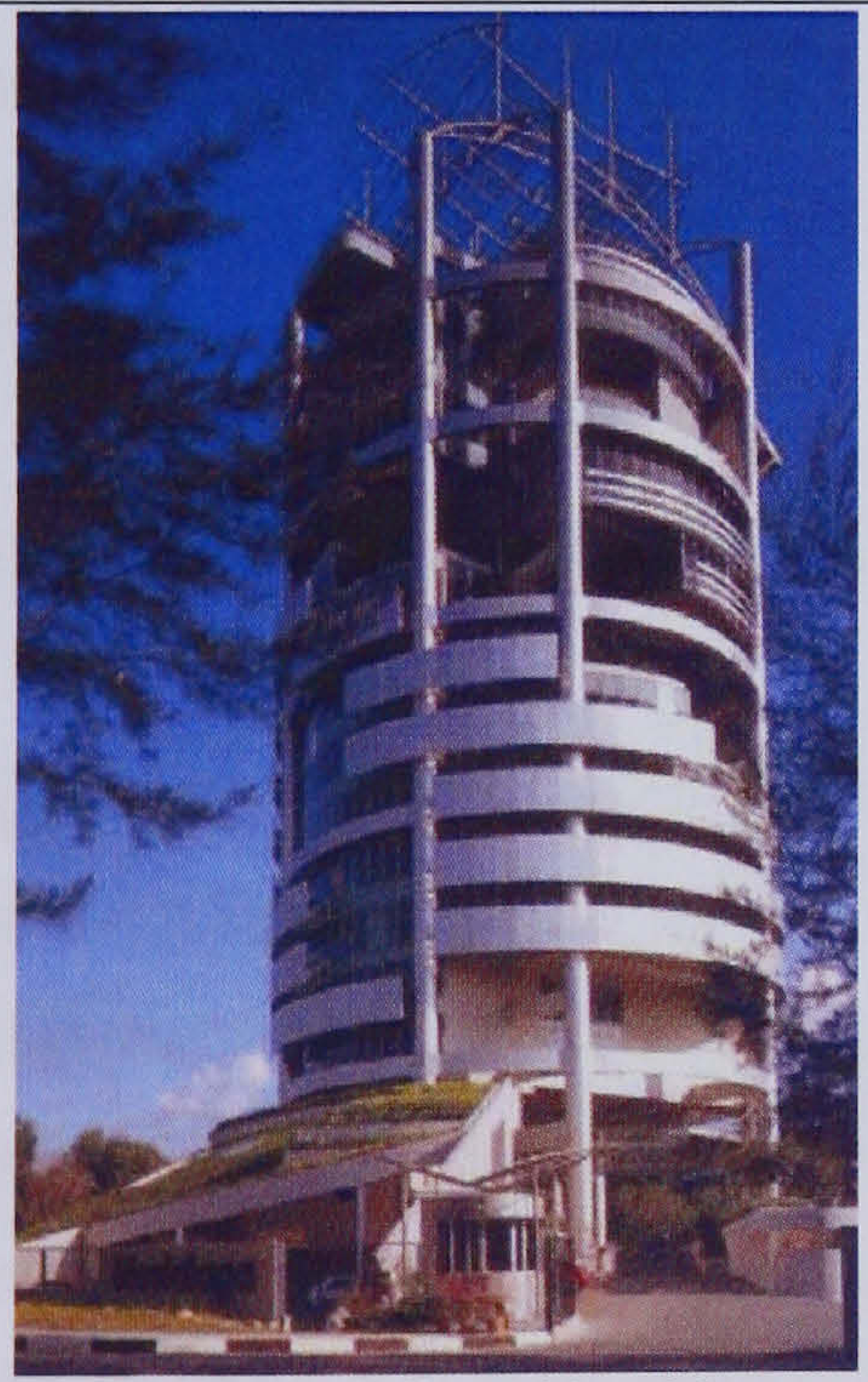
Currently, the most popular and most practical approaches in ecological urban architecture are the eco-centric architecture solution (practised by Ken Yeang) and the eco-technical architecture solution (practised by Michael Hopkins, Nicholas Grimshaw, Norman Foster, Richard Rogers and so on). Therefore, the principles and practical examples of these two approaches should be brought in and discussed for comparison with the following vernacular/traditional architecture solution.

1.3.1.1 Eco-centric architecture solutions

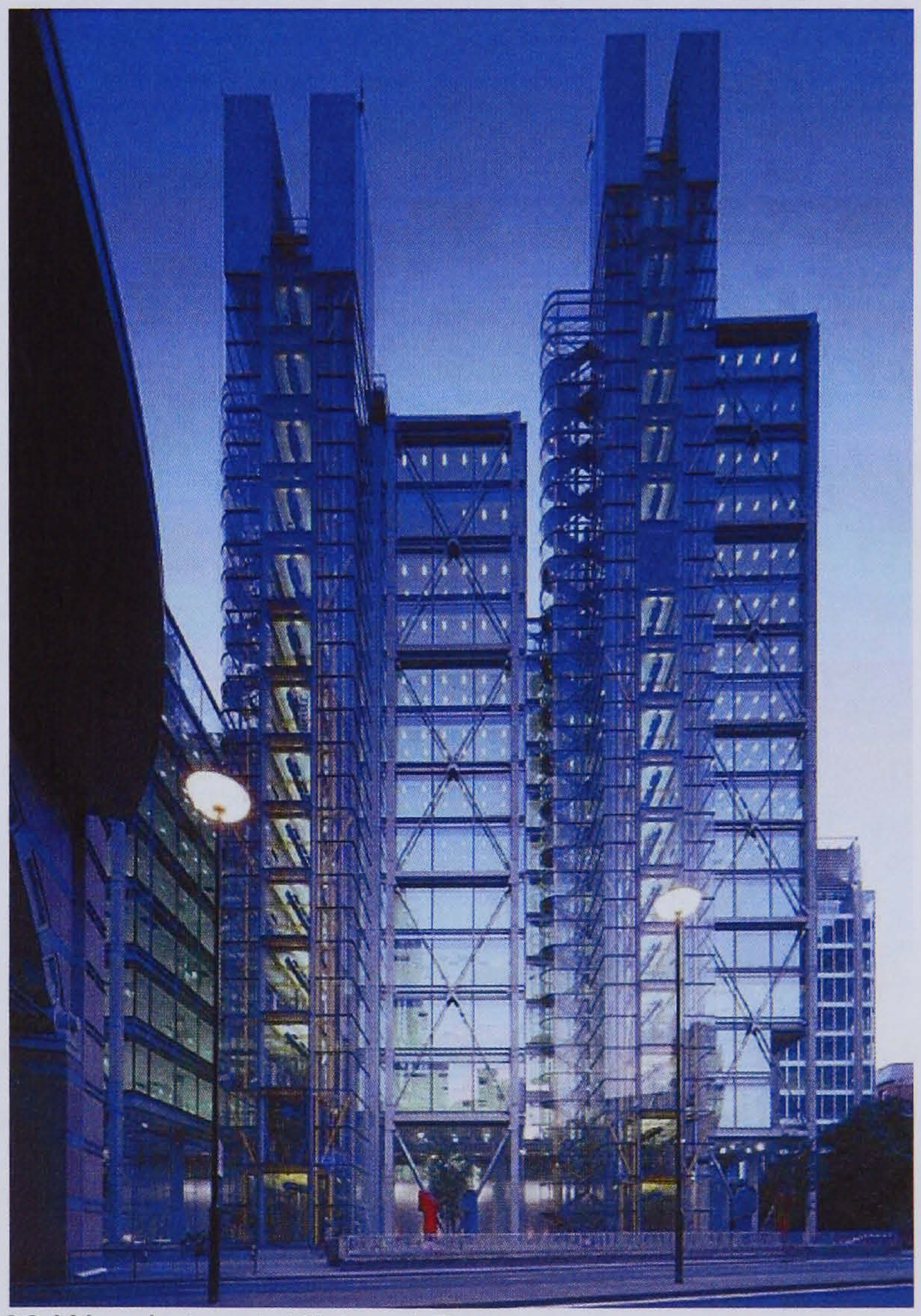
For the eco-centric architecture solution, nature is the best technology that has already been at work for millions of years on a micro and macro scale. To look at the way nature designs and works is to unlock a most useful direction in order to get better ecological development. Malcolm Wells (1981) asks if building design can be based on life principles, in imitation of nature. It creates pure air and pure water, stores rainwater, produces its own food, creates rich soil, uses solar energy, creates silence, consumes its own waste, maintains itself and matches nature's pace. Buckminster Fuller steps further and claims that what science discovers but fails to communicate to the public, is that the technology of the universe, which we speak of comprehensively as 'nature', operates only as a complex integration of exact mathematical laws that science discovers (Steiner, 2002). 'If nature wants to make a specialist, she is very good at it, whereas she seems to have designed man to be a very generally adaptable creature' (Fuller, 1970:343-390). Todd & Todd provide their vision of eco-nature design; they interpret ecological design principles which focus on the emerging precepts of biological design. 'By this term we mean design for human settlements that incorporates principles inherent in the natural world in order to sustain human populations over a long span of time. This design adapts the wisdom and strategies of the natural world to human problems' (Todd and Todd,1994:1). This approach has been much developed following the development of the biotechnology.



a:Source:www.people.umass.edu



b:Bioclimatic building, Ken Yeang
Source: Powell, 1999:43



c:88 Wood street, Richard Rogers
Source: www.rsh-p.com/rende

Fig.1.3 Ecological approaches

Some experiential projects have been constructed under the principles of Fuller, such as the geodesic dome (Fig.1.3, a), and more recently, *Ken Yeang's* bioclimatic skyscrapers have applied this approach (Fig.1.3, b). Ken Yeang has concluded that the following design principles are necessary for a good eco-centric design: the arrangements of the buildings' cores which are determined by *sunpath* and the provision of buffer zones, the orientation determines the position of glazed areas, opening up the plan into clusters, allowing air movement related to prevailing winds and orientation, provision of wind-wing walls and skycourts, and the experimental use of roof aerofoils to assist airflow within the section incorporating the stack effect, materials research, taking account of life-cycle and time of the cladding and skin, using the vertical landscape strategies to bring biodiversity and nature into the buildings, recycling of rainwater, and so on (Yeang, 1996; 1999; 2002; 2004). Generally, this approach has taken into account the environmental crisis that has been created by human activities, and therefore tries to protect our ecosystem through an environmentally friendly design. However, as the above studies indicated (Yeang's eco-centric design principles), the eco-centric design principles are mainly determined by the rational scientific analysis of the impact of the climate on the buildings, and the buildings then respond to the local built environment in a natural way, like all other life on the planet. However, the ability to discover and imitate nature's rules is still in the experimental stages, and these principles have been criticized for isolating humans from society, and also face many criticisms such as the waste of building space, lack of architectural aesthetics, expensive construction costs and the high cost of sustaining the buildings, etc.

1.3.1.2 Eco-technical/high technology architecture approach

High technology is another important practical ecological architectural approach to sustainable buildings, which has been broadly used across the world. Since the Industrial Revolution, particularly in the present century, the twin phenomena of more widely diffused wealth and relatively cheaper energy have resulted in a widespread increase in energy use. The cost of maintaining a highly efficient artificial light, heating or cooling source is one thousandth of that which a tallow candle represented 100 years ago (Hawkes, 1996). All these greater, more affordable energy achievements of modern technology have produced a much better physical living environment than before. However, the rise of environmental consciousness since 1970s recognizes the existence of environmental problems and one approach to solving them is through management of the environment by technology.

The high technology approach trusts objective analysis and rational scientific methods. A key character of this approach is its globalizing viewpoint, and its belief that high technology can solve all the problems of sustainability (Fig.1.3, c). It 'represents a belief in incremental, techno-economic change and that science and technology can provide the solutions to environmental problems...the concerns are mainly for the universal, global environmental problems of climate change, global warming, ozone layer depletion, and translational pollution issues such as acid rain' (Guy & Farmer, 2001:141-2). Furthermore, the eco-technical approach claims to be able to cope with the ecological crisis without affecting the power of existing economies. In this approach, capitalism and ecology are not contradictory when brought together under the banner of sustainable development. A high technology approach involves the holistic consideration of the careful use and the recycling of sustainable energy and materials in a renovated designed-system, and endeavours to reduce the impact on the natural environment. 'Energy efficiency' is another key issue in achieving ecological form through the design of the building, at community and city levels. This approach currently is the most practical method of coping with environmental problems and has been broadly practiced by Dean Hawkes, Michael Hopkins, Nicholas Grimshaw, Norman Foster, Richard Rogers, and also includes the work of Renzo Piano, Thomas Herzog and so on. However, this approach is gaining more and more critics for its belief that technology can solve all the environmental problems, that man can dominate nature, the expensive construction cost, the isolation of people from society, and so on.

1.3.1.3 Summary

To explore how nature works and employ biotechnology is the main concern of the eco-centric architecture solution (learn the way nature works and then apply these rules to buildings). The eco-technical approach emphasises the dominant role of technological innovations (man dominates nature and also energy efficiency). These two approaches have played a great role in improving humans' physical living quality. However, both of these approaches have mainly relied on the development of technology, the rational and scientific analysis of the built environment, and both of them have been criticized for isolating people from society and lacking social-cultural and economic consideration. Meanwhile, the high cost of constructing and sustaining such buildings has also been broadly criticized. High technology has also been criticized for ignoring the geographical differences across the world. Furthermore, neither of these approaches has built a bridge that can firmly link the past and the future, nature and architecture, theoryl and practice. Therefore, a new way of reflective thinking about the relationship between man and nature and how to improve it in an ecological way should be further explored.

1.3.2 Deep ecology philosophy in architecture solution and its relationship to Chinese Daoism

'We feel our world in crisis, we walk around and sense an emptiness in our way of living and the course which we follow' (Naess, 1989:20)

As introduced in section 1.3, one of the most influential thinkers on approaches in ecology, Arne Naess, separated out what he termed 'shallow ecology', or put simply how humans cope with dwindling natural resources from deep ecological thinking which requires a much more fundamental transformation in the way in which we understand the world and our place within natural systems. Ian L.McHarge in his 'Design with nature', refused the simplicity of separation between man and nature, and recommended a potential harmony of man-nature, and to achieve it, believed man must design with nature (1971). As the above studies suggested, these ecological consciousnesses from the past or the contemporary deep ecology are in sharp contrast with the dominant world view of a high technology approach which fundamentally isolates humans from the rest of nature. 'For thousands of years, Western culture has become increasingly obsessed with the idea of dominance: with dominance of humans over non-human Nature' (Devall & Sessions, 1985:66).

'Deep ecology therefore goes beyond a limited, piecemeal, shallow approach to environmental problems and attempts to articulate a comprehensive religious and philosophical worldview. The foundations of deep ecology are the basic intuitions and experiencing of ourselves and nature which comprise ecological consciousness' (Devall & Sessions, 1985: 65). The core principles of deep ecology are mainly to promote a harmonious relationship between man and nature, and among people. 'Deep ecology is not concerned with developing an axiology, a theory of value of the non-human world. Its discussion of intrinsic values is primarily phenomenological rather than moral or prescriptive' (Elizabeth, 1996:95). However, deep ecological principles are nothing new, they derive from the people and start to seek 'a basis for philosophy, religion, cosmology, and conservation practices that can be applied to our own society' (Devall & Sessions, 1995:96). The contemporary deep ecology theorists see themselves as borrowing the 'ancient truth' of pre-industrial, non-urban, and pre-capitalist societies for their future primitivism. Sessions (1981) introduces a long list of influences to deep ecology from around the world: Christian Franciscanism, Taoism, Buddhism, hunter-gatherer tribal religions and so on.

In China, Daoism is one of the key influential philosophies first developed around 2,500 years ago (for a full explanation see Chapter X Section X). Taoists follow the art of *wuwei* (non-doing) both for nature and humans, which is to let nature take its course and it regards man as one part of nature. For example, one should allow a river to flow towards the sea unimpeded; this approach would not sanction the erection of a dam that would interfere with its natural flow. Peter Marshall, in his history of ecological thinking argues that Daoism 'provides the philosophical foundations for a genuinely ecological society and a way to resolve the ancient antagonism between humanity and nature which continues to bedevil the world' (1992: 23). Daoism starts as a combination of psychology and philosophical thinking of the relation between 'man and nature' and then evolves into a religious faith which practices 'inner calm', 'harmony with nature', 'following the rules of nature' and 'non-doing' principles. The ancient Chinese also sought order and harmony through natural phenomena, and took this to be the ideal relationship for humans. Furthermore, this relationship is not static but always transforming. 'Early Chinese thinkers were also extremely impressed by the recurrences and cyclical movements which they observed in Nature – the four seasons, the phases of the moon, the paths of the planets, the return of comets, the cycle of birth, maturity, decay and death in all things living' (Needham, 2004:911). Following the course of nature, working in harmony with nature and furthermore pursuing a harmonious relationship between man and nature, and among people are the main principles of the Daoism.

Generally, the basic principles of deep ecology, in contrast with the principles of the approaches of eco nature and high technology can be concluded as follows:

- In contrast with the eco-centric approach of man following nature's working rules and high technology's man dominating the relationship with nature, deep ecology promotes a harmonious work relationship between man and nature. 'The equal right to live and blossom is an intuitively clear and obvious value axiom. Its restriction to humans is an anthropocentrism with detrimental effects upon the life quality of humans themselves. This quality depends in part upon the deep pleasure and satisfaction we received from close partnership with other forms of life' (Naess & Rothenberg, 1989:28). This view of deep ecology of nature is also the Daoist view of nature; humans belong to nature and function as one element inside nature and should also work in harmony with nature.
- Deep ecology also respects the richness and diversity of nature and decreases the interference with the non-human world. 'The flourishing of human life and cultures is compatible with a substantial decrease of the human population. The flourishing of non-human life requires such a decrease' (Naess & Rothenberg, 1989:29). This principle also indicates that the man-made built environment should have minimum influence on the natural environment.
- A social cultural context has been brought into consideration in the philosophy of deep ecology, rather than isolated from society, as eco nature and high technology do, which suggests a mixed community. For a community, decisions in areas which affect all the members are taken through direct communication.
- The ideological change is that deep ecology appreciates life quality rather than the high standard of life.

From this part of the studies, one of the fundamental problems which has caused the current environmental crisis is the view of the relationship between man and nature, one which believes that 'technology can solve all of our problems' (Ferkiss, 1993:173) and also that 'man dominates nature', and so on. Today, humans emerge as potentially the most destructive force in nature and its greatest exploiter; the attitude towards people and nature that man holds is essential for the development of an ecological approach. A deep ecology view point is a radical departure from current thinking yet may provide the most efficacious basis for any sustainable architecture design solutions. In relation to the practices of deep ecology in architecture, the most well-known figures in deep ecology-such as Warwick Fox (1990), Arne Naess (1989),and Bill Devall & George Sessions(1985) all find it difficult to directly transfer the deep ecological philosophy into architectural practise because of the ethical, political and social limits of the deep ecology principles. Deep ecology principles, therefore, mainly provide the guidelines and principles for the further practice of sustainable architecture, however, the continuous influence from 'deep ecology now plainly extends beyond the philosophical analysis of nature' (Luke, 2002: 179).

1.3.2.1 Vernacular/traditional architectural approaches

'The deceptively simple form of the traditional houses implicitly embodied an intimate knowledge of the locality and its potential for sustainable life' (Cofaigh, et al., 1996:2). In Guy and Farmer's (2001) studies, the influence of traditional architecture is acknowledged as a part of a specific approach (eco-cultural logic) that emphasizes the adoption of local and bioregional physical and cultural characteristics. 'Respect for local traditions in materials and design, not only did they arise from practical experience over the centuries of what works well in the area, it was respect of the past generation of designers that created the harmony which is now so admired in our towns and villages' (Fox and Murrell, 1989: 39-43). Papanek further interprets the advantages of vernacular architecture as follows; 'previous ages possessed one great advantage: a precise moral aim that gave meaning and direction to all planning and design. Classical antiquity sought a sense of harmony and balance, the medieval was mystic fulfilment, the Renaissance strove for an elegance of proportions and more recent times for enlightened humanism. Builders knew precisely what they wanted' (1995:105). Therefore, 'the knowledge of an appropriate climatic response was implicit in many traditional ways for building and living. Today, this knowledge no longer automatically forms part of the architect's repertoire: it must be relearned' (Cofaigh, et al., 1996:9)

Meanwhile, China, from the Neolithic (New Stone Age) culture to the 21st century, represents the most significant achievements of the world's longest continuous civilization which suggests the country itself is a sustainable nation within nature, social-cultural and economic contexts. The Chinese architecture system has continuously developed over thousands of years, following the deep ecology philosophy of Daoism. In the process of its development, superior architectural techniques and artistic design were combined to make a unique Chinese architectural style. Therefore a deceptively simple form of the traditional courtyard dwellings, for example, implicitly embodies an intimate knowledge of the locality and its potential for ecological life. 'A deep look into history helps us to come to terms with the present and motivates us toward the future' (Wu, 2000:9).

The traditional courtyard buildings have been the main building type in Beijing and many other Chinese cities for more than a thousand years. As houses are grouped together, the logic of their bioclimatic design might be compromised; yet often in traditional forms there is a metamorphosis, to turn limitations into advantages, so that the ensemble of buildings becomes more than the sum of their parts. Moreover, courtyard buildings were not only used as ordinary dwellings but palaces of the imperial family, religious buildings and so on; they were also broadly and continuously used across many areas in China. So far, very few of studies have investigated how the Chinese traditional courtyard dwellings respond to the local built environment, particularly in the urban area of Beijing. However, across the world, Correa in India has interpreted the vernacular architecture as follows: 'If we look at all the major concerns of humanists and environmentalists today; balanced eco-systems, recycling of products, people's participation, appropriate life-styles, indigenous technology, etc we find the people of Asia already have it all' (Correa, 1987:172). The vernacular approach towards the traditional living environment has been broadly studied across the world, such as Wu in China, Correa in India, Fathy in Egypt, Oliver in UK, Reynolds and Knapp in America and so forth. They have all tried to uncover the vernacular/traditional design values from the traditional living environment (see Chapter 2 literature review on traditional courtyard buildings environment studies). Therefore, during the period of uncertainty following the decline in confidence in the eco nature approach and also the high technology approach, a vernacular approach which has followed the deep ecology thinking is timeless in the very best sense of the word. It provides identity, simplicity, harmony and balance, honesty, and is native, community-oriented and low cost to the architectural construction.

1.3.3 Summary

'Eco-architecture sees buildings as part of the large ecology of the planet and the buildings as part of the larger ecology of the planet and the building as part of a living habitat' (Roaf et al.,2001:1). This contrasts with the more common notions of many architects, who see a building as a work of art, machine or product. For this study, different approaches of ecological architecture solutions have been identified, and the keyword in ecological architecture is 'integrate' (Yeang, 2006). Therefore, it must be clear that the vernacular/traditional approach is just one of the options for the ecological architecture design. According to the relationship between man and nature, there are also the eco-nature and high technology architecture design solutions. However, ecological development requires not just the innovation of high technology and an exploration of how nature works, but more importantly the new ways of thinking about the relationship between man and nature, the physical, environmental, social-cultural and economic goals and how to achieve them in a sustainable way.

In Beijing, many solutions have been tried over the past fifty years, and currently the city not only faces housing shortage problems but also an environmental and socio-cultural crisis. A new solution emphasising the local social culture, natural environment and also economic contexts is desperately needed to cope with this crisis. A major characteristic of this new thinking of the ecological movement is holism: the belief that things are interconnected, that each problem is part of a larger one, and that solutions to problems in one area can create problems for someone else to solve in another (Fowles, 2000). And this interconnection is also the main character of the basic concept of 'ecology', therefore, the author uses the term ecological architecture (vernacular /traditional approach) to describe an ecological solution that originate from China's own living contexts.

1.4 Limitations and constraints of the research

This research, like many other studies on the traditional living environment, has encountered limitations and constraints in the following major aspects:

1) On the urban neighbourhood level, there is a lack of sufficient physical evidence or data on historical buildings, mainly because some of the important buildings such as the *Dongsi* archways, and temples were demolished before 1960s (see Chapter 5 on place studies and Chapter 6 on morphology studies).
2) The social culture context was tragically destroyed during the Chinese cultural revolution in 1960s, and this part of the studies has to rely on the archives,

documentaries, novels, travel books, newspapers, and the elders' memories of the neighbourhood (see Chapter 5 on place studies).

3) The historical maps of the neighbourhood, like many other traditional drawings on Chinese traditional buildings, are not in the right proportion because of the method of traditional Chinese representation (see Chapter 6 on morphology studies).
4) The transformation also means these studies lack some important physical evidence of the buildings' elements, such as the decorated entrance gate, external screen walls, gardens and so on (see Chapter 6 on morphology studies, Chapter 7 on social culture values studies).
5) On the courtyard buildings level, the buildings have been kept in a relatively good condition. But very little physical survey work has been done to the buildings except for a brief single line plan survey from IPPR design institute on the conversation work in 2003. Furthermore, it is impossible to carry out all the physical survey on some of the large scale buildings and the groups of courtyard buildings because of the time and cost limitations of the field work (see Chapter 8 on architectural economics and environmental value studies). Therefore, the theoretical background studies on Chinese traditional architecture in Chapter 4 will be very important in helping to get the information through the building regulations.

1.5 The scope of the study

Issues of ecological urban dwelling design in China, as well as many other areas, are extremely broad and wide-ranging. The main objective of this research is to explore the ecological design values of the traditional urban courtyard environment in Beijing. This study was conducted acknowledging the roles of the physical environment, social culture and also architectural economics (design aspect) that have influenced the evolution of the courtyard house. Therefore, the choice of the city of Beijing, focusing on the two levels of study, will help to achieve the main objectives of this research.

Beijing has been chosen because: (1) Beijing represents the Chinese traditional capital cities which follow the ideal imperial city planning principles from *Zhouli* (*zhou* rituals, in 770-475BC, see also Chapter 4). (2) Twenty five historical neighbourhoods in Beijing with similar conditions have been classified as conservation areas, which helps to achieve a better external validation. (3)The urban courtyard dwellings in Beijing have developed over six hundred years, so the mature design principles and techniques will help to improve the validity of this research. (4) Various types of courtyard dwellings in Beijing could provide good examples of the different physical environments, social-culture and economic situation. (5) The traditional courtyard and the urban context are under threat of demolition to make way for new development. (6) Beijing is, like other cities in China, under pressure of a natural, social-cultural and economic crisis. (7) The studies of the traditional values of the courtyard buildings' neighbourhood also has implications for the conservation work on the neighbourhood.

Furthermore, the thesis deals with a holistic ecological approach to design, so this research will therefore mainly focus on the field which encompasses many areas, from urban neighbourhood to different courtyard buildings, from macro space to micro space. However, this does not mean the whole research will be isolated from the city context or the building components; the city and building components context will be brought in as needed. Therefore, one of the strengths of this study is to attempt to relate the urban neighbourhoods and building groups and further put them into a wider context which includes the city and building elements, in the appropriate place. In relation to the choice of scale, the research theories and methodologies can be categorized into two camps:

1. Design theory and strategies based on scale (urban neighbourhood)
2. Design strategies and techniques based on scale (building groups)

Finally, the study will concentrate on the relationship between the ecological (response to environment) values and two levels of architectural studies (buildings and neighbourhood). This is also due to my own personal architectural and urban design background and preference for design theories and practical issues. To study the ecological design values of the traditional urban courtyard environment is the main aim of this research. That is, to take the existing experience and knowledge which has so far been applied in bits and pieces and the knowledge from the case studies of urban traditional courtyard dwellings in Beijing, and use these traditional design values to provide guidance for the ecological (vernacular) approach to urban housing design.

This thesis is divided into three parts. Part one includes Chapters 1 and 2 and presents the origin of the research and identifies the research gaps on the courtyard buildings and the urban environment studies in China. Part two includes Chapter 3 and Chapter 4. It raises the research questions and also introduces the research methodology. The theoretical background has also been provided for the following neighbourhood and courtyard buildings studies. Part three, which includes Chapters 5, 6, 7, 8, 9 and 10 includes the ecological value studies, analyses and conclusions of the traditional urban courtyard dwelling environment. This part of the study has been further divided into four sections which include the urban neighbourhood studies in Chapters 5 and 6 (section one), traditional courtyard dwellings studies in Chapters 7 and 8 (section two), Chapter 9 (section three) for the transformation studies and finally the conclusions (section four).

Chapter 1 raises the issues that a practical ecological solution is desperately needed to cope with the current and future mass construction of the urban housing in Beijing, as in many other cities in China. Following this, different ecological approaches in the architectural field have been studied and compared, including the eco-nature approach, high technology approach, deep ecological approach and vernacular/traditional approach. The studies have identified that deep ecology and the practical vernacular approach are the main objectives of this research, after recognizing that traditional courtyard neighbourhoods have successfully coped with the local built environment for several centuries in Beijing. Therefore this raises the key question of the research: How does the traditional courtyard man-made environment work with the local built environment? Following the original research question, Chapter 2 provides a literature review on the traditional courtyard and the urban environment studies. The courtyard buildings' prototypes and the primary shaping forces have been identified and analysed first. Then, the current literature on the Chinese traditional courtyard buildings has been studied and analyzed under the framework of ecological design. The studies on different cultures and also modern courtyard studies have been brought in for comparison and to identify the research gaps.

Chapter 3 follows Chapters 1 and 2 and identifies the research questions and outlines the research methodology. The research methodology is based on the literature and archive review, direct observation, physical measurement and focus groups. This part of the study also provides the theoretical background for the following neighbourhood, courtyard buildings and transformation studies. Chapter 4 explores the theoretical background of the traditional courtyard dwellings environment in China, which includes the primary forces shaping Chinese traditional architecture and urban planning. Studies of Daoism; Confucianism; *Fengshui* theories; *Wangcheng* (ideal Imperial City) planning; the state building standard in Song Dynasty (1103) and building regulations in Qing Dynasty (1734). It provides a theoretical foundation to explain the phenomena of the traditional courtyard neighbourhood in Beijing within its built environment.

Chapter 5 and Chapter 6 (section 1) mainly focus on the place and morphology studies of the neighbourhood. Chapter 5 provides a brief place study of the *Dongsi* neighbourhood, which includes the historical background of traditional Beijing, physical location studies, the historical studies of the neighbourhood, classification of the urban elements studies and the four social culture foci studies (the archway, temples and temples fairs, *hutong* and also the courtyard entrance gate). This gives a rich description, recovery and classification of the urban social cultural contexts of the neighbourhood. Then Chapter 6 focuses on the urban morphology, and the figure ground theory is used to identify the basic urban patterns. The plot types, the building types, the uses, the streets and the spatial hierarchal theories are also employed for further study and analysis of the urban patterns and shape. The analysis of the courtyard dwellings (section 2) mainly focuses on the social cultural, physical environmental and architectural economic (structure design aspect) values of traditional courtyard buildings through the plan, colour, structure and section typology studies. Chapter 7 focuses on the social cultural values of the traditional courtyard dwellings, the vast and diverse courtyard buildings are classified first, the typology studies which include the plan typology and colour typology are employed for social culture values (the sections have been brought in at the appropriate place), and the secondary buildings are also studied carefully for the traditional design values. Chapter 8 mainly focuses on the architectural economic (design aspect) value studies through the structure typology studies. The response to environmental values is studied in the section studies (plans have been brought in at the appropriate place). Chapter 9 (section three) is of the transformation studies of the courtyard dwellings and also the neighbourhood, which helps to identify the primary shaping forces and also identifies the transformation cycle of the traditional Chinese courtyard environment. This part of the study also helps to provide implications for the conservation work in the neighbourhood. Chapter 10 (section 4) summarizes the key ecological values from the urban neighbourhood and courtyard buildings studies, along with a recommendation for further studies on new urban courtyard prototypes in the urban area of China.

1.6 Conclusion

The purpose of this study is not just to describe what happened in the past, but to analyse it and render it intelligible and meaningful to us in the present and the future. With ecological (vernacular/traditional approach) design, the concern of the designers is not just the residents with courtyard buildings or communities in a neighbourhood but also more broadly requires a deep understanding of the relationship of man and nature and also how humans respond to nature.

Many solutions have been applied to Beijing to help to cope with the housing problems before, but none of them have successfully solved the problem. A new way of thinking should be generated from people's original ideas on the relationship between nature and mankind, which has been identified as deep ecology in previous studies. The studies have identified the vernacular/traditional approach as the practical approach which has followed the deep ecology principles (Daoist thinking), and have also highlighted that very few studies have touched on the traditional courtyard buildings environment which has existed in Beijing for several centuries and has successfully coped with the local built environment. Therefore, this research will explore the ecological design values and implications of the traditional urban courtyard environment in Beijing to provide implications for creating new urban courtyard building prototypes that can help to cope with the current environmental, social cultural, economic request for ecological urban housing development.

Chapter 2: Literature review of traditional urban courtyard built environment studies

'Set in the middle of the universe, man needs a place of peace, seclusion, as part of the greater, hostile, amorphous world outside, a space which, all the same, receives its share of day and night, sun and moon, heat and cold and rain. This space, which is subservient to the passage of the days and years and to the rules that order existence, is the 'courtyard' (Blaser, 1985:7).

Courtyard buildings have been constructed in many parts of the world, in varying climates, in differing cultures and economic environments. Currently the courtyard dwelling is still used as one of the important building types for human dwellings. The 'courtyards serve as buildings of nearly every imaginable function. Residences are particularly likely to be designed around courtyards, because courtyards offer both privacy and access to nature' (Reynolds, 2002:3). Courtyard buildings are also one of the most important building types in the urban area which 'group together; courtyard houses generate a compact urban fabric with a clear separation of public and private open spaces' (Macintosh, 1973:7). Meanwhile, in China, the courtyard house is essentially an urban dwelling type which has been widely developed in the ancient city of Beijing as well as in many other traditional cities. An understanding of the traditional design values of the courtyard buildings may provide an ecological design approach for a contemporary housing. Therefore, it is important to know how the traditional Chinese courtyard buildings have been studied. This literature review will broadly examine the current studies of the living environment that was created by the courtyard buildings types, and includes research papers, novels, articles, reports, travel books, plays and operas that cover issues of the traditional urban environment and courtyard studies of Beijing. The studies of the different cultures and modern courtyard buildings will also be brought in at the appropriate place to compare, identify the research gaps and also explore the potential research methodologies.

Many studies have focused on the courtyard dwellings across the world (Correa, 1987; Fathy, 1986; Macintosh, 1973; Oliver, 1997, 2003; Reynolds, 2002; Steele, 1997;) and China (Blaster, 1974, 1985; Liu, 1956; Knapp, 1989,1999, 2000; Inn, 1940, 1950; Wu, 1999; etc.). These studies try to articulate the vernacular design values from the traditional courtyard and the urban environment studies, and some of them have gone further and tried to provide a bridge between traditional courtyard buildings studies and modern housing design (Correa, 1987; Fathy, 1986; Reynolds, 2002; Wu, 1999). The issues of courtyard buildings have been studied and examined from different perspectives across the world. Correa from India points out that 'this old architecture-especially the vernacular-has much to teach us as it always develops a typology of fundamental common sense' (Correa, 1987:172), Fathy's research reveals how the vernacular architecture of the Arab World and neighbouring regions not only solved the climatic problems but did so with a combination of beauty and physical and social functionalism (Fathy, 1986). Reynolds (2002) in his studies on the courtyard in South America and Europe recognizes that the courtyard buildings can not only bring social and thermal satisfaction but also achieve aesthetic pleasure. And Wu's (1999) study of the courtyard buildings and the urban pattern of traditional Beijing has helped to develop a new prototype of the courtyard buildings for the organic renewal inside the historical areas of Beijing. Why does the traditional form of the courtyard still arouse so much interest? Why have courtyard buildings and their built environment been studied so broadly across the world? How have courtyards been studied? In general, the aims of this literature review will be to:

1) Identify the prototypes and the primary shaping forces of the courtyard buildings
2) Classify the main studies and writings on the traditional urban neighbourhood and courtyard dwellings built environment studies that concern ecological values (vernacular/traditional approach) in China.
3) Bring in similar studies on the courtyard building from contemporary and different cultures on ecological topics at the appropriate place for international comparison and identification of the research gaps of the Chinese courtyard studies.
4) Identify the key research methodology of the traditional Chinese courtyard buildings and urban environment studies.

However, this research is unlike many previous studies that mainly focus on providing conservation guidelines for the traditional urban living quarters. This study will seek to understand the design values of the traditional courtyard built environment and use them as one of the potential ecological solutions (vernacular/traditional approach, see also Chapter 1) to cope with the current housing and environmental crisis in Beijing. Therefore, this literature review will focus on the way traditional built environment has been studied in China as well as many other studies from different cultures.

2.1 The primary shaping forces and courtyard prototypes

'Nature forces people to build a suitable environment, and thus, to search for certain objects in the environment. To make use of these objects, people must transform them to suit their purposes' (Stea & Turan, 1993:12). For the primitive and peasant builders, the impact of environmental factors on living space were simply to achieve maximum comfort by using minimum resources. Therefore, to meet basic human needs was the main concern of vernacular architecture, although contemporary builders are repeatedly struck by the knowledge and experience in the selection of sites and materials suitable to the specific local microclimate and their native function. This basic need should include the physiological needs for warmth, comfort, safety and security (Maslow, 1968). When the basic living function is met, some studies have suggested that 'a better physical environment will improve people's social behaviour' (Tiesdell & Oc, 1993:44). However Rapoport (1969) suggested that the social culture is the primary shaping force for the forms of vernacular buildings, and that climate, construction, materials and technology are modifying factors. Therefore, the following literature review will try to explore the major courtyard prototypes with various shaping forces both historically and geographically.

2.1.1 The historical studies on courtyard prototypes

Courtyard buildings have a long history. The earliest known houses date from 3000BC in Mesopotamia and were built by the Sumerians (Blaser, 1985). In China the archaeological evidence of courtyard buildings has been explored by *Guo Qinghua*; 'the *Erlitou* site reveals that the courtyard layout of the palace at the time of the completion of the work dated back to late Xia (c. 2,200-1,750 BC) or early Shang (1480-1050 BC)', and this evidence has also been mentioned by Knapp (2000) and Zhang (1986). In Europe, the courtyard reached its apogee during the heyday of Greek civilization in the 4^{th} and 5^{th} centuries B.C, 'the Greek *Megaron* house with a courtyard pillared on only one side was entered directly from the street; the reconstructed examples in Delos and *Priene* are of this type' (Blaser, 1985:13). Generally, courtyard buildings have emerged from different built environments and also time periods, which include the atrium house in Greece and Rome, patio and court house in Spain, Middle East and America, courtyard houses in India, quadrangle buildings (*Siheyuan*) in China, and so on.

In China, 'because native traditions of the house builders as well as building materials and climate differ, courtyard-style houses are distinct in the various regions in which they are constructed ' (Sun, 2002:302). Knapp (2000) and Huang (1992) have further indicated this distinction by identifying two prototypes of the courtyard buildings, which are the 'enclosing' of open space and the 'excavating' of a 'well' in the middle of building. In northern China, according to the hypothetical progression, the 'enclosing' of open space began with the addition of a wing and continues until a complete quadrangular dwelling, termed *Siheyuan* (courtyard buildings) results. In southern China, an open space resulted from 'excavating' a 'well' from the internal space, which may eventually emerge as a true skywell and then duplicate while the dwelling grows. Unfortunately, neither researcher has disclosed the emerging shaping forces of these two prototypes. Suha Özkan made a similar claim (enclosing the open space) when he examined the courtyard prototype of the Middle East; he suggests that 'the logic behind this type of plan was mainly to provide a protective area from outside forces, such as invasion by humans and wild animals. Over time, it has developed into a solid, logical configuration that maximises the built-up area in the urban context and allows controlled sunlight, especially in regions where it is abundant' (2006: xv). In many ways, the undeveloped circumstances of ancient communities force people to live together in defence against harsh weather, enemies and offenders. Therefore, a group of buildings in ancient societies have gathered together to meet these physical and psychological requirements. Blaser introduced a different courtyard prototype in ancient Greece; a fire-hearth in the middle of the buildings requires a hole for the smoke and it then developed into the atrium house. As the urban house comes to play a more socially exalted role, the courtyard is converted into a reception room with a pool, fountain and lawn. We may suppose that it is from the Greek house that the 'Roman atrium house developed as an all-in-one house with its living quarters and utility rooms under one roof' (Blaser, 1985:13), which is similar to the Chinese 'excavating' a 'well' from the middle of the buildings. He further points out that this house receives its light and ventilation through the roof opening, and therefore the 'atrium' is the hall with an open roof. As time went by, the shape and the form of the open roof and the atrium have been transferred to suit the local climatic conditions.

All these precedents indicate that the 'enclosing' and 'opening' courtyard prototypes have been broadly used in historic Europe, Middle East, and China. In an attempt to explain why and how so many courtyard houses have been built across the world, many writers have tried to establish a connection between courtyard buildings and earlier vernacular examples, as well as between the vernacular courtyard dwellings and primary shaping forces.

2.1.2 Contemporary courtyard building prototypes studies in China

The courtyard house of this century is quite different from the vernacular version. The courtyard house has been broadly used as a building prototype across the world for different uses such as libraries, shopping malls, galleries, hotels, winter gardens and so on.

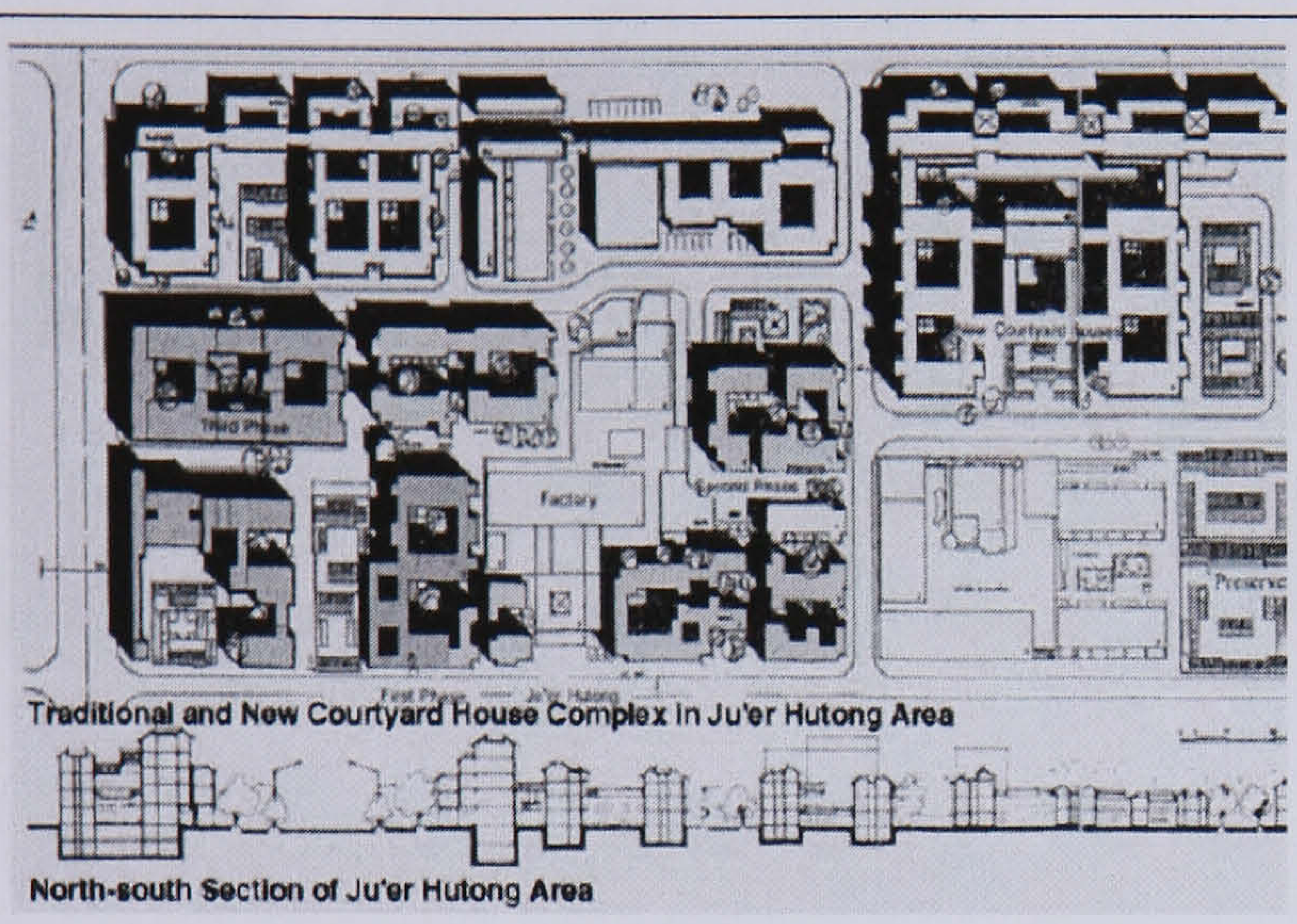
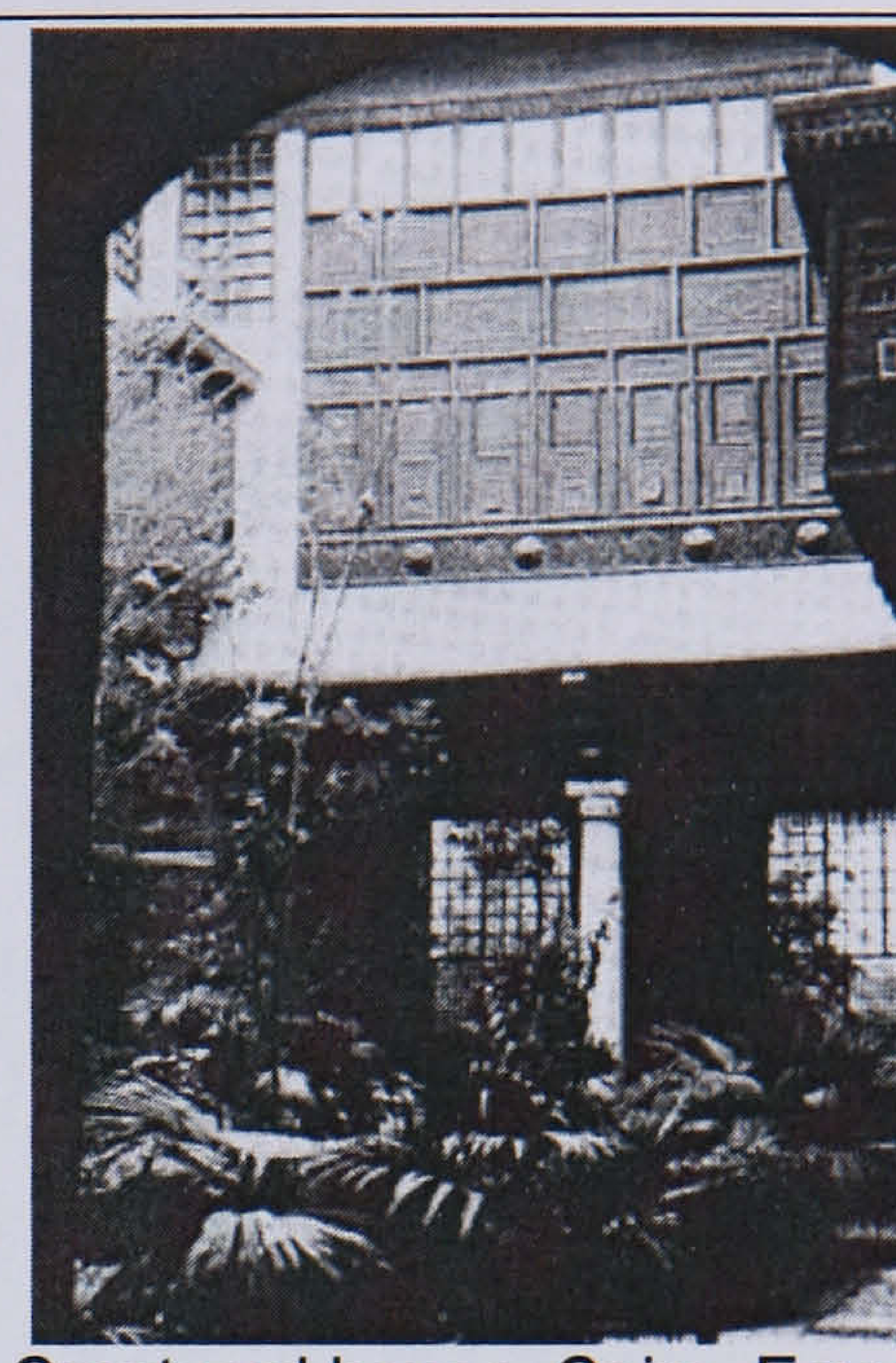


Fig. 2.1 Ju'er Hutong Project
Sources: Wu, 1999:132

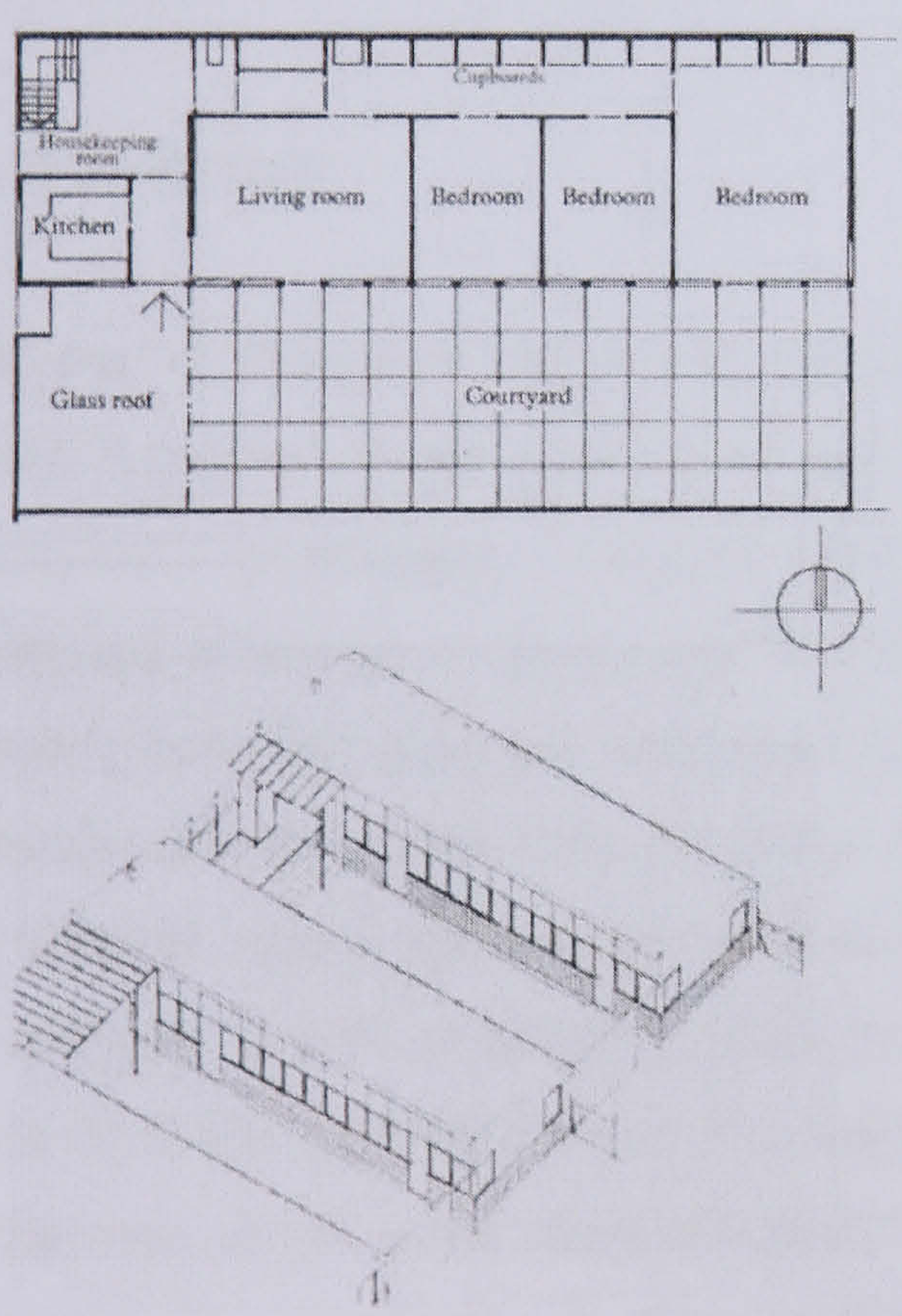
Wu Liangyong in China used the newly created courtyard prototype for a new housing renewal project of *Juer hutong* in the historical area of Beijing in 1987 (fig.2.1). The multi-storey courtyard building prototypes for modern urban living have been created based on the design values and implications from the traditional courtyard buildings studies in Beijing. The new modern courtyard prototype has tried to 'work out a standard courtyard house unit that achieves an ideal balance of sunshine, ventilation, lighting, and other environmental conditions on the one hand, and an intense use of land on the other' (Wu, 1999:104). The new courtyard prototype has also employed the courtyard space as the communal space. This project has gained a great reputation for its respect for the local tradition and the local climate, and also for achieving an intimate atmosphere, a human scale and so on. However, this project also has inherent problems; the wing buildings overheated in the summer, car parking problems, and so on. The land values in the city centre and the also the demolition strategy of the whole site have not permitted any further similar development. Furthermore, Fathy in Egypt, Correa in India (Fig.2.2) and Reynolds in America have all tried to use the traditional courtyard prototypes and design values and then helped to develop new courtyard building types for contemporary comfortable living. But this approach still lacks a systematic strategies analysis of socio-cultural factors and economic issues (mainly the low population density that the courtyard buildings created) that modern urban living raises.

Courtyard house at Belapur, India
Source: Correa, 1989:55

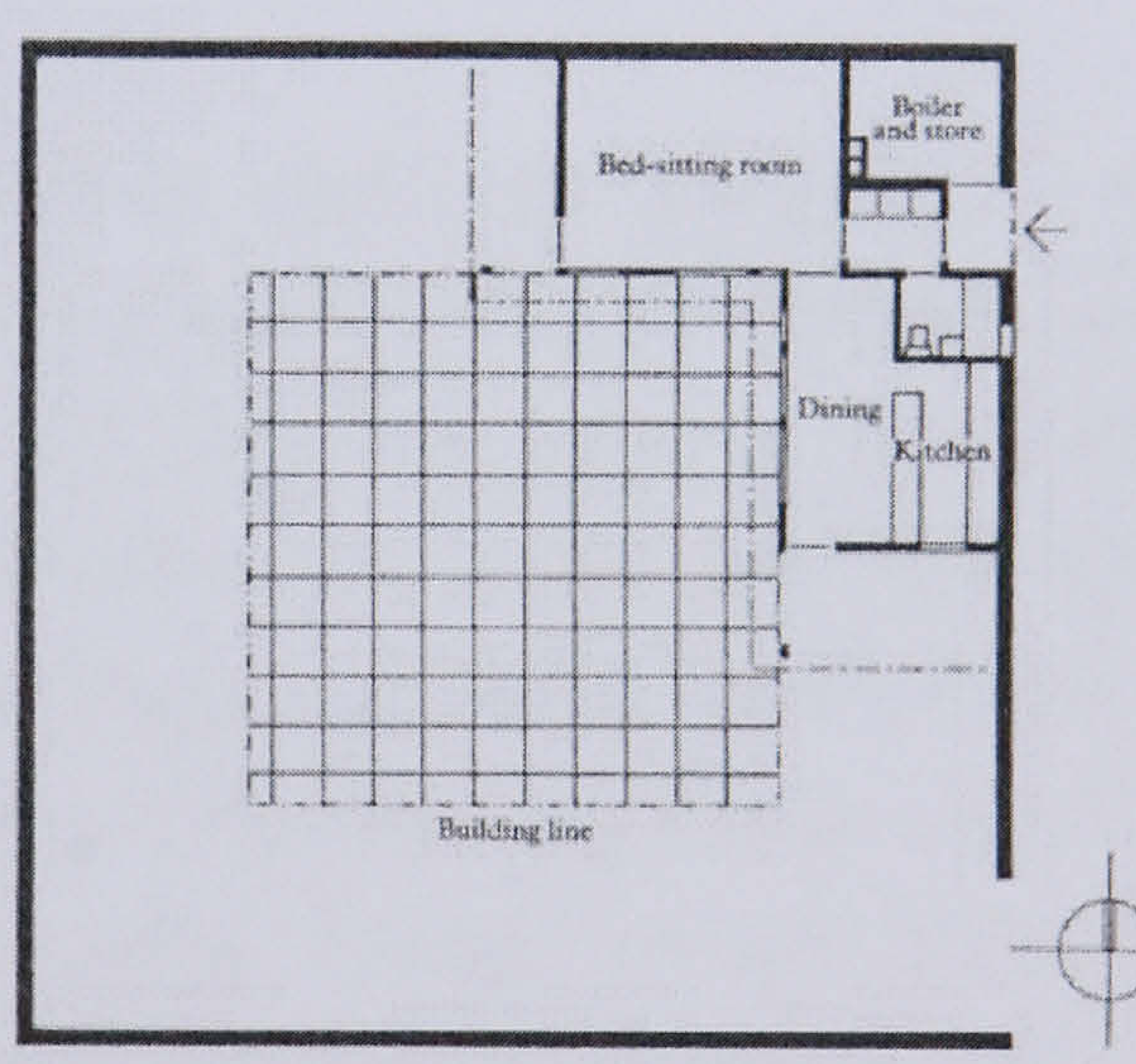


Courtyard house, Cairo, Egypt
Fathy,1986: 140

Fig. 2.2 Vernacular courtyard house



L-shaped house, 1928, Hugo Häring
Source: Macintosh, 1973:28



Growing house, Møgelvang and Jørn Utzon,
Source: Macintosh,1973: 26

Fig.2.3 Contemporary courtyard house

Meanwhile, the idea of 'building for a smaller family and for a more comfortable way of life than those which existed in previous centuries' (Macintosh, 1973:8) has been broadly applied to the modern residential buildings, not just in the third world countries but also widely across Europe and America. According to Macintosh's study, there are three main types of development for the modern courtyard dwellings in Europe and America. First, mass courtyard housing in northern Europe was developed without any reference to the tradition. Second, the modern atrium house has been modelled approximately on the Roman atrium house. The third main genre, the patio house in the United States, began as an imitation of the Spanish patio house during the Spanish Colonial Revival in southern California. Quite a few courtyard prototypes emerged during this period, particularly Jørn Utzon's expanded courtyard house in Denmark, which achieved great flexibility to allow for potential new construction when the family expands. Hugo Häring's L-shaped courtyard house in Finland also has had a great influence on contemporary courtyard living (Fig.2.3). Using the courtyard as the building prototype and creating low rise and high density urban living are the main characteristics of this period of development. However, these modern courtyard buildings prototypes have achieved a comfortable living like many other modern buildings do, which depends heavily on modern technology rather than the design values and implications from the traditional courtyard architecture.

2.1.3 Summary

This part of the study has briefly identified the main courtyard prototypes across the world. Together, three approaches can be concluded regarding the emergence of the courtyard's prototypes. The first approach describes the origin of the traditional courtyard buildings as being derived from the search for physical and psychological comfort from the external and internal world. Defence from the harsh climate from enemies and the protection of private property are the main shaping forces. Creating an internal space for natural ventilation and gaining sunlight for comfortable living (analogous to that of ancient Greek and Chinese courtyard buildings) is the shaping force from the internal area of the dwellings. The second approach is the emergence of the new, small scale courtyard prototype, mainly found in Asia and the Middle East, following the research on the traditional courtyard built environment, which has brought in the design values and implications from the traditional courtyard built environment studies. From this approach, comfortable living is mainly ensured by the natural ventilation, sunlight and so on. The third approach includes the emergence of modern courtyards, which follows a modern lifestyle, and implies smaller family size and a good standard of living which are mainly ensured by the mechanical services. Furthermore, Chapter one has indicated that this study will focus on the studies on the traditional urban courtyard built environment. Thus the literature review will focus on how current literature has explored the design values and implications from the traditional courtyard living environment.

2.2 Traditional urban courtyard neighbourhood built environment studies in Beijing

The above studies have identified the origins, prototypes and the primary shaping forces of the courtyard buildings in China and across the world. This part of the study will go further to concentrate on the traditional urban courtyard on an urban neighbourhood scale in China.

In urban pattern studies, an urban neighbourhood which was dominated by a courtyard buildings ward ('*Zhaohui-Jinggong Fang*') in Beijing has been studied by *Wu Liangyong* (1999). The conventional planning principles for the traditional urban layout were introduced. 'When *Dadu* (Beijing) was built, a strict code was issued concerning the size of the allotments for the houses of residents...the rich and highly ranked officials had priority...each unit was still 8 *Mu*. Where the allotment was greater than 8 *Mu* in size, or the household was not able to make full use of the allotment, the surplus space had to be given to commoners who could then build their own houses' (Wu, 1999:77). The typical street system of the neighbourhood is also conventional, which includes the *Dajie* (major street, 24 paces, 1pace=1.55m), *Xiaojie* (minor street, 12 paces) and the *Hutong* (6 paces). The typical width of the *Hutong* is 70 to 80 meters. From Wu's study, the physical courtyard built environment urban pattern of Beijing has emerged, a 'fish-bone-like' transportation network, 'where a series of major *hutong* are either joined by smaller transverse *hutong* or lead to even smaller dead-end *hutong* that occasionally run between housing plots' (Wu,1999:74). His studies also indicate that the courtyard neighbourhood is an important focus of social life, but the really social contexts, activities, and communities of the neighbourhood have not been studied in detail.

A great many literary works, as well as film, opera, and plays have celebrated the social and cultural life inside the old neighbourhood of Beijing. The novel '*Hong Loumeng*' (Red stone champers) from *Cao Xueqin* (1714-1763) gave a vivid description of the city, of a courtyard dwelling in ancient Beijing through the eyes of *Daiyu* (the girl's name) 'from the windows of her sedan chair, she took in the incomparable wealth and splendour of the imperial city, which needless to say, far surpassed that of *Yangchow* (a city in south China where *Daiyu* comes from). Suddenly she saw on the north side of the street an imposing entrance, consisting of a great gate and a smaller one on either side. Two huge stone lions flanked the approach, and over the main gate there was a panel bearing the characters '*NingKuo Fu*' (mansion). The centre gate was closed, but one of the side doors was open, and under it there were more than a score of menservants lounging about on long benches' (Cao, 1958:27).

Laose (1899-1966) has also contributed to knowledge through the great play '*Chaguan*' (Tea house) which has demonstrated the tea house as the main public meeting place in traditional Beijing. It offers a graphic depiction of what happened to a teahouse in Beijing and the fate of *Wang Lifa*, the owner of the teahouse and a group of characters connected with it. Teahouse mirrored the social turmoil and the seamy side of society between 1898 and 1949. *Si Shi Tong Tang* (Four Generations under One Roof, 1944–1950) is another important work from *Laose*, and this novel describes the life of Chinese people during the Japanese occupation. The play '*Xiaojing Hutong*' (Small well lane) from Li longyuan (1948-) also narrates the social life of a *hutong* in contemporary Beijing. The author himself also grew up in the southern part of the downtown area of Beijing and in his memory, 'the little alley where we lived had a rather civilized name, 'the small well'. Small well lane was old and crumbling, but in my heart and in my memories it is forever lively, warm, and filled with tenderness. Like a mother, it offered me a gentle breast to rest upon and a strong hand to guide me in the first steps...I believe that every writer has a piece of land that his heart calls home, and every home has its own unique smell, colour, taste and song. I never stop dreaming of the old arch over the gate made of green brick and the worn down couplets on either side of the gate' (Li, 2002: xi). Here is another vivid description of traditional Beijing by an eighteenth century traveller: 'one is astonished to see the enormous crows that fill these streets, and the jams caused by the amazing number of horses, mules, donkeys, camels, wagons and sedan chairs, not to mention the knots of one or two hundred men who gather in every open space to listen to fortune-tellers, thimble-riggers, ballad-singers and others who read or tell comic tales...or sorts of quacks who are eloquent in extolling the miraculous properties of the remedies they distribute' (Du Halde, 1735).

All these novels, stage plays, and travelers' books have narrated the rich social activities of traditional Beijing. Although most of these stories did not directly study the physical buildings or urban patterns of the neighbourhood, they can still bring us vivid social images of the old city of Beijing. In general, these studies, like many other urban studies (Antoniou, 2001; Bouvier, 1972; Chan, 1991; Su, 1964; Mitchell and Wu, 1998) on the Chinese urban environment mainly focused on the thick description studies, historically studies, and helped to understand the social cultural contexts of the place. However, very few studies have tried to understand the physical urban patterns, urban form, urban shape, urban spatial qualities that hold the rich urban activities.

Zhu jianfei (2004) has gone further; in a recently study on the quality of the Chinese urban environment in Beijing, the spatial strategies of traditional Beijing have been systematically analysed by the figure ground theory and also the space syntax theory which helped to understand the relationship between space and social life. Generally, there is still a lack of rational and systematic studies on the traditional courtyard built environment in China, but across the world, many studies have been carried out on the traditional urban built environment.

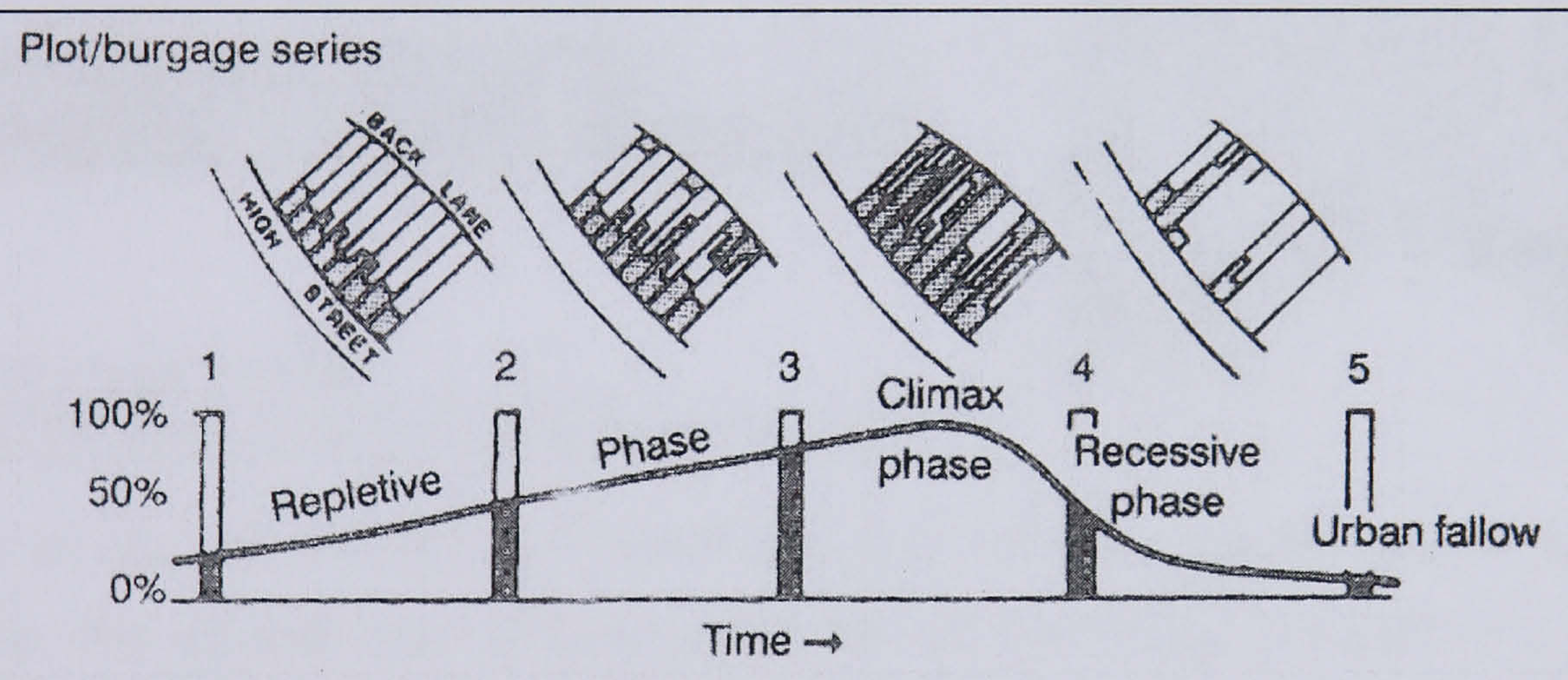
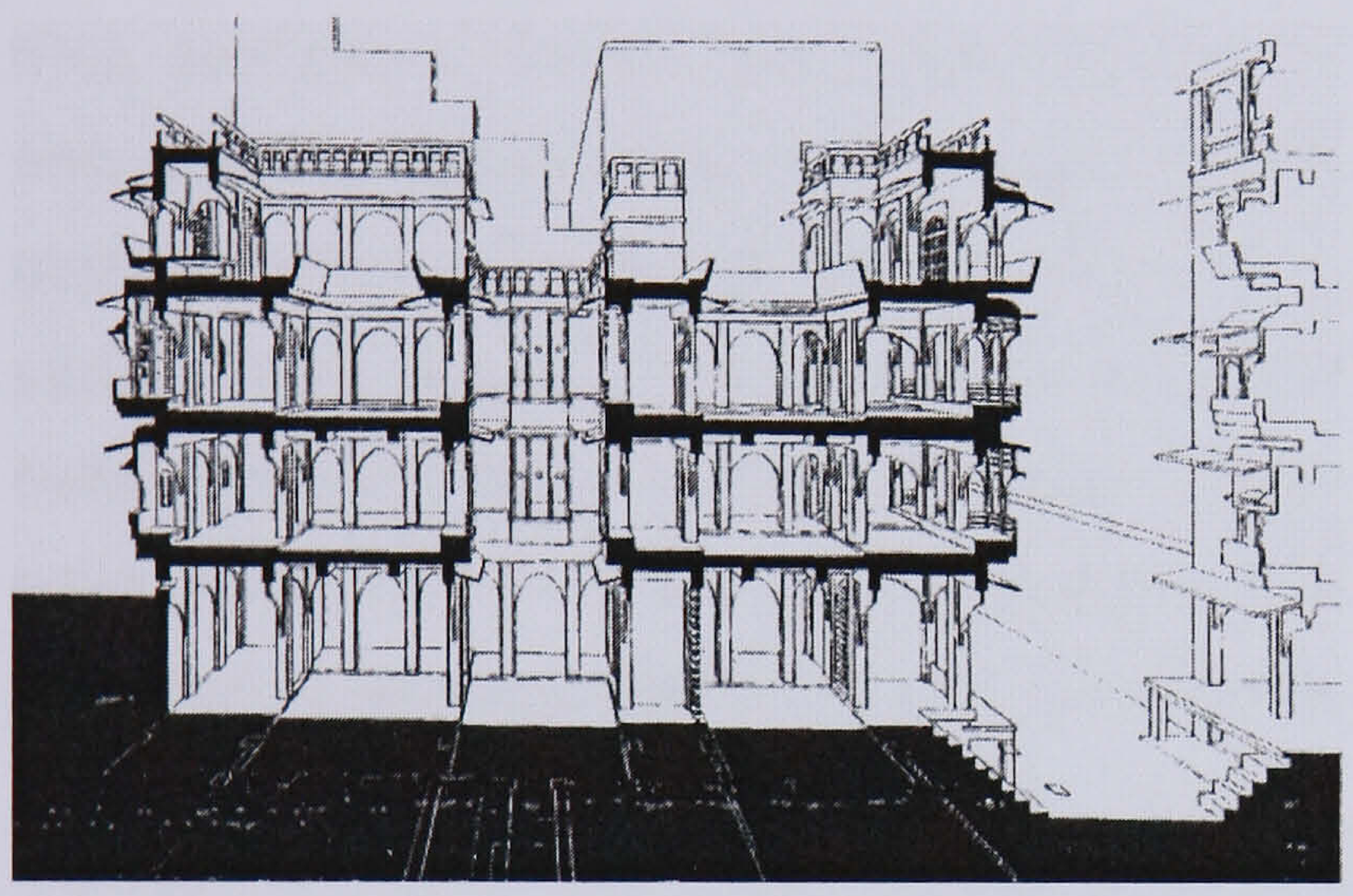


Fig.2.4 The Burgage cycle
Source: Larkham, 1996:33

M.R.G. Conzen (1960) considers land use, building structure, plot pattern and street pattern to be the most important elements to a traditional urban morphology study. Conzen (1960) also makes an important contribution to the urban transformation studies. He argues that plots have often had a recognisable progression or cycle of building development, e.g the medieval 'burgage' plots transformation cycle which has been studied, 'which started out as long, narrow fields laid out perpendicular to a street or circulation route. Because the first part of a plot to be developed was that adjacent to the street, development generally began in 'perimeter block' form' (Carmona etc., 2003:63), and then more construction work was developed inside the 'perimeter block'. The building was cleared after it reached the climax of construction

(Fig.2.4). A similar transformation has also been proven to be true in eighteenth and nineteenth century Paris (Loyer, 1988), and the cycle also holds true for nineteenth century industrial towns and twentieth century suburbs (Whitehead, 1992). Will the traditional Chinese courtyard living environment also experience a similar transformation during its long history? What is the urban morphology of the traditional Chinese courtyard neighbourhood? These questions need to be examined in this research.



Section of a typical home

street section

Fig. 2.5 The microclimate of Jaisalmer city in India

Studies of the microclimate of the traditional Chinese neighbourhood are rare; therefore, the studies from different cultures will be briefly brought in to help to identify the research methodology for future studies. Paul Oliver contributes his Middle East neighbourhood microclimate studies: 'desert settlements tend to be clustered together and urban forms of compact housing are common throughout the Middle East... This is particularly the case with the roof, which receives the highest levels of solar radiation and so should have the minimum surface commensurate with the necessary spans of the internal spaces' (1997:118). Daniels contributes a study on the microclimate of Jaisalmer (a desert city) in India, the 'integrated air-conditioning system' from the working of the neighbourhood and the courtyard has been analysed, in other words, 'incoming wind and thermal currents cool the houses from the direction of the courtyards. Slender shafts inside the homes create the necessary thermal up-currents, and the re-circulating flow of air is facilitated by air-permeable stone grids, thus the air can circulate, ensuring relatively comfortable conditions for living in this desert area (Fig.2.5)' (Daniels, 1998:53). From this part of the study, a comfortable living space can be achieved, not just by the exquisite design of the courtyard, building types and street, but also more importantly, through the extraordinarily compact urban plan, the shading strategies of the roof, the microclimate system that is created by using the right materials and also the courtyard. All these strategies/implications can be borrowed for contemporary, comfortable urban living and the research methodology can also be guided to the traditional courtyard living environment in Beijing.

From this part of the literature review, we can see that the studies on the traditional Chinese urban built environment have mainly relied on the historical, geographical, thick description, social, spatial and figure ground studies. A lack of the systematic and rational analysis of the urban patterns and spatial quality are the main research gaps, therefore, the figure ground studies, morphological studies, transformation studies, and also the physical urban microclimate studies can help to achieve a better understanding of the traditional urban courtyard built environment on a neighbourhood scale. Meanwhile, isolation from the real urban context is another important concern of the traditional urban environment studies in China.

2.3 Traditional courtyard dwelling studies in Beijing

There is a vast amount of literature on the subject of traditional courtyard building living environment studies both in China and abroad. The following work will classify this existing literature on the traditional Chinese courtyard types studies into the ecological components which include the environmental significance, social significance, and economic significance (see Chapter one). 'One window provides a view, a number of windows provide a vista' (Stea & Turan 1993:4). This literature review goes beyond the products of building and pursues an examination of products within the framework of ecological contexts. Meanwhile, the traditional courtyard living environment studies from different cultures and also the modern courtyard studies will be brought in for comparison, in addition to identifying the research gaps and research methodology for the traditional Chinese courtyard studies.

2.3.1 Social-culture significance

Given a certain climate, certain materials, certain economics, and the availability of certain technology, what layout of the building form would we get? The answer will possibly depend on the social-culture background of the builders, the buildings 'as a symbol of the self, as physical encoding of many of the values of a society' (Oliver, 1987:153). These cultural values 'are transmitted from one generation to the next through the process of socialization' (Lang 1987:80). Rapoport argued that 'almost every culture, with a few exceptions, has buildings of religious or social significance, often both at the same time, which possess greater symbolic value and content than the ordinary dwellings' (1969:10). He suggests social-cultural aspects are the determining force behind the great variety of house types and forms. An enormous amount of research has studied the social culture values of traditional Chinese courtyard buildings in recent years. The following studies will try to collect the parts of the studies on the most influential shaping forces of the traditional Chinese courtyard buildings that have been identified as Daoism, *Fenghsui* and Confucianism. Some secondary shaping forces such as colour scheme, number system, roof types and entrance gates will also be brought in.

2.3.1.1 Daoism and traditional Chinese courtyard buildings

The Chinese did not build houses only for dwelling sake, but also to express a notion of a proper place in the universe in a micro place, which is the main principle of the Chinese way of living. The studies on Daoism can help to understand this relationship between the cosmos and the courtyard buildings. Ronan and Needham explain the Chinese way of thinking about the universe, 'the order of Nature, or the imminent power within and behind the universe' is the Dao' (1978:85), and 'the Tao is the Order of Nature, which brought all things into existence and governs their every action, not so much by force as by a kind of natural curvature in space and time' (Needham, 1956:37). Knapp further revealed that 'a good deal of Chinese architecture is not mere building, the enclosure of space, yet is still guided by cosmological sentiments and patterns of social relationships. At its most elegant, Chinese architecture is a sculptured expression of the cosmos' (1986:1). Here the Chinese courtyard house can be conceived as a microcosm of the universe, and the courtyard can be regarded as the container pervaded by *Qi* (energy) where, just like the universe, the boundary of this container is the boundary limiting *Qi's* movement, which in courtyard buildings can be defined as the buildings and enclosure walls. Meanwhile, courtyard buildings types have been recognized as the basic urban element, and composed the urban fabric of traditional Beijing, which also follows the basic principles of *Daoist's* Dao. However, Daoism has existed in China for thousands of years, and the basic principles of Daoism will be further studied in Chapter four.

2.3.1.2 Traditional Chinese courtyard buildings and Confucianism

Another important shaping force of Chinese traditional courtyard dwellings that has been broadly studied is Confucianism; Confucianism mainly concerns the proper location of a resident in society and family. 'Confucianism proved most influential to China's architecture in the earliest periods in numerous ways. Confucianism regarded rites as central to successful state administration and standards of personal behaviour' (Fu, 2002:6). Boyd (1962), in his 'Chinese architecture' studies, interpreted the social hierarchy of a family to be 'based on Confucian principles and rather rigidly patriarchal, which consisted, in its complete form, of parents, their unmarried children, their married sons with their wives and family, all living under one 'roof' ... in the hierarchy of the family the older generation had precedence over the younger, and the head of the family was the father of the oldest generation' (Boyd, 1962:75). Within this cellular form of a *siheyuan*, the spatial manifestations of open or closed, front or back, and above or below not only echoed but also helped to regenerate traditional Chinese social relationships. In order to plan a courtyard building, the Confucian hierarchical principles are matched with the plan layout and also the uses of a courtyard buildings group. A similar plan and social hierarchical arrangement studies of the courtyard buildings layout have also been studied and analysed by many researchers (Li & Wang, 1999, Liu, 2004; Knapp, 2000; Sun, 2002), which have mostly focused on the conventional principles of an ideal courtyard buildings plan layout and the social behaviour of the residents and the visitors. Very few studies have tried to collect real urban evidence from the actual courtyard built environment.

2.3.1.3 Traditional Chinese courtyard buildings and *Fengshui* theories

'Wind and water express the power of the flowing elements of the natural environment and this power is expressed in, and derived from the flow of energy not only on the surface, which has been sculpted by wind and water, but also through the earth' (Skinner, 1982). *Fengshui* (Wind and Water) principles have been studied and explained by many scholars who have proven that the layout of the courtyard buildings guarantees the flow of the *Qi* (energy) (Oliver, 1987; Xu, 1998; Lu, 2000).

The current literature on *Fengshui* studies can be classified into two levels of study for courtyard buildings. The first level mainly focuses on courtyard buildings in an ideal geographical place, which is used to guide builders with theory and help inhabitants to identify a good living environment in which to build their ideal home. It encompasses an array of patterns and symbols to assist in the selection of the proper sites for cities, palaces, graves and dwellings. 'The application of *fengshui* to site selection includes two major aspects: dealing with landforms and arranging *Qi* (energy). Dealing with landforms addresses the relationship of *Qi* with mountains, surrounding hills, and water; arranging Qi emphasizes the relationship of Qi with orientations and positions. Both have greatly influenced the design of the Beijing courtyard dwelling' (Xu, 1998:271). According to *Fengshui* theories, an ideal site is enclosed by surrounding hills, called 'tiger at right and dragon at left', which symbolize the protection of the dwellings from the outside world. The ideal site faces south, and in front of the site is an open space containing either a lake or a meandering river. In this place, lively '*Qi*' is accumulated.

The second level studies focus on the layout of the courtyard itself. Mitchell and Wu (1998) point out that the external and internal details of the buildings layout of the Chinese traditional buildings have been guided by the *Fengshui* theories to ensure the wealth and prosperity of the family. *Fengshui* plays a significant role in forming the space of the Beijing courtyard dwellings; buildings corresponded to mountains, roads to rivers, and walls to hills. Lu (2000) describes the relationship between the courtyard plan and the *Fengshui* principles as follows: '*Tsuo Hsian Fang*, the building on the left-hand side of the main structure, has the position of 'Green Dragon' in *Fengshui* while Yu Hsiang Fang has the position 'White Tiger'. Green Dragon is related to the orientation bringing vital energy in *Fengshui*, while White Tiger brings negative energy' (2000:362). His studies also suggested that *Fengshui* has directly shaped the layout of the courtyard buildings. Many studies have also explained how to employ *Fengshui* principles when designing courtyard gardens, building openings and enclosures, decoration, colour and so on (Lip, 1995; Lu, 2000; Mitchell &Wu, 1998). Taken as a whole, *Fengshui* principles have been used to harmonize people with their environment and to ensure prosperity of the family. However, some of the studies also argue that *Fenghsui* mainly focuses on man's consciousness in relation to the local built environment, without scientific proof, and that *Fengshui* is more about superstition (Liu, 2004). For this part of the studies, the *Fengshui* studies on the courtyard buildings are mainly gained through the description and the studies of principles. The building contexts from the real life context of a courtyard dwelling will greatly help to understand and examine the *Fengshui* theories. The basic principles of *Fengshui* theory will be expanded in Chapter 4 on traditional Chinese architecture theoretical background studies.

2.3.1.4 The secondary social culture shaping forces of the traditional courtyard buildings.

Apart from the key literature studies on Daoism, Confucianism and *Fengshui* theory, and their influence on the layout of the courtyard buildings, the colour scheme, the number system, roof types, and entrance gate types all give a profound indication of the social culture values of the traditional courtyard buildings.

Colour scheme: Colour in traditional Chinese architecture was considered by a few researchers. *Xu Jingzhi* explains that 'China is actually one of the earliest countries in the world to use paint' (1964:222). *Xu* (1964) and Lip's (1995) studies also have suggested that the Chinese Colour Scheme has been linked closely with the Chinese Five Elements. The five basic colours represent Five Elements and the five orientations, which are metal (white, west), wood (green, east), water (black, north), fire (red, south) and earth (yellow, central). Wu further points out that the traditional colour and the quality of the urban design, 'the unity and variety of colour also strengthens the artistic effect of the architectural complex. The palaces, temples, and other ceremonial buildings have bright primary colours: red walls, white pedestals, crimson columns, and green eaves. Contrasting with them are the plain, simple grey-coloured houses of common people who were not allowed to decorate as they pleased' (Wu, 1999:13). Therefore, the colour schemes can also indicate the social culture values of the traditional living environment.

Number system: *Guo Qinghua* has explained the traditional Chinese numbering system, 'Chinese architecture, no doubt, employed a magical numbering system related to Chinese cosmology...the arrangement of buildings with central bays brings the focus to the centre. With the central column cleared, visual symmetry was created, and the feeling of powerfulness was added' (Guo, 2005:13). Wu also mentions this system and the courtyard buildings in his studies (1999): 'buildings almost universally have an odd number of bays and are entered through the central bay, which contains the most public room, leading to more private rooms on the sides'. However, this part of the study mainly focuses on the introduction of the conventional principle of the odd number system and the lack of proof from the real urban context.

Roof types and the entrance gates types: the roof types and the social culture contexts of the traditional Chinese buildings have been broadly introduced and studied by the research circle (Boyd, 1962; Liang, 2001; Lip, 1995; Lam, 2001; Su, 1964; Zhao, 2001). Five roof types have been recognized as the conventional Chinese roofs which include the hip-and-gable roof, the hip roof, the overhang gable roof, the flush gable roof and also the pyramid roof (Liang, 2001). The latter two roof types can only be used by the imperial family, public institutions and religious buildings. Li and Wang (1999) contribute research on the entrance gate of the Chinese courtyard buildings; five conventional formal entrance gates which include the mansion entrance gate, *Zai Damen* (narrow entrance gate), *Ruyi Damen* (free entrance gate), *Jinzhu Damen* (gold post entrance gate) and *Guangliang Damen* (board entrance gate). The respective social culture values have been considered, and also the south-east location has been generally recognized as the privileged entrance gate for an ordinary courtyard building- the central location can only be used by the imperial family or in the religious buildings. The roof and entrance gate types have all been recognized as the conventional principles for planning a traditional Chinese courtyard building, and therefore will be looked at in detail in Chapter 4 under the theoretical background to the traditional Chinese courtyard buildings.

2.3.1.5 Summary

In general, the literature on the social culture context of the traditional courtyard buildings has been studied broadly in China, from the primary shaping forces such as Daoism, *Fengshui* and Confucianism to the details of the building elements such as the colour schemes and so on. Most of the literature has studied the traditional courtyard only from a very limited point of view, and it mainly relies on the general description studies, very few of which have tried to provide a comprehensive study and get proof from the real courtyard built environment. Meanwhile, the thick description, geographical, historical, spatial hierarchy and social behaviour have all been used in Chinese traditional courtyard studies. In comparison with courtyard studies in America, Middle East and Europe, there is a lack of systematic rational analysis of the courtyard buildings, and they are also isolated from the real life context, thus creating the main research gap on the social cultural sector of the Chinese courtyard studies.

2.3.2 The significance of the physical environment

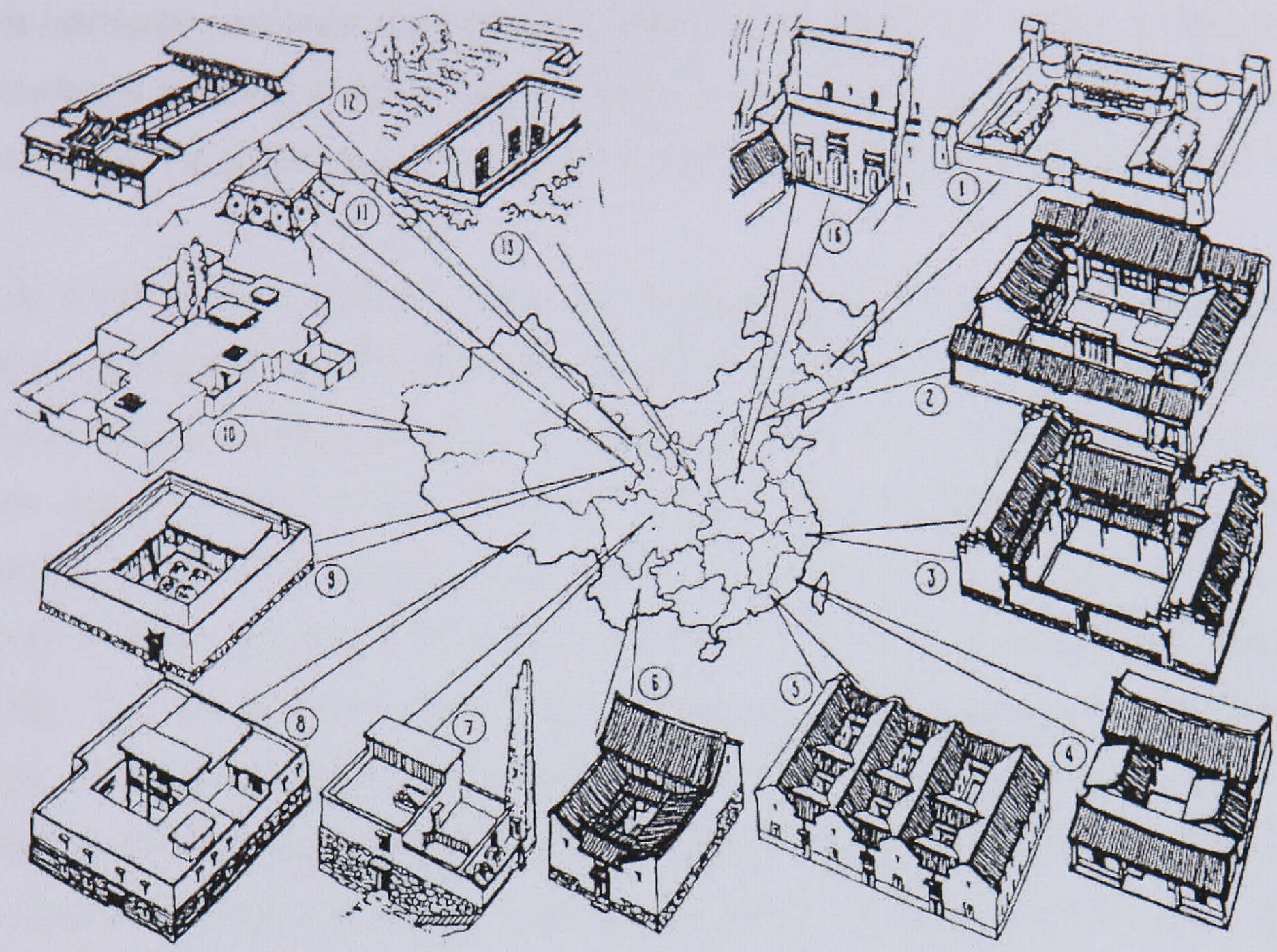


Fig. 2.6 Vernacular courtyard dwelling types of China
Source: Liu 1990:206

Bouvier points out the climatic characteristics of China, 'Northern China is a land of vast plains and plateaux...where the climate is mostly cold and dry...the south, in contrast, is a jumble of hills and dales, where travel is difficult and rainfall copious' (1971:5). Paul Oliver has further identified this classification: 'the traditional distinction between *Huabei* (north China) and *Huanan* (south China) provides a useful first order division for examining vernacular patterns' (1997:874). Oliver also studies the diverse vernacular architecture in China from north to south with reference to the general climatic and geographic contexts, building materials, technologies, and spatial qualities. Xu's study however suggests: 'owing to the differences in natural environment and ways of living, Chinese houses vary in their set-ups. The whole country can be divided into four regions, each having its own special house...the plan of *Szu Ho Yuan*, or courtyard type plan, is used commonly in these four regions' (Xu, 1964:227). Liu (1990) further categorizes courtyards according to the local built environment. From this map (Fig.2.6), it is clear that the size of a courtyard in the north China is larger than those in the south, which allows more sunlight to penetrate into the courtyard buildings in the north of China during the cold winter. Liu (1956), Knapp (1999; 2000; 2003; 2005) and Blaser (1985) go further; the environmental shaping forces and the courtyard forms and size have been brought in. Liu points out that the east-west dimension of the courtyard of south China is normally narrower than that of north China, therefore, 'there is less sunlight for a courtyard building in the south of China during the summer, and it also has the lower temperature and is therefore less overheated like western houses(1956:148).

China is such a vast country, and the geographical difference of the traditional courtyard buildings is significant because of the climate, materials, and social culture differences. Liang (1984) highlights the adaptability of the Chinese traditional timber structure system, 'due to its extreme flexibility and adaptability, this method of construction could be employed wherever Chinese civilization spread and would effectively shelter occupants from the elements, however diverse they might be' (1984:82). This building structure certainly has allowed the spread of the courtyard buildings into vast areas of China (Fig.2.6), and the different geography is mainly indicated by the enclosure materials, the shape and size of the courtyard and so on. Knapp also points out the similar findings; 'dwellings throughout the region (Beijing area) reflect these harsh climatic realities and give evidence of significant environmental adaptation' (Knapp, 2000a:171).

Wu has also demonstrated the regional differences in his studies on Chinese courtyard buildings; 'in different regions in China, courtyard houses have been developed with their own characteristics according to regional conditions. In northern cities, such as Beijing, the courtyard is large, in order to let in sufficient sunlight, while in southern cities, it is much smaller in order to create more shade and better ventilation' (1999:80). However, Wu's study does not further reveal the physical environment values and design implications from the traditional urban courtyard living environment in Beijing. In their studies on the traditional Chinese buildings, Zhao (2001) and Knapp (2000a) point out that the good quality of the natural sunlight of the traditional courtyard buildings can be achieved by the curved roof, 'the natural sunlight can reach into the deep back enclosure wall in winter, but in summer the sunlight can only reach the end of the front enclosure wall because of the effect of the curved roof' (Zhao, 1991:96). *Jing* (1999) in his vernacular architecture study has mentioned that the good quality of the natural light and natural ventilation of the courtyard buildings can be achieved by use of the landscape; 'tree shadow and sun shading devices can regulate the indoor microclimate to some extent' (1999:36). As the above literature studies have indicated, the microclimate and the diversity of the courtyard buildings have been linked. Some of the studies have pointed out the regional differences in the courtyards which have been caused by the adaptability of the traditional structure system. Others go further to identify the strategies used to create the curved roof, landscape and so on, which help to achieve a comfortable living environment. However, the research methodology on how the courtyard buildings in Beijing respond to the local physical environment is rather shallow, and mainly relies on observation studies.

The following traditional courtyard studies will bring in the physical environment studies from different cultures and also the contemporary courtyard studies, which will help to identify the research methodologies for the courtyard studies and also help to identify the research gaps in the traditional Chinese courtyard studies. Hassan Fathy's research revealed how the vernacular architecture of the Arab World and neighbouring regions not only solves the climatic problems, but does so with a combination of beauty and physical and social functionality. Fathy created a series of typologies by studying the history of Islamic architecture in general and the medieval quarter of his own city of Cairo in particular. His conversion of these visible spatial models into a set of rules led to the development of many of the early designs. 'He especially noted that the internal courtyard, which has been used throughout the Middle East for millennia, had efficiently served as a temperature regulator in each of the houses that he studied, and also helped to filter the dust from the air in the city' (Steele, 1997:12). With a similar approach, the microclimate of the courtyards in Tunisia, North Africa are also briefly analysed by Paul Oliver: 'the shafts of the subterranean dwellings of the Matmata Mountains of Tunisia are 10-15 meters in diameter, excavated into the red sandstone and marl to a depth of 5-6 meters, sometimes approximately circular, sometimes more square in plan' (2003:135). This shaft acts as the 'thermal lung' for exchanging warm air with cool air in the course of twenty-four hours. Sun-heated surfaces act as a heat-stone, slowly transmitting their warmth to the rooms and the rooms can still keep warm during the cold night.

In Indian, Correa (1986) has successfully applied the microclimate design strategies/implications from the studies on the traditional courtyard buildings to the design of modern buildings. The sunken courtyards, the pergola-covered courtyard, double-height terrace garden, courtyard and waterpools design principles and strategies have all been analysed and have then contributed to contemporary architecture. Finally he argued that 'a country like India cannot afford to squander resources on this. This is actually an advantage; for it means that the building itself, through its very form, must create the 'control' that the user needs. Such a response necessitates much more than just sun-angles and louvers; it must involve the section, the plan, the shape, in short, the very heart of the building' (Correa, 1986:172). Reynolds (2002) went further; a research methodology which studied the physical living environment scientifically of courtyard buildings was brought in, the physical characteristics of 43 measured courtyards in South America and Spain were examined and analysed, the aspect ratio and solar shadow index were used to examine both the natural light and the comfortable quality of the courtyard. Similar studies on the microclimate of the courtyard buildings have also been carried out by Dana Raydan, Carlo Ratti and Koen Steemers (2005) for the courtyard studies in the Middle East. The study 'demonstrates that the configuration type shows better response than the contemporary urban blocks through the calculated environmental variables (surface to volume ratio, shadow density, daylight distribution, sky view factor' (2005:144). The contemporary courtyard dwellings studies mainly focus on how to achieve a comfortable living environment by employing courtyard buildings types. Brown and Dekay (2001), in their studies of 'Sun, Wind & Light' focused on the study of natural light and ventilation of the atrium and courtyard buildings. The size, shape and orientation of the courtyard and atrium with the strategies of how to achieve a good quality of natural light and ventilation have been studied in detail. The aspect ratio for natural light, and cross-wind, with the proportion of the courtyard has also been discussed to achieve a good quality comfortable living space.

To sum up, the literature on the physical environmental studies of the courtyard buildings, and the studies on the traditional Chinese courtyard buildings mainly concentrate on general observation and description of the physical characteristics of the courtyard buildings microclimate (Wu, 1999; Jing, 1999; Inn, 1940; Zhao, 2001). Therefore, a broader view of traditional courtyard buildings and how they respond to the local physical environment has been discussed for comparison. This has helped to bring in different research methodologies. From the above studies, the general description may start from one particular point such as the regional variation of the courtyard form and size, the function of the landscape and buildings elements, the adaptability and buildings structure and so on, to explain how the traditional courtyard dwellings respond to the local environment. However, the courtyard studies from different cultures and modern courtyards can bring us a much broader view. Hassan Fathy has focused on the typology studies of the traditional courtyard dwellings in Egypt, Paul Oliver has highlighted the 'thermal lung' microclimate strategy in Tunisia, Charles Correa has used many strategies from the traditional courtyard studies in India, and Reynolds in North America and Spain courtyard studies and also many other contemporary courtyard studies have employed the aspect ratio and solar shadow index and many other scientifically analyzed strategies on the microclimate of the courtyard dwellings, which help to get the right size, proportion, enclosure of the courtyard and so on for comfortable living. From this comparison, there is generally a lack of systematic analysis of the courtyard dwellings in China, such as typology studies and microclimate strategies, and also a lack of scientific proof of the right size, proportion, and enclosure of the courtyard and buildings. This gap, just like the gap that Needham (2004) and Huff (1993) identified on the generally defects of Chinese scientific thought, mainly lacks logical proof as well as the concept of mathematical proof. Meanwhile, there is still a lack of real life contexts proving how the Chinese traditional courtyard buildings respond to the local physical environment.

2.3.3 The significance of architectural economic (design aspect)

Economic sustainability issues are also an important part of an ecological design, particularly when the vernacular architecture has been transformed into the urban architecture. Rapoport points out that 'economics has been widely used to explain settlement and building form, and its importance is indeed great' (1969: 33). The economic context studies of the traditional courtyard building are very broad; these can include materials, construction, labour, the employment of the courtyard buildings groups and so forth. However, I will further attempt to specifically relate these to architecture and design.

In 1734, a building regulation was declared by the *Qing* authority. This first formally regulated the economic cost of a standard Chinese building. 'The last twenty-four chapters are rules for the estimation of materials and labour' (Liang, 2001:109). Boyd, in his Chinese architecture studies examined the choices of the materials for the courtyard buildings; 'timber as a material was light for its strength, cheap to transport, easy to work and to carve, easy to mass produce and to standardise' (1962:24). Knapp (2000) and Steinhardt (2004) also point out that the timber structure system is much easier for economical extension and repair. Furthermore, the interlocking network of the wooden structure of traditional Chinese architecture plays an important role in achieving a sustainable meaningful architecture, 'time has proved that Chinese timber-frame buildings can withstand almost any climate and earthquakes as powerful as 7 to 8 on the Richter scale' (Steinhardt, 2002:1).

Liang (2001) further points out that the core values of this Chinese structure are the Chinese modular system, which started to be applied in 1103 from the Song Dynasty (960-1279). Modular construction plays an important role in the transformation from the vernacular architecture to urban architecture; Modular systems are also an important parameter for mass construction and prefabrication. In the meantime, a few researchers have studied or been influenced by the ancient modular system of the vernacular architecture. In the 1930s, Le Corbusier wrote eloquently on his conviction that primitive tribes have intuitively used a modular system of dimensions and relationships; through it was based on the French metric system of the 18^{th} century. Richard Neutra ascribed an intuitive cognition of the same metric measuring systems to Indian villages and settlements in Indonesia (Neutra, 1962). Victor Papanek (1995) expresses his difficulty finding an intelligent discussion of the classic Japanese house with its sophisticated and subtle use of modular components (tatami, shoji, fusuma) in writing about vernacular architecture. In contrast with the ancient modular system from different cultures, the Chinese modular system is the first one to be declared by the central government, and has also been broadly used in all the formal major urban and courtyard buildings construction for nearly a thousand years. However, except for the translation by Liang (2000) and Guo (1998, 1999) of the traditional Chinese structural system into modern language, little literature has got any further in disclosing the architectural economic design values of this traditional Chinese structure system.

In relation to the economic values of the courtyard, Correa's Open-to-sky space is another valuable design strategy learned from the traditional courtyard dwellings in India; Open-to-sky space not only improves living conditions but can also has considerable economic value, particularly in developing countries like India, where families could augment their income by keeping chickens or a goat and other livestock. Correa is also concerned with cultural heritage in Asia, 'in Asia we live in societies of great cultural heritage...I have seen the past and it works' (Correa, 1987:175). Correa has transformed the ecological values from the vernacular dwellings to a wide range of low-rise, low-cost, high-density housing and urban scale buildings in India. Similarly in Utzon's courtyard house studies in Fredensborg, 'one old gentleman of ninety used to have a plantation in Malaysia, and then moved to a farm on the Danish island of Fyn. When he retired to Fredensborg he missed his vegetable garden, and turned the grassy area in his courtyard into a place where he could plant his potatoes. He also supplied the kitchen with lettuce, radishes, peas and dill. Another very pleasing fact is that although the courtyards are essentially used for recreation and rest they also function as activity areas, which is very simulating for elderly people' (Tobias, 1991:10-11). Utzon's expanding courtyard house also has great flexibility for construction, which also indicates a good quality of economic thinking. The multiuse of the courtyard also indicates its economic values, 'almost any activity can be carried on at least temporarily in a courtyard. The most common usages of courtyards and arcades are as extensions of living, dining, and kitchen activities' (Reynolds, 2002: 57).

This part of the literature review shows that the studies on the architectural economic values of the traditional Chinese courtyard architecture are still rare. The previous studies on materials, the modular system, the structure system, the flexibility of the courtyard buildings group and also the multi uses of the courtyards all have profoundly economic thinking. Therefore, this study will go further to study the economic values of the traditional courtyard buildings which can be achieved by architectural design.

2.4 Conclusion

From the above literature review, current studies on the Chinese courtyard buildings built environment are limited to three lines of inquiry. They are either concerned primarily with physical form, or the geographical variations in the area of Chinese architecture and neighbourhood studies (Boyd, 1954; Bouvier, 1972; Liu, 1956; Liang, 1984; Su, 1964; Guo, 1999, 1998, 2005; Oliver, 1997; Zhao, 2001). Meanwhile, the studies on the physical and geography contexts mainly rely on the direct observation or thick description. These lack rational analysis and isolate the buildings from the real urban context and are the main research gap of this part of the study. In social culture studies, when an attempt is made to move beyond physical geography, the focus is either on symbolic and spiritual dimensions, or studied only though a point (such as *Fengshui*) of the whole system, although there is a large amount of research (Lip, 1995; Chan, 1991; Knapp, 1989, 2000, 2002; Mitchell & Wu 1998), which still 'lacks analytical penetration, of detailed and differentiated analysis, on specific form, space, social use and cultural discourse' (Zhu, 2004:1). Isolation from the real living context is another main research gap on the social culture studies. To study architectural economic (design aspect) values in traditional Chinese architecture is also very important (Liang, 2001; Guo, 2002, 2005; Steinhardt, 2002; Zhao, 2001), and currently few of the researchers pay attention to this perspective, although the existing studies suggest the Chinese timber structure with traditional Chinese modular system have great potential to help to achieve a sustainable design. As such, studies on traditional Chinese courtyard buildings remain much constrained; nonetheless, this research will try to explore and analyse the values of the traditional urban courtyard living environment, particularly on how the traditional courtyard living environment responds to the local built environment environmentally, socio-culturally, and economically, which can provide the design implications for the future ecological urban housing design in Beijing. This literature review has also helped to identity the current studies and also the research methodologies which have been used on the traditional Chinese urban courtyard living environment studies. The international studies and their research methodologies have also been brought in for comparison, thus identifying the research gap and research methodology for the following traditional courtyard living environment studies.

Chapter 3: Research questions and methodology

This part of the study concentrates on the research questions and also how to answer them after identifying the gaps in studies on the living environment of Chinese traditional courtyard buildings. The traditional urban courtyard environment can be studied in many different ways; one can look at it geographically or chronologically, one can trace the transformation over time either of techniques, materials, forms, ideas and building regulations, or of the thoughts of the key designers. The nature of this study addresses the current ecological deterioration, the issue of housing shortages and also looks at the availability of the traditional courtyard environment in Beijing. Therefore, this research has studied them from a specific point of view; an ecological architecture (traditional/vernacular approach) point of view. The research questions and the methodology therefore have focused on how to get the ecological (vernacular approach) design values from the traditional urban courtyard living environment studies in Beijing.

3.1: The research questions

My research concern is to learn the ecological design (vernacular approach) values from the traditional urban courtyard dwelling building environment in Beijing, and use these values as an ecological design indicator to cope with the current housing and the ecological environment crisis, therefore my key research question is **how Beijing's traditional urban neighbourhood and courtyard dwellings respond to the local build environment socio-culturally, economically (architectural design aspect) and environmentally.** Within this study, there are a number of secondary research questions:

1. What are the primary shaping forces of Chinese traditional architecture and how have they shaped the urban patterns and the great variety of courtyard buildings in China?
2. How has *Dongsi* neighbourhood (1st through 10th lanes) worked with the local built environment?
3. How do the traditional courtyard buildings (1st through 10th lanes at *Dongsi* neighbourhood) respond to the local built environment?
4. How have the traditional courtyard buildings been transformed in 1st to 10th lanes of *Dongsi* neighbourhood after the completely building types emerged in the neighbourhood in 1900's? What are the shaping forces?
5. How can the ecological design values learned from the historic urban

neighbourhood and courtyard living environment studies provide the design implications to help to achieve an ecological living environment?

3.2: Research methodology: a two phase design

Chapter two has identified the research gaps in the current Chinese traditional neighbourhood and courtyard buildings studies, and the research gaps are mainly highlighted by comparing them with the studies from different cultures and also modern courtyard studies. However, in the use of analytical methods, social concepts and theories, one question that should be raised is this: can western ideas and methods be employed for a case study of China? In today's cross-cultural and global environment, it is felt that if cultural difference is carefully respected, it is advisable, even desirable, to test ideas and methods across cultural boundaries (Zhu, 2004). Generally, for the Chinese traditional courtyard building studies, a logical, systematic and rational analysis is desperately needed; to study the traditional courtyard building environment from the real life context is also expected. Therefore, a case study from real urban life in Beijing will help the studies on the traditional urban neighbourhood and courtyard dwellings.

The chosen case study of *Dongsi* neighbourhood was studied in a systematic way, and the parameter has mainly focused on two levels (defined in chapter 1) which were the urban neighbourhood (1st to 10th lane) and also the courtyard buildings groups level (12 different courtyard building groups), the city and secondary building elements contexts have also been brought in at the appropriate place for a comprehensive study. Furthermore, the research methodology was developed to suit the specific purposes of each typology level study. A two-phase case study research design has been employed for this study. One of the key features of this case study was its incorporation of multiple sources of evidence; direct observation, sketches, documentation and archive reviews, physical survey and focus groups all helped to collect the evidence for the case study. The more variations in places, the more people and procedures a case study can withstand and still yield the same findings, the more external validity (Yin, 1993). In order to provide the data for the ecological (vernacular approach) design studies and analysis, five particular steps have been designed for these case studies: (1) Case study selection (2) Selection of research methodology for each proposition of the study (3) Categorising, sorting and storing (4) Timetable (5) Techniques of analysis.

3.2.1 Case study selection

As previous studies suggested, examination of ecological values has inevitably involved two levels of study: the traditional courtyard buildings and the neighbourhood. Therefore, two-phase design case studies have been chosen for this research. 'As the term itself suggests, a two-phase research design involves combining two or more strategies in a sequence of distinct phases. The advantage of such an approach is that the particular procedures and standards associated with each strategy can be presented fully and distinctly. A disadvantage is that the project could lack coherence if the strategies are not conceptually well linked' (Groat & Wang, 2002:362). This study therefore focused on the traditional courtyard buildings and their existing urban environment, and the two levels of studies are linked both physically and conceptually. Chapter one explained the reasons for choosing Beijing as the studied city, and the following studies will state the reason for choosing 1st through 10th lanes of *Dongsi* neighbourhood and 12 traditional courtyard buildings inside the neighbourhood as the case studies.

3.2.1.1 First phase case chosen: 1st to 10th lanes, *Dongsi* neighbourhood:

1. 1st to 10th lanes of *Dongsi* neighbourhood are still a living quarter, and the majority of the courtyard buildings inside the neighbourhood are used as dwellings.
2. The identification of the firstly four lanes of the neighbourhood can be traced back to the *Ming* Dynasty (1368-1644). The mature design principles and techniques will help to improve the validation of this research.
3. Most of the residents have already lived inside the courtyard buildings and the neighbourhood for a relatively long period.
4. The diversity of the traditional courtyard buildings include the royal family courtyard building group which occupies 1st to 3rd lanes, and also the large noble courtyard building, relatively small courtyard buildings and so on. Some of the courtyard buildings are still used by one family and kept in good condition.
5. There are diverse uses, which include the religious buildings, community buildings, commercial buildings and so on.
6. 3rd through to 8th lanes of *Dongsi* neighbourhood, like the other 24 traditional neighbourhoods in Beijing, have been kept well and were classified as a conservation area in 2002. The relatively good quality of the living

environment can help in the collection of reliable evidence for this research. The case study plot area included 3^{rd} to 8^{th} lanes as the core study area, together with the edge area of 1st & 2nd lanes on the south side and the 9^{th} &10^{th} lanes on the north side, which physically and socio- culturally emerged as a comprehensive neighbourhood for case studies.

7. The availability of the preliminary survey, drawn from IPPR design institute which includes the plan and a good quality courtyard list, made the further fieldwork, studies and analysis possible.

3.2.1.2 Second phase cases chosen: the traditional courtyard buildings:

There are various traditional courtyard buildings inside the neighbourhood, and many of them vary in living quality, orientation, colour, standard of building, and the number of yards and courtyards. Therefore a criterion should be set for choosing traditional courtyard cases.

1. Because this study mainly focuses on learning the ecological values from the traditional living environment, the chosen traditional courtyard buildings should be in relatively good condition to make the research reliable.
2. The original use of the courtyard buildings should be domestic to make the output reliable for the ecological housing design.
3. Each courtyard should be chosen for a specific reason but not for the simple replication, and should have internal as well as external validity.

The following 12 courtyard buildings have been chosen for the cases for different specific reasons[1] which include the orientation and location of the main entrance gate and the main buildings, the number of the courtyards and yards, the height of the buildings, the shape of the buildings, and so on. Basically, there is no replication in these twelve courtyard buildings. These twelve courtyard buildings are also in a relatively good condition, which helps to get reliable data (Fig.3.1).

[1] The case study selection is not an easy task particularly for the courtyard buildings level. Some of the private buildings which are normally in a good quality courtyard may not be accessible, and the living rooms are even more difficult to visit. Therefore, the accessibility of these courtyard buildings is also an important reason for choosing the site..

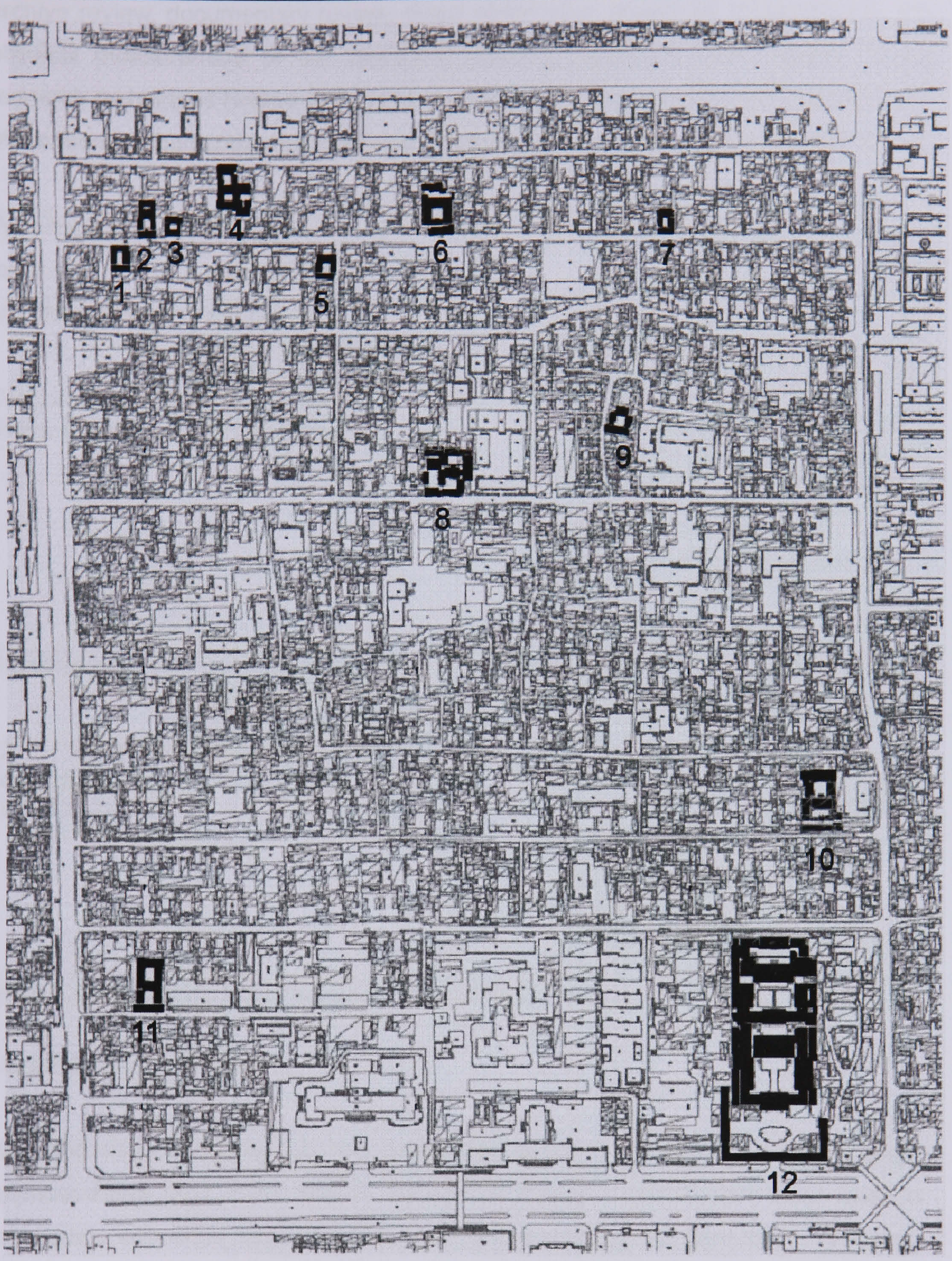


Fig. 3.1 the case studied courtyard of 1st to 10th lane of *Dongsi* neighbourhood

Scale: 1:5000 0 m 100m 200m 300m N

3.2.2 Selection of the research methodology for each phase of the case study.

Evidence from several resources has been used for the field studies, which includes archive review, documentary review, direct observation (sketches, photographs), the physical measurement of the courtyard buildings, and the focus groups. These research techniques helped to achieve multi-sources and provided an understanding of traditional urban courtyard dwellings and the building environment (Table 3.1).

Typological level	**Research methodology**	**Tactics: data sources**
Neighbourhood Dongsi 1st to 10th lanes, Beijing	Archive review Documentary review Direct Observation, Physical survey Focus groups	➢ Archive review: maps, and preliminary survey of the neighbourhood from Libraries and IPPR design institute ➢ Documentary review: newspaper clippings, articles, books, letters and writings, novels, travel books, plays ➢ Direct observation: sketches, photographs and videos ➢ Physical survey: measurement of the road width, size of buildings by ruler ➢ Seven exploratory focus groups
Building groups 12 represent courtyard buildings groups	Archive review Direct Observation, Documentary review Physical survey Focus groups	➢ Archive review: preliminary survey of the buildings plans and the good quality courtyard list from IPPR design institute and libraries ➢ Documentary review: newspaper clippings, articles, books, letters and writings, novels, travel books. ➢ Direct observation: sketches, photographs and videos ➢ Physical survey: measure buildings and elements of buildings ➢ Seven exploratory focus groups

Table 3.1: Research methodology for two phases research

3.2.2.1 Archival review

Historical maps of Beijing and the preliminary survey of 1st to 10th lanes of Dongsi neighbourhood from IPPR Design Institute in Beijing in 2003 have been used in conjunction with other sources of information in producing this case study. However, the accuracy of the historical maps should be considered very carefully because these maps; *Wanli-Jinmen tu* (map), 1593; Qing Beijing *Cheng* (Qing Beijing map), 1750; *Daqing Tongti Zhi* (Great Qing united maps), 1784; Beijing *zuixin quantu* (the newest Beijing elaborate map), 1908, are basically not in scale. However, the preliminary survey from IPPR design institute which includes the brief plan drawings and the good quality courtyard buildings list are very useful for the field work.

3.2.2.2 Documentary review

Many forms of documentary information were available for this research and 'these and other types of documents are useful even though they are not always accurate and may not be lacking in bias' (Yin, 2003: 87). Many forms of information have been collected from the fieldwork and also the visits to the libraries both in China (mainly National library) and UK (Newcastle University, Durham University, SOAS, UCL and British Library). These included Journal articles, newspaper clippings, reports, books, letters and writings, plays, novels, travel books, and so on. However, the validity of every document should be questioned although most of the materials have provided a vivid description of the place. In this research, the evidence that the document provided has been used with other evidence and in addition we have treated inferences only as clues worthy of further investigation rather than the final findings.

3.2.2.3 Direct observation

'By making a field visit to the case study 'site', you are creating the opportunity for direct observations. Assuming that the phenomena of interest have not been purely historical, some relevant behaviour to environmental conditions will be available for observation' (Yin, 2003:92). Observational evidence always provides additional information for the research topic such as the existing communities, social culture events and decorations, materials and colour of the courtyard buildings, particularly for the existing building environment. The eight weeks in the field provided rich observational evidence for the case studies. Meanwhile, sketches, photographs and videos have also been used to collect evidence from the field which helped to convey important case characteristics to the outside observers.

3.2.2.4 Physical survey

The urban structure and some of the traditional courtyard buildings have been kept in a relatively good condition, but very little physical survey work has been done to the neighbourhood, particularly on the vertical dimension such as the height of the buildings, columns, walls, entrance gates and so on. However, these physical dimensions are also very important in helping to identify the quality of the urban and architectural space. Therefore, this research has tried to carry out a physical survey of the smaller scale courtyard buildings groups, i.e., the diameter of the columns, the height of the walls, the size of the courtyard and yards, the dimension of the bays and so on. But for the larger scale buildings such as *Fuwangfu* mansion, it is impossible to get the detailed dimensions of all the buildings and building elements, for those unreachable physical measurements, the theoretical background studies on Chinese traditional architecture (the building regulation section) may help to get the right size of the buildings through the conventional proportion and scale calculation.

3.2.2.5 Focus groups

'The successful built environments are successful not just because of their physical attributes, but also because of many human considerations' (Groat & Wang, 2002). The exploratory focus group studies importantly elicit the participants' feelings, attitudes and perceptions of the selected topic of the neighbourhood and courtyard studies, and 'bring together attitudes, opinions, and experiences in an effort to find out not only what participants think about an issue but also how they think about it and why they think the way they do' (Puchta & Potter, 2004: 74). The focus group also helped to encourage communication and get the objective values of the neighbourhood, courtyard dwellings and also the current environment without too much influence from the researcher. The residents' real life attitudes and experiences in the building environment are essential to help to understand the current living environment and also achieve the ecological approach to design values. The details of the focus group will be briefly introduced as follows:

(a): Sample size and sampling strategies

The appropriate numbers of focus groups for this study depended on the number of the investigated courtyard dwellings and the available communities in the lanes. However, the limitation of time, resources and cost, the factors of the accessibility of the courtyard dwellings also had to be taken into account. In total, seven focus groups took part in the study inside the neighbourhood (Appendix 2 & 3). Meanwhile, I based the method on Barbour + Kitzinger's topic-specific sampling strategy (1999), using open-ended topics to build my questions framework which came from a sampling of ecological design literature and my own architectural and urban design background (Appendix 4). This framework has been revised after a pilot study on Fayuansi (temple) neighbourhood that basically helped to achieve a better understanding of the questions and also focus on the research topic (ecological values).

(b): Group size and composition

The orthodoxy emerging from the market research literature stipulates that the ideal number of participants is between 8 and 12 (Barbour& Kitzinger 1999). However, this study mainly explored the residents' experience and their feeling about the living quality inside the courtyard building environment. It also mainly focused on the traditional design values and not the current situation. Therefore, the longer the participants lived in the neighbourhood, the more valuable the material of the collected focus groups material. The number of participants in each focus group mainly depended on the family size in the single family courtyard buildings that the author visited, and the existing community size that the author met on the street.

(c): The research setting

In general, the meeting place was chosen as either inside the courtyard buildings, the courtyard, or at the entrance gate of the courtyard and street (*hutong*). The following places are the location of the focus group site: the pedestrian area of the 10th lane, inside No 129, No 111 and No 71 of lane 8, courtyard dwellings, in lane 8, and also inside the courtyard buildings groups of No 2 of lane 4, and No 21 of lane 2 (Appendix 2 & 3).

(d): Focus group moderation

When with the focus group participants, I mainly started with the prepared topics and avoided providing any judgement on the discussion, and also avoided presenting myself as an expert or making any assumptions that closed off exploration. However, during the focus groups' discussions, I tried to intervene to enable the incomplete sentences to be finished and encourage everyone to participate, particularly when some of the participants, e.g. the female servant in No 111 of lane 8 were not likely to take part. Therefore, one of the key skills was ensuring that interaction and discussion between research participants was encouraged.

(e): Using stimulus materials and exercises

A list of questions framework was presented to encourage participant communication. These stimulus materials encouraged participants to concentrate and familiarise themselves with the questions and forced them to explain and defend their differing perspectives.

(f): Recording

Tape-recording was used because it provided far richer research access to the discussion. However, as with many other studies, one of the challenges is to identify the individual speakers from the recording and link the speakers with their background, so the voice and the background of each participant were checked before starting the discussion. However, some of the residents, such as those in the focus group in No 129 of lane 8, did not want to be recorded for privacy reasons. The residents came from the aero industry and therefore did not want to be recorded. In that case, the discussion notes were taken.

3.2. 3. Categorizing, sorting and storing the data

The key sources that were used to record and describe the urban courtyard buildings and the neighbourhood have been divided into two main typological levels: the neighbourhood and the courtyard buildings, Beijing city and its building elements have also been brought in, which helped to achieve a holistic study of the ecological (vernacular/traditional approach) design values from the traditional courtyard living environment.

1) The parameter of the first typological level, characterizing the nature and manmade built environment where the neighbourhood is located and referred to as the city, will help to build up the background and is also for the external validity for the traditional neighbourhood and courtyard dwellings studies.
2) The parameter of the second typological level, characterizing the nature and manmade built environment of the courtyard buildings site, can be referred to as the neighbourhood. The place studies of the neighbourhood which includes the historical studies of Beijing, the physical location and the historical context of the neighbourhood, and also clarifies the urban elements. The social culture context has been employed to understand the neighbourhood and the also the place. The morphology studies include the figure ground, the plot patterns, the building types, the uses, the street patterns and the spatial hierarchy.

Typological level	Theory/ principles	Content
City	*Fengshui* theory Lip, 1995.	Site choice and urban planning
	Wangcheng (royal city)theory from *Zhouli:Kaogongji.*	Urban details planning, and the layout of all the institutional buildings
Neighbourhood	**Place studies** Trancik, 1986; Lynch, 1960; Wu, 1999.	Historical studies Classification of the urban elements Social culture foci studies
	Morphology studies Trancik, 1986; Conzen,1960; Carmona,etc, 2003; Cullen,1961; Zhu, 2004.	Figure ground The uses Plot pattern Building types Street types The spatial hierarchy
Building groups	**Social culture values** Oliver, 1997; Liang, 1999; Zhu, 2004.	Plan typology Secondary buildings Colour typology
	Architectural economics (design aspect) and environmental values Reynolds,2002; Edwards, etc, 2006; Liang, 2001.	materials Structure typology Section typology
Building elements	Buildings elements Brown, 1985.	Window type Door type Wall type

Table 3.2 Theoretical background for different levels of the studies

- The parameters of the third typological level, characterizing the nature and manmade condition of the living compounds, are referred to as the courtyard building groups. This part of the study has focused on social culture values, the architectural economic (design aspect) and the environment values studies.

- The parameters of the fourth typological level, characterizing the nature and manmade conditions of the living environment that has been created by buildings enclosures and openings, is referred to as the building elements.

For the focus groups materials, there was also a process of data categorizing, sorting and storing before analysing; it was to index and locate all the key words or phrases, sort them and store them in one place following each focus group topic so that they could be reviewed for key ideas expressed in the responses.

In thought-collecting tasks, the participants provide their thoughts and the researcher's creativity determines their use (Fern, 2001). The focus group used the framework that came from a sampling of the ecological approach (Table 3.2). These selected parameters have broken down the courtyard buildings built environment studies into their own set of components, which helped to organize, categorize, sort, and store the collected data.

3.2.4 Timetable: see appendix 5

3.2. 5 Techniques of analysis

Many strategies and techniques can be employed to analyse the collected evidence. 'Theoretical propositions' and also 'rival explanation' analysing strategies that were developed and identified by Yin (2003) have been used as the main research analysing strategies. The original research objectives and the design of the case study is also based on such theoretical propositions, 'which in turn reflected a set of research questions, reviews of the literature, and new hypotheses or propositions' (Yin, 2003:112). However, the theoretical propositions analyzing approach will focus on certain kinds of data and ignore others. Therefore, for this research, multi-sources data has been used to decrease this negative influence. Furthermore, the 'rival explanation' strategy has been used to fit the gap which the 'theoretical propositions' ignored. This part of 'rival explanation' analysis which focused on the observed outcomes was, in fact, the result of some other influence. Therefore, the case study data collection also has to include the possible 'other influences' such as the different culture, culture resolutions, earthquakes and so on, particularly in the courtyard transformation studies. Following the general strategy, three specific analytic techniques have been applied to this research:

1) The time-series analysis techniques have been used both in the neighbourhood place studies and also transformation studies. 'The important case study objective is to examine some relevant 'how' and 'why' questions about the relationship of events over time, not merely to observe the time trends alone' (Yin, 2003:127). An essential feature for time-series in this study was to identify the specific indicator to be traced over time and then build up the casual postulate. Time-series analysis has identified different social foci of the neighbourhood, and also different uses of the buildings that have vanished, such as the religious buildings, market buildings and so on. This part of the studies has also helped to identify the primary forces shaping of the transformation process.

2) Pattern matching: For this research, the social cultural, physical environmental and architectural economic (design aspect) values are the three main predicted outcomes from the traditional urban courtyard living environment studies. Such logic has been used to compare an empirically based pattern with this predicted one (or with several alternative predictions), and if the patterns coincide; the results can help a case study to strengthen its internal validity (Trochim, 1989). Therefore, the analyses of the collected evidence through different research methodology studies (Table.3.2) have been compared to those three predicted ecological contexts to see if the pattern coincides. 'If the results are as predicted, that is, even if one variable does not behave as predicted-the initial proposition would have to be questioned' (Yin, 2003:117). At urban neighbourhood and courtyard buildings level, the ecological values which include the social culture, physical environment and architectural economic ecological values all have been found from this study and therefore can prove there is a strong causal inference between the traditional courtyard living environment and the ecological design implications. Furthermore, a pilot study in *Fayuansi* temple, neighbourhood which is also one of the 25 conservation areas in Beijing, has been used to prove that the three main ecological sectors of the design were valuable before we conducted the field work in 1st to 10th lanes of *Dongsi* neighbourhood.

3) Cross cases synthesis: this analysis technique has been applied to the second phase of the traditional courtyard studies analysis, which treated each individual courtyard buildings case study as a separate study. The

analysis can start to prove whether different courtyard cases appear to share similarities and deserve to be considered as an instance of the same 'type' and 'typology' of the general cases. The analysis of the entire collection of the courtyard cases enabled the study to draw cross-case conclusions about the traditional courtyard dwellings.

Therefore, the general analyse have mainly relied on the 'theoretical propositions' strategy for the ecological design values (vernacular approach) analysis and also brought in the 'rival explanations' strategy to analyse the evidence that 'theoretical propositions' ignored. Then the 'time-series analysis', 'pattern matching' and 'cross cases synthesis' analysis techniques have been employed to deal with the collected data in detail.

3.2. 6 Summary

For this research methodology, a two phase case study has been designed to work for the traditional urban neighbourhood and the courtyard dwellings built environment studies. With setting different parameters to each level of the studies, the case study evidence has been collected by direct observation, archive review, documentary review, physical survey and focus group, which together provided multiple sources and triangulating evidence from the real, urban context of the 1st to 10th lanes Dongsi neighbourhood, and this triangulating evidence will help to construct the validity and reliability of this research. The causal links between the traditional courtyard built environment and the ecological design values have been studied, analysed and evaluated by the 'theoretical propositions' and also 'rival explanation' analysing strategies.

3.3 Methods and approaches drawn from Western theory

The Chapter 2 literature review studies suggested that there is a lack of rational analysis of the traditional Chinese courtyard living environment studies, which was also one of the major research gaps in the current Chinese historical courtyard living environment studies. Therefore, this part of the research will mainly focus on the rational research methodology of each component of the courtyard living environment studies. Different analytical methods and approaches (with attention to the social, cultural and economic differences) from Western theory will be brought in for the following traditional Chinese courtyard studies.

3.3.1 Beijing city studies

It is impossible to carry out the neighbourhood and the courtyard buildings studies without understanding the urban form and structure of traditional Beijing as a whole. The aim of the brief study of traditional Beijing is to provide a theoretical background and also the external validity for the neighbourhood and courtyard dwellings studies. Therefore, how to introduce the city as a whole has to be the main concern. 'Design decisions are largely based on models in the head of designer. Presumably, those models connect with more general theories, but models and theories can be surprisingly independent of each other…for our purpose, a model is a picture of how the environment ought to be made, a description of a form or a process which is a prototype to follow' (Lynch 1981:277). Three ideal city models have been broadly adopted as the basic city models, each ideal city model has an enormous influence on contemporary urban planning and cityscape, and they are Ebenezer Howard's 'Garden city', Le Corbusier's 'The contemporary city' and Frank Lloyd Wright's 'Broadacre city'. For these ideal city models, the ideal city model, the founder, theory and principles, ideal city size and population, physical form and the description of the city have been used to give the general introduction of an ideal city. Traditional Beijing city has similarities with these ideal cities and is also strongly influenced the cityscape of Chinese traditional imperial cities. Therefore, the conventional principles for planning a Chinese traditional ideal city have been brought into this study in Chapter 4.

Fig. 3.2 Zhang, part of Qingming Shanghe Tu, 12th century

Traditionally, the historical urban scene paintings have also been used to describe the urban life of traditional Chinese cities. The famous silk painting scroll *QingmingShangheTu* (Riverside Scene at *Qingming* Festival) from *Zhang Zeduan* (960 -1127) is one of the earliest observations of an ancient Chinese city. Zhang carefully recorded the ancient capital cityscape of *Bianliang* (today Kaifeng, *Henan*

Province), capturing the complexity of all of its various elements, townscape and the urban social life: Men and women, monks and merchants, peasants and soldiers, etc. (Fig.3.2). The historical painting itself narrates a story of the urban life from the past, therefore, the archived paintings of Beijing have been used for the possible observation of the urban place of traditional Beijing.

3.3.2 **The neighbourhood/urban living quarter**

The historical urban cores represent long living survivals from the past, constitute counter structures to the ephemeral nature of fashions, products, values, etc., where the urban space is rooted in the growing flow of events in time (Dietvorst & Ashworth, 1995; Gospodini, 2001). Trancik points out in his analysis of historic urban environment that traditional urban space consists both of 'concrete things having material substance, shape, texture and colour' and of more intangible cultural associations, a certain patina given by human use over time' (1986:112). Further as the literature review in Chapter 2 has identified, there is a general lack of systematic and morphological studies on the Chinese traditional neighbourhood living environment studies, and the current studies were also isolated from the real urban built environment contexts. Therefore, these urban neighbourhoods built environment studies have not only included the real life context in the urban neighbourhood but also the physical urban form studies where urban life was carried out. The studies of the real urban context (place studies) included the historical context, the classification of the urban elements and the social culture context. The morphological studies for the urban patterns and shapes have included the figure ground, plot types, building types, uses, street pattern and spatial hierarchal studies.

3. 3. 2 .1 Place studies theory

The place studies have contributed a whole picture of 1st to 10th lane of *Dongsi* neighbourhood both physically and social culturally, which include the neighbourhood location and size, the historical context, the classified urban elements, the social culture foci studies and so on. The essence of the place studies lies in understanding the cultural and human characteristics inside the physical urban space.

Historical studies: The historical urban context studies have been used to understand the traditional urban context of the neighbourhood. The archive review, documentary review and also the focus group materials from the senior residents of the neighbourhood have been used to explore and recover the urban contexts. This part of the study is very important in order to discover the original urban living environment.

The classification studies: Lynch's (1960) Five Urban Elements have been used to classify the urban elements of the neighbourhood which include the paths, urban edges, district, urban node and urban landmark. However, some of the studies have criticized Lynch's theory for a lack of concern about social culture context. However, Lynch's innovative use of graphic notation to link quite abstract ideas of urban structure with the human perceptual experience can still greatly liberate the physical urban elements from the plans.

1) **Paths:** 'Paths are the channels along which the observer customarily, occasionally, or potentially moves. They may be streets, walkways, transit lines, canals, railroads' (Lynch, 1960:47). More importantly, the paths have not only just been used for transportation but also helped to link other urban elements together.
2) **Urban edges:** Here the urban edges have been defined as the linear elements that have not been used or considered as paths by the observer. The urban edges are most likely the boundaries between two kinds of area. From Lynch's study, the water front, railways, city walls, throughways and so on can all be considered the urban edges. Lynch also argued that while 'continuity and visibility are crucial, strong edges are not necessarily impenetrable. Many edges are uniting seams, rather than isolating barriers' (Lynch, 1960:65), and it is interesting to see the differences in effect in the neighbourhood.
3) **Urban district:** 'Districts are the relatively large city areas which the observer can mentally go inside of, and which have some common character' (Lynch, 1960:66). In Lynch's studies in Boston, the districts were the basic elements of the city image.
4) **Urban nodes:** 'Nodes are the strategic foci into which the observer can enter, typically either junctions of paths, or concentrations of some characteristic' (Lynch, 1960:72). The urban nodes can be the city square, the junction or a place of a break in transportation, the tube station, railroad stations, airports, thematic concentration, and so on.
5) **Urban landmark:** Landmarks have been defined as the points of reference to the external observer, and the reference elements may vary widely in

scale. The spatial prominence can establish elements as landmarks in either of two ways: 'by making the elements visible from many locations, or by setting up a local contrast with nearby elements (Lynch, 1960:80).

After identifying the urban elements of the neighbourhood based on Lynch's 'Five Urban Elements', the social culture studies have focused on the cultural buildings, events, festivals, activities, communities, and on 'the city as a theatre of memory, with the idea of nostalgia and accumulation as the sources for the perfect design' (Trancik, 1986). The essence of the place studies here in the urban neighbourhood of 1st to 10th lanes at *Dongsi* area lay in understanding the sequence of architecture and human characteristics inside the physical urban spaces.

3. 2 .2.2 Theoretical background for urban morphology studies

Following the place studies of the neighbourhood, the urban morphology studies have been carried out to determine 'the physical (or built) fabric of urban form, and the people and processes shaping it' (Larkham & Jones, 1991:55). The urban form and shape can be analysed by the figure ground theory which has helped to clarify the structure and order of urban patterns, and then can be seen in terms of several key elements for the quality of the urban place which include the plot patterns, building types, land uses, street patterns and also the spatial hierarchal (Conzen 1960; Carmona, Heath, Oc & Tiesdell, 2003).

1): Figure ground studies: The figure ground research methodology has been employed to provide a general mass and void relationship studies of the neighbourhood. The main purpose of this part of the study before the morphological studies is to consider 'the buildings not just act as objects, but also as background' (Carmona, Heath, Oc, Tiesdell, 2003: 69). More importantly, the figure ground studies also helped to clarify the structure and order of urban spaces, and also the urban patterns. Here the urban-solid types include all building types, building elements and public monuments. The urban-void types included entry foyers, inner-block courtyards and yards, networks of streets, lanes and sub-lanes, gardens and so on. The figure ground tool has contributed a static and two-dimensional concept of urban patterns and textures of 1st through 10th lanes at *Dongsi* neighbourhood.

2): Plot pattern: The plot pattern has been used to identify the fundamental urban fabric of the urban place and also the social status of the residents, and furthermore indicated the urban density of the neighbourhood. However, the plots can be bought and sold, destroyed and rebuilt, uses can be modified, boundaries can be changed, large plots may be sub-divided, or smaller plots can be amalgamated, and this process could occur in both directions. The study of the plot pattern in a dynamic way could offer a clearer understanding of the characteristics of the courtyard buildings, and also help to understand the current plot patterns of the neighbourhood.

3): Building types: The traditional building types of the neighbourhood have been identified and analysed, as being essential to understanding the physical form of 1st to 10th lanes of *Dongsi* neighbourhood. There was a discussion on the social culture and economic status, and physical characteristics of each building type, and the possible new varieties of the five conventional roof types (see Chapter 4.3.1) inside the neighbourhood. these have also been explored and studied.

4): Land Uses: 'Compared with the other key elements in the urban area, land uses are relatively temporary' (Carmona, etc., 2003: 61), but the uses arrangement will be essential to achieve a good quality of urban living. This part of the research has tried to explore the traditional uses of the neighbourhood and how they shaped its quality of life.

5): Street patterns: 'Streets and their sidewalks, the main public places of a city, are its most vital organs. Think of a city and what comes to mind? It is a street. If a city's streets look interesting, the city looks interesting; if they look dull, the city looks dull' (Jacobs, 1965:39). Streets are the 'only places which are accessible to people and can offer them choice' (Bentley, Murrain, McGlynn, Smith, 1996:12). Furthermore, Lynch classified access according to the features of the street to which access is given and to whom it is afforded: (1) access to other people, (2) access to certain human activities, (3) access to places, (4) access to information (Lynch, 1981:188). Therefore, this research not only regardes the street as a transport artery but also as the main urban pubic space for human activities such as exchanging goods, social activities, merchandise, service and communities and so on. The streets have been classified according to their physical characteristics and also the functions. Meanwhile, the street length and also the street proportion (the width of the street by the height of the buildings) have also been identified to show its spatial quality.

6): Spatial hierarchies: The spatial hierarchy is another important tool for analysis of the quality of living space inside the traditional urban neighbourhood. The traditional space of urban design in this study has been seen as the amalgam of at least three sectors: the public space, the private space and the space between them. The public realm is concerned with the spaces formed by the courtyard building groups that include the public movement systems, the open space of the quarter, and the communication space for people to use. Private space refers to the space for the residents to live in and control. The space between the public and private space is the space that we normally term semi-public space. Furthermore, more spatial transition points have been explored from these traditional urban courtyard spatial transition studies.

3. 3. 3 Courtyard building group studies

'Traditional Chinese architecture, whether an Imperial palace or common residential house, usually means a group composed of many separate buildings' (Steinhardt, 2002: 8). When one courtyard is not enough, more courtyards will be designed in front of or behind the main buildings, and there, even more courtyards or gardens will be added on the left or right of the main buildings if the owners request it. Therefore, the studies of the courtyard dwellings are of a group of buildings rather than a single building. A classification of various courtyard buildings groups based on the primary shaping forces was carried out before the typology studies. Then the plan typology and colour typology (with the secondary buildings) was studied in order to identify the social culture values. The structural typology was analysed for the architectural economic (design aspect) values, and the section typology studies for the courtyard dwellings' environmental values. This does not imply, however, that these typological studies should be considered in isolation, but rather that all the information is needed to understand the complexities involved.

3. 3 .3. 1 The classification of the courtyard dwellings

As the above studies indicated, the investigated 12 courtyard buildings have been chosen for different specific reasons but not for simple replication. However, this differentiation also caused the mixture and confusion of the collected data. In order to communicate the collected data, the collected information has to be classified and identified for the common characteristics that enable architectural phenomena to be considered in specific classes or sub-classes. Therefore, following the studies of the primacy shaping forces on the physical layout of the courtyard dwellings, the courtyard buildings groups have been classified into courtyard units with different numbers. The secondary buildings also have been identified for the future studies.

3. 3. 3. 2 The courtyard dwellings typology studies

'The word typology means the study by types. Typology is concerned with those aspects of human production which can be grouped because of some inherent characteristics which make them similar' (Bandini, 1993). The extraordinary aspect of typology study as an analysis device lies in the fact that it is generative; two forms can belong to the same type but can appear and can be construed as different from each other. 'It does not necessarily bring about sterile repletion of forms, but can reinforce architectural attributes shared by many buildings at the urban scale' (Polyzoides, Roger & Tice, 1992:1). Therefore, in order to communicate and to impart or exchange information of the courtyard dwellings, the plan typology, colour typology, structural and section typology have been used to identify the common characteristics of the layout of courtyard buildings, which allowed for the reduction of the complexity of the phenomena to essential principles to convey arguments or ideas.

1): Plan typology

The plan typology has been used to study the spatial organization, proximity relationships, social hierarchies, as well as aspects of structure and construction (Oliver, 1997). For the courtyard buildings studies, the uses of each courtyard, yard and the buildings, the social hierarchy of each family inside the neighbourhood and also the inside the courtyard buildings groups, the location and the social culture meaning of the entrance gate have all been carefully analysed and discussed to get the social culture design values. Following this part of the plan typology studies, the secondary buildings have also been studied for the social culture values.

2): Colour typology

The colour schemes and the painting are one of the most impressive characteristics of the Chinese traditional courtyard buildings. The social culture and function values of the Chinese colour schemes and painting techniques have been briefly introduced and analysed.

3): Structure typology

'Primitive men at all times and in all places, as also the bearers of high civilizations, Egyptian, Chaldean, Greek, all these have built and, by that token, measured. They were eternal and enduring, precious because they are linked to the human person. The names of these tools were: elbow (cubit), finger (digit), thumb (inch), foot, pace, and so forth...Let us say it at once: they formed an integral part of the human body, and for that reason and they were fit to serve as measures for the huts, the houses and the temples that had to be built' (Corbusier 1954: 15-19). This fundamental model and scale system has been identified as the model system for different cultures by Corbusier, and have been regarded as the fundamental elements for a successful structure system. Structure is normally the most expensive part of building construction. Therefore, the structure typology studies have explored the Chinese structure system by analysing the Chinese modular system, the space unit system, roof type and also the structural types. Particularly the Chinese modular system has great economic thinking behind it, and is also different from the modular system that has been used by different cultures (human scale from different cultures and timber scale from China). The underlying social culture values and more importantly the economic values which have been achieved by the architectural design aspects of this modular system and the structure system have been carefully studied and explored.

4): Section studies

The section studies can indicate the quality of the space both physically and social culturally, which can help the studies on the structure system, building standard, spatial hierarchal, and more importantly, how the courtyard buildings have responded to the local climate. The microclimate of the courtyard buildings that was created by the yards, courtyards, buildings, front lanes and back lanes has been classified according to the location of the yards and courtyards, and then the aspect ratio for the winter sun and the solar shadow index for the openness to the sky have been employed to identify the basic physical characteristics of each microclimate type.

Solar shadow index: south wall height/north-south floor width

The solar shadow index has been employed to examine the quality of winter sunlight in the courtyard, yard and buildings. In winter when the sun is low in the sky, it is essential to get direct sunlight into the main buildings due to the cold and dry continental weather in Beijing. The greater the solar shadow index, the deeper the well formed by the south faced wall/ buildings, and the less winter sunlight reaches the courtyards and buildings.

Aspect ratio: floor area of courtyard and yard /the square of the average height of surrounding walls

Aspect ratio indicates the courtyards, yards and buildings' degree of openness to the sky, which indicates the different solar gain of each courtyard and yard during the summer. The greater the aspect ratio, the more exposed is the courtyard to the sky. This exposure allows heating by the sun by day, cooling by radiation to the cold sky by night. The natural ventilation that is created by the different aspect ratio figures of the microclimate has also been analysed and discussed.

After examining the basic physical characters of the microclimate of each courtyard buildings unit, the strategies for natural sunlight, natural ventilation and also for the right humidity have been discussed and analysed following the different factors, which include the orientation factor, the landscape factor, the buildings envelope factor, and so on.

3. 4 The courtyard built environment transformation studies

The historical studies from 1900's (when the new building types from different cultures first emerged into the neighbourhood) have been used to study the built environment transformation of the neighbourhood, which will help to explain the current living environment and also the potential future. Furthermore, in the morphology transformation studies on the neighbourhood, the uses studies have included the emergence of the new and vanishing traditional uses. The street transformation studies contained the emergence of modern transportation, the plot pattern studies started from the emergence of the modern buildings, the building types studies included the disappearance of the traditional building types and also the emergence of the modern buildings, and the spatial hierarchal transformation studies mainly focused on the mixed community courtyard buildings. In the transformation studies on the courtyard buildings groups, the plan studies with the social behaviour, the structural studies with the design based economics, and the section typology with the response to physical environment values have all been discussed to disclose the flexibility and adaptability of the courtyard buildings and the neighbourhood, which will greatly help to guide future conservation works on the neighbourhood and the courtyard dwellings.

3.5 Conclusion

The main concern of this research is how the traditional urban neighbourhood and courtyard buildings respond to the local build environment. A two-phase case study has been designed for the case studies. Multiple resources evidence includes the document and archive evidence, direct observation, physical survey and focus group evidence which all help to reduce the bias that might have arisen from a small number of sources. Then the theoretical propositions and rival explanation analysis strategies have been employed for the data analysis, which help to disclose the ecological (vernacular/traditional approach) design values and design implications from the courtyard built environment studies. Meanwhile, the research methodology theoretical background for the urban neighbourhood and courtyard dwellings studies have also been introduced and discussed.

Chapter 4: Theoretical background for studying traditional Chinese courtyard built environment in Beijing

Chinese traditional architecture has continuously developed for thousands of years and spread broadly into its vast land and also to the area from Turkistan to Japan, from Mongolia to Southeast Asia, as this was the area of Chinese cultural influence. That system of architecture perpetuated itself for more than four thousand years over such a vast territory and still remains a living architecture (Liang, 2001). 'Chinese civilization, and with its Chinese architecture, is less remarkable for its antiquity than for its continuity' (Boyd 1962:5). During this long period, Chinese architecture still retained its principal characteristics, in spite of the repeated foreign invasions (military, intellectual, and spiritual) and this is a phenomenon comparable only to the continuity of civilization. Meanwhile, for many thousands of years, China and Western countries have held a different view of their living environment. 'From the start it must be emphasized that we shall find considerable differences between the Chinese outlook and our own; between Western traditional ways of looking at the natural world and the ways customary in China' (Ronan & Needham, 1978: 78). In architecture, the Chinese did not employ the same planning and construction principles as Western countries (Boyd, 1962). From the literature review, the social culture context (Daoism, Confucianism, *Fengshui* theory, the conventional roof and entrance gate), architectural economic context (structure design aspect) and their influence on the courtyard buildings in Beijing have been identified and studied. However, these shaping forces are not just formed by the courtyard buildings built in Beijing but have existed and continuously shaped the Chinese traditional built environment for thousands of years. Therefore, to go further to understand the Chinese view of the built environment, the way of responding, and the method of conventional construction can provide a theoretical background and is also crucial in order to follow the Chinese traditional neighbourhood and courtyard dwellings studies.

4.1 Daoism and Confucianism: the primary shaping philosophy in Chinese traditional architecture:

For over a thousand years, Chinese religion, social order, architectural and philosophical thinking have not changed drastically. Ancient China hardly extended beyond the vast plain where the Yellow River (*Huang-he*) runs its course. A sedentary people dwelt there, dedicated to work in the fields and to animal husbandry, and here developed the fundamental element of both secular and religious organization that was the tribal society. Henri Maspero explains the relation between the tribal society and the religions as follows: 'The seignory society was founded upon two bases: the family group and possession of the seigniorial land. Likewise, religion was founded upon two kinds of worship: of ancestors and of local earth gods. The two kinds of worship were merely the two fundamental bases of society transposed onto the religious plane: the ancestors were the family made divine, as the earth god was the seignory defied. These two cults were to be found at all levels' (1981:5). We can clearly describe two themes corresponding to the general tendencies of religious thought in China of this period, tendencies representing the Chinese manifestation of the two attitudes which have divided minds over fundamental religious questions, 'these were the rationalist and the mystical attitudes, though preferences for collective forms and for personal forms of religion were intermingled with them. One of the currents was thus a rationalistic effort to give religion a scientific explanation, emptying it of all irrational content, while maintaining its external forms. This was accompanied by a philosophical movement which gave a remarkably lively brilliance to the literature of the time. The second was a search for a personal religion which sought to provide all that was lacking in the official worship and its group ceremonies' (Maspero 1981). These two types of worship gradually developed into two important schools of philosophy during the Warring States Period (476-221 B.C.). The first is Confucianism, the second is Taoism. Furthermore, these two powerful philosophies have a great influence on the Chinese conventional view of the world, and therefore the way to respond to the local built environment.

In China, as everywhere, political revolutions, foreign invasions and social transformations have had profound repercussions upon philosophical ideas, but new ideas were always introduced gradually with the result that they could be integrated into the ancient Chinese philosophical framework which was constructed by Daoism and Confucianism. 'Thus there never occurred any such complete revolution as came about several times in the west, interrupting continuity: conversion to Christianity, then conversion to Islam in a part of the East, and still later the reformation in some countries of the West' (Maspero 1981:3). However, this does not mean each aspect of philosophy still strongly influences the social behavior of contemporary China. There are hardly more than a few general ideas left, perhaps rather a way of feeling than any specific belief, but the framework of Daoism and Confucianism has lasted, though emptied little by little of its ancient substance, which has never had that sense of a sudden break with the past, and their influence on traditional Chinese architecture also lasted.

4.1.1 Daoism

'Taoism (Daoism) was the only system of mysticism which the world has ever seen which was not profoundly anti-scientific' (Needham, 1956:3). However, 'we know very little about *Lao Zi*, the founder of Taoism [Daoism]. According to the 'Records of the Grand Historian' by *Sima Qian, Laozi* was born in the State of Chu, in present–day *Henan* Province, a little earlier than Confucius' (Ding, 2001:30). Almost any book or research on the subject of Daoism starts by admitting that it is very difficult to interpret what Daoism is. Contemporary research into Daoism is more focused on its relationship with ecological approaches (Daoism has been identified as the Deep ecology in Chapter one). Peter Marshall, in his history of ecological thinking argues that Daoism 'provides the philosophical foundations for a genuinely ecological society and a way to resolve the ancient antagonism between humanity and nature which continues to bedevil the world' (Marshall 1992: 23). Most researchers believe Daoism plays an important role in understanding Chinese history and civilization. Furthermore, Daoism has been linked with a bewildering variety of practises, including alchemical experiments, martial arts, medicine, physics, landscape design, architecture design and city planning.

4.1.1.1 Dao and Daoism

It is very difficult to give an appropriate concept of the Dao, although it is always conceived as responsible for the creation, as well as the support of the universe, which concerns the law that governs the development and change of all the things in the universe. *LaoZi* himself interprets Dao as: 'Dao gave birth to the one; the one gave birth to two things, three things, up to ten thousand' (*Daodejing*: Ch.42) and 'all creatures issue from the Tao; they are its children' (Chapter 52). One of those famous imaginary interviews between *LaoZi* (Lao Tzu) and *KongFuZi* (Confucius) can help to understand what Dao is about: 'I will outline it for you. Light came from darkness, order from the formless. The Tao (Dao) produces vital energy, and this gives birth to forms; all the myriad things of shape giving rise to shape' (Needham, 1956:38-39). Furthermore, Miller (2005) crucially reminds us that Daoism is a variety of beliefs that have, at their heart, the Dao as 'the wellspring of life, and the human condition as inextricably folded into a matrix of cosmic creativity. The staggering diversity and often conflicting values of these movements preclude any attempt at defining a unitary *Daoist* view of nature' (2005: 8). *LaoZi* further puts forward a series of profound views on the universe, he holds that things and concepts are relative: being and non-being produce each other, the difficult and easy complement each other, the long and the short shape each other, the high and low contain each other, and what is before, and what is after, follow each other. Of every pair of opposite concepts, each produces the other, or the existence of each depends on the existence of the other. Here, what the Taoist philosophers stressed more than anything else, was the unity of Nature, and the eternity and 'uncreatedness' of the Dao.

4.1.1.2 *WuWei* (Non-action)

The above studies have tried to explain what Dao and Daoism is, and how people respond to nature. This part of the study will try to explain the relation between nature and humans in Daoism. According to Taoist philosophy, no God produced the world from outside by making it (*wei*); the world just grew, it was a product of Non-action (*wuwei*). Taoists follow this principle of Non-action in their own lives, and are content to sit back and grow like the universe of nature itself. Daoism has been recognized as one of the deep ecology philosophies that follow the art of '*wuwei*' (Non-action) which is to let nature take its course and work in harmony with nature, and it believes that society should also follow these natural rules. Roger Ames points out that *WuWei* is often portrayed as non-action in terms of passivity, which is presented as a model for creative participation in the cosmos in a manner that fits in with one's surroundings rather than resists them. For Ames, *Wuwei* represents a mode of action, but one that does not go against the grain of nature, so to speak. It is the kind of action or engagement with the world which does not 'make something false to itself' (Ames 1986: 343). In a similar fashion, '*Wuwei* does not actually mean purely passive or negative attitudes, but a high standard or criterion, which means the most appropriate behavior' (Liu, 2001: 329). For both of them, *WuWei* refers to humans naturally restraining action on nature, and the opposite are reckless, aggressive, and harmful actions toward self, society, and the natural order.

4.1.1.3 Daoism as a religion

The *Daoist* religion was established in the middle and late Eastern *Han* Dynasty (AD 25-220) with the purpose of achieving immortality by cultivating Dao. Daoism inherited the concepts of the Taoist School and developed them, and put them into practice. Taoist thoughts in many ways started as a combination of psychology and philosophical thinking of the relationship between man and nature and then evolved into a religious faith which practices 'inner calm', 'harmony with nature', 'following the rules of nature' and 'non-action' principles.

4.1.1.4 Daoism and Chinese traditional architecture

Daoism is one of the dominant Chinese philosophies combining the origin of the universe and the way the universe works, and has a great influence on different aspects of the Chinese way of constructing. The influence of 'Dao' principles in traditional Chinese architecture is enormous. It includes the continuous use of the ideal imperial city models, the replication of the courtyard building types across different geographical areas of China, the use of the courtyard types as the basic buildings types for religious use, public institutions, commercial uses, housing, imperial dwellings, leisure uses and so forth. Generally, 'Non-action' is the main principle of the man made built environment to respond to nature in a harmonious way. Therefore, our man made built environment should follow the course of nature for the choice of site and placement of the buildings, and so on. Furthermore, traditional Chinese *Daoist* temples, the courtyard buildings (see also the literature review in Chapter 2) and the traditional Chinese gardens have also been strongly shaped by Taoist thinking.

(a) *Daoist* temples

The practice of Daoism has directly helped to create the Daoist temple. Temples are the shrines for the cultivation of Dao and the worship of the divinities of Daoism. Meanwhile, in ancient China, temples were the most vibrant and spectacular sites for public life, which not only provided a place for public worship, but also provided a place for social gathering and commercial events. They constituted the most significant hubs of the civic and public domain in Chinese society. Although there was official involvement and control in temple maintenance and in worship practice, as well as official restrictions on public gathering, temples and temple fairs remained the most open venues and times for interaction among the population, for the dynamic flows of public life.

The courtyard plan form was also used for the *Daoist* temple; 'many of the Taoist and Buddhist monasteries were renovated or converted from private residences (Su

1964:68). In fact, 'the design of palaces, temples, and residences was in general similar and indeed, in use, they were quite interchangeable. Palaces, official buildings, residences and temples were basically of the *si-he-yuan* (courtyard buildings), or courtyard plan, with strict adherence to symmetry, axiality, north-south orientation and walled enclosure' (Tao 1965: 17-18). These temples are not only a precious legacy of Chinese Daoism, but also the most important public social gathering place in the urban area.

(b) Daoism and courtyard buildings

From the literature review in Chapter two, courtyard buildings have been broadly used as the basic building prototypes across China, which can broadly vary from the residential buildings, leisure buildings, religious buildings, commercial buildings, civic buildings, groups such as education and government, and even the Imperial 'Forbidden city' (Lip, 1993; Boyd, 1954). Meanwhile, the mixture of uses has created different types of courtyard buildings which can vary from one courtyard group to the multi courtyard group. This high replication of the courtyard buildings prototypes in traditional Beijing has generally followed the principles of Daoism's 'Dao', because the courtyard building is a type that has followed the Taoist's view of the universe (also see Chapter 2).

(c) Daoism and gardens

The influence of Daoism in traditional Chinese gardens can also easily been found. In a typical Chinese garden there is no straight road or a big central hall. Instead, there are winding paths between bamboos and trees, small houses hidden behind hills or rocks, and ponds with wooden bridges across them. The purpose of a Chinese garden is to mirror nature and make one feel that one is living in the midst of nature, far from the busy world. 'This special respect for the landscape had a philosophical basis...the people who formulated its doctrine were known as Taoists, and they looked on man, not as the measure of all things, but as an inseparable part of the great universe in which he existed. They sought to discover how this Universe worked, and removed themselves from involvement in worldly concerns' (Keswick, 1978:13). Furthermore, Chinese gardens were not only built for the emperors and royal families but were also widely built by the rich and nobles, poets, painters, scholars and literary men. Chinese gardens have also evolved closely with the urban courtyard buildings; 'the courtyard itself is invariably a garden courtyard with covered verandas, single trees and large flower tubs with oleander and pomegranate trees. Concepts such as tree, flower, water and mountain are represented symbolically - a world in miniature' (Blaser, 1985: 16). The creation of the gardens inside the courtyard buildings certainly helps residents to approach the natural world and work in harmony with nature.

4.1.1.5 Summary

In generally, Daoism was the dominant philosophy and religion in ancient China holding the view of how the universe worked, which is that it is responsible for the creation as well as the support of the universe. It also focuses on the 'non-action' and 'harmony with nature' strategies to work with nature as well as society. Daoism as a religion practises 'inner calm', 'following the rules of the nature' and 'non doing' principles that help to achieve harmony with nature. The Taoist temple, the urban courtyard buildings and the Chinese landscape gardens have also been shaped by the Chinese view of the universe. The case studies will go further, to explore the influence of the principles of Taoism on the real traditional urban courtyard in Beijing, which will also help to classify the different types of courtyard buildings of the neighbourhood (see Chapter 7).

4. 1. 2 Confucianism

Confucius was born in 551BC in the small state of Lu (B.C. 1100-B.C. 256) now known as Shandong Province; he spent his life developing and propagating a philosophy of justice and harmonious social relationships. The '*Lunyu*' (conversations and discourses, generally known as the Analects) were put together in written form soon after his death, and these preserve the most reliable information about him. The social and political background to Confucianism should be provided for an understanding of Confucianism philosophy. 'When the grasp of the Zhou Kings over the states weakened ...the administrative system began to collapse...many thinkers explored the cause of chaos and disorder, and expanded upon their ways of solving the problems. Some became pioneers of different schools, and Confucius was one of them, probably the most famous one of his time' (Yao, 2000:22). Because they faced the collapse of the old administration system, 'Confucianism was the philosophy of social organization, of common sense and practical knowledge. It provided Chinese society with a system of education and with strict conventions of social etiquette. One of its main purposes was to form an ethical basis for the traditional Chinese family system with its complex structure and its rituals of ancestor worship (Capra, 1975:102).

Confucianism emphasised the virtues of *Ren* (humaneness) and *Yi* (righteousness). From Confucius' point of view, people's whole life had to be regulated according to the natural order; this is what was called the Royal Order or Way. This heavenly or natural order was naturally held in the primarily observable, regular alternation of the seasons and of night and day. Confucius taught a way of life in which morality occupies a supreme position. Meanwhile, Confucius's view concerning the actual duties a man has is traditional; a man is born into certain relationships and as a result has certain duties. For instance, he has a duty of loyalty to his lord, a filial duty to his parents, a duty to help his friends, and a duty of common humanity towards his fellow beings. These duties are not of equal stringency. A man's duty to his lord and parents comes before his duty to his friends and fellow human beings. Gillingham also holds the similar view, 'a hierarchy of human relationships that is man to elders, man to ancestors and man to family' (1971:107). The self in Confucianism is essentially an ethical concept, representing a holistic view of a continuing constructive process driven by self cultivation and moral orientations under Confucian principles. The moral philosophy of Confucianism could offer intellectual support to those people who cannot find it in Daoism when they think of themselves in association and communication with others.

Confucianism is not a completely static philosophy but has continually developed over the last two thousand years. It is commonly agreed that as a distinctive school, Confucianism took shape in the hands of Confucius and he was responsible for the formation of basic Confucianism. 'A prominent scholar of the *Han* Dynasty (206 BCE – 220 CE), *Liu Xin* (?-23 CE), located the formation of *ru* (Confucianism) as a profession in the early years of the Zhou Dynasty (1100? – 256BCE) and asserted that *ru* was characteristic of its devotion to the 'six classics' (the Book of Poetry, the Book of History, the Book of Rites, the Book of Music, the Book of Changes, and the Spring and Autumn Annals)' (Yao, 2000:17). One of them, the 'Book of Music', was completely lost in the 'burning of books' in the *Qin* Dynasty (221B.C.-207B.C.), and so the 'Six Classics' became the Five, and from the Han Dynasty (206 B.C -AD 220), the 'Five Classics' became the official learning and standard for selecting civil servants. However, this situation changed during the *Song* Dynasty (960 -1279), when great Neo-Confucians, especially *Zhu Xi* (1130-1200), paid more attention to the 'Analects of Confucius', '*DaXue*' (Great Learning), '*ZhongYong*' (the Doctrine of the Mean), '*LunYu*' (Analects) and the 'Book of Mengzi'. These have been named as the 'Four Books'. Zhu's annotations and commentaries on them were published as a book entitled '*Sishu Jizhu*' (Collected Annotations on the Four Books). In 1313 the Imperial court of the Yuan Dynasty (1260-1370) decreed that the questions for state civil examination had to be taken from the 'Four Books' and all the answers had to be based on *Zhu Xi*'s annotations and commentaries. From then until the end of the *Qing* Dynasty (1644-1911), the majority of Confucian scholars concentrated on the 'Four Books' and every schoolboy had to learn them by heart before he reached adolescence (Needham, 1956; Tucker & Berthrong, 1998; Yao, 1996;).

As the above studies indicate, Confucianism as a philosophy guides the personal and social life, and rarely mentions the relation with the environment. This limitation has been greatly improved by the Neo-Confucianism, which refers to a second wave, or revival of Confucianism in the eleventh and twelfth centuries by scholars *Zhou Dunyi* (1017-1073), *ShaoYong* (1011-1077), *ZhangZai* (1020-1077), *ChengHao* (1032-1085) and *ChengYi* (1130-1200). Neo-Confucianism explored a series of fundamental problems regarding the universe and humans, such as principle (*Li*), material-force (*Qi*), Yin and Yang, human nature, human feelings and so on. However, its core principles were certainly still Confucianism, but it contained *Daoist* and Buddhist thinking as well. The following studies will discuss the main Confucianism principles that relate to traditional Chinese architecture.

4.1.2.1 The 'supreme pole' (*Wu Ji*), Yin and Yang, Five Elements

'Chou Tun-I (*Zhou Dunyi*) was more of a teacher than a writer, and left little behind. His fame stemmed from a very short exposition of a comical diagram, the '*Thai Chi Thu Shuo*' (Explanations of the Diagram of the Supreme Pole), upon which Chu Hsi (*Zhu Xi*), took it as fundamental for his thought' (Needham, 1956:460). *ZhuXi*, as stated, is the most dominant scholar of Neo-Confucianism; his interpretation of the 'supreme pole' and other core principles of the universe can be concluded as follows: because there is no Pole, and yet it is itself the Supreme Pole! The 'Supreme Pole', which is real and not void, produces Yang and Yin through the alternations between movement and quiescence. The Yin and Yang take up their appointed function, and so the two forces are established. The Yang is transformed by reacting with the Yin, and so water, fire, wood, metal and earth are produced (Needham, 1956; Smith, 1973). This explanatory commentary is based on the *I Ching* (the Book of changes) from the previous 'Five Classics' of Confucianism. It was a systematic attempt to explain the origin of all things in the universe. These principles have been employed by Chinese *Fenghsui* theory that has greatly shaped traditional Chinese urban planning and architecture. *Fenghsui* theory will be introduced in the following *Fengshui* section studies.

4.1.2.2 The study of the universal pattern: *Qi* (Matter-energy) and *Li* (organization)

Following the emergence of the *Taiji* (Supreme Pole), Yin and Yang and also the Five Elements, in order to understand the rhythm of nature, the Chinese developed a complete explanatory system that was based on the concepts of *Qi*, and this vital concept of *Qi* originated during the period of the Han Dynasty (206B.C. – A.D. 220). 'It is no doubt that in general these two terms represent the material and non-material elements respectively in a basically naturalistic universe' (Needham, 1956:472). From *ZhuXi*'s point of view, *Qi* represents energy; the dispersion of this energy was governed by fixed rules or laws of nature. These rules, which were called 'Li', already existed prior to the first breath of *Qi*. They include the principles of Yin and Yang and the Five Elements and so on. '*Qi*, as expressed through the laws of Li, was the primary consideration in traditional Chinese architecture, wind and water were the most important earthly forms carrying *Qi*' (Mitchell& Wu, 1998:15). For traditional Chinese architecture, almost every aspect of Chinese traditional design captures and channels the *Qi* that flows through the environment in a beneficial way.

4.1.2.3 Confucianism and traditional Chinese architecture

The above studies suggest that man is born into certain relationships and as a result has certain duties; Confucianism is interested in the orderly administration of affairs and also has a strong influence on traditional Chinese urban planning, for example, the rich and noble will have the privilege of choosing ideal sites. The internal arrangement of the buildings of each courtyard also closely follows the social roles of the family, and this social identity of Confucianism has greatly shaped the layout of the courtyard buildings. Central location is more of a privilege than the other places, a location on the left can gain more respect than one on the right. The location of the entrance gate is also very important because the entrance gates are the most important link point between the external and internal place of the courtyard buildings, which can also indicate the social status of the residents. The following text describes an ordinary courtyard building and the social hierarchal arrangement of ordinary courtyard buildings in Beijing: 'large or small, each room of a courtyard-style dwelling has its own function. The first building, for example, has a room for receiving guests, a room for the man in charge of the family's finances, and a room for the doorman. The functions of the main entertainment hall and main residential hall are clear from their names. They might be the same or similar in outward appearance, but the first was formal and for visitors and the second for the family alone. Within the main residential building, the oldest generation residing in the compound used the central room, and those on the sides were ranked according to family, older siblings closer to the centre than the younger siblings. The back buildings were for servants, cooking, and storage. Space was determined according to the patriarchal system, which was so strong that a plan alone can tell us who lived in, used, and could enter each of the main buildings and its interior compartments' (Sun, 2002:302). As we can see from the above description, every resident has a clear physical location inside a courtyard buildings group according to his social status.

Furthermore, from the point of view of Confucianism, the 'heaven in circular form covers and Earth in square form carries' (*Zhouli*, *juan*10: 66), these Confucianism views have greatly shaped the layout plan of the traditional Chinese city and buildings, which all basically have a quadrangle plan layout to follow the universal rules. Meanwhile, the *WangCheng* (Imperial City) planning principles have also been formulated from *Zhou Li* (Zhou rituals, 770B.C.～476 B.C) *Kaogongji* (Record of Traders) section, which will be introduced in the following studies section: 'Chinese Ideal Imperial City'.

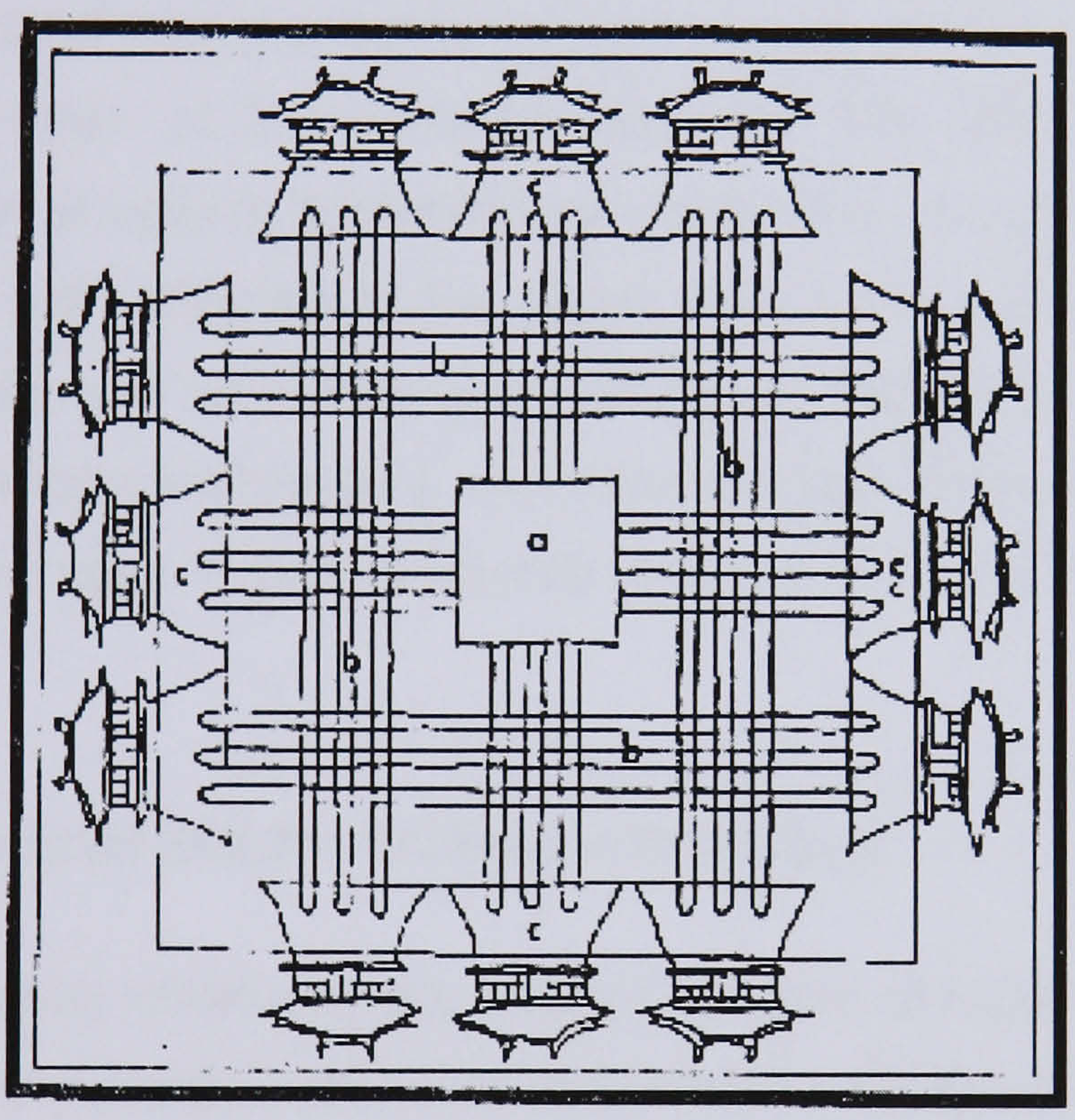
4.1.2.4 The ideal *WangCheng* (Imperial city)

Here, where Heaven and Earth are in perfect accord, where the four seasons come together, where the winds and the rains gather, where the forces of *Yin* and *Yang* are harmonized, one builds a royal capital.- '*Zhou Li*' (*Zhou* Rituals 11th century BC)

The ideal Chinese capital city was first described in the '*Kaogong ji*' (Record of trades) section of the '*Zhou Li*' (Zhou Rituals[1]), which was written in the Spring and Autumn Period and Warring State era (770 B.C-221 B.C) and stated the basic guidelines for a traditional ideal Chinese imperial city, which was a great influence on the Beijing city. The key principles are translated and interpreted by Liu (1982) as follows: (1) the

[1] The *Zhouli* is one of four extant collections of ritual matters of the Zhou Dynasty. The obscure book *Zhouli* consists of a long listing of the officials that the Zhou kings theoretically engaged to run the empire.

capital city should be a walled square of 9 *Li* (3,735 meters) on each side; (2) each side of the city wall should have three gates; (3) there are nine longitudinal and nine latitudinal major streets perpendicularly intersected; (4) the imperial palace is at the centre, with the ancestral temple of the imperial family on the left and the altar of land and harvest on the right; and (5) the state court is in front of the imperial palace and the market place is behind it' (Fig.4.1). These city planning principles had considerable impact on the urban form and shape of capital cities through many feudal dynasties in China. With the foundation of the centralized national states later, the patterns of those capitals were a result of the application of the city planning principles in their actual sites and they became the model of an ideal capital city in historical China.



(a). Palace (b). Streets (c). Gates

Fig 4.1 The ideal city model based on the *Zhouli:Kaogongji*
Source: Wu, 1999

The ideal city model used the city wall as the city boundary, and then conventionally created the north-south central axis which includes the city gate, road, palace, Ancestral Temple, Altars of Soil and Grain, Hall of Audience, and market at the appropriate place. Social identity and hierarchy is the main characteristic of this ideal city model, and then the one kilometre urban grid transportation system which is identified by the city gates with the imperial palace in the centre is the dominant urban morphology of the city. This ideal city model has greatly shaped the Chinese traditional imperial cities and also the current City of Beijing where the case studies were chosen from.

4.1.3 Summary

Daoism mainly concerns the Chinese view of the universe and nature, and how people response to nature in a harmonious way through the principle of 'non-action'. Its influences on Chinese architecture are in many, and include the Daoist temple, the courtyard buildings and also Daoist landscape gardens. Confucianism mainly concerns the social identity and social hierarchy inside the family and society, and tries to achieve the virtues of humaneness (*ren*) and righteousness (*yi*) through self-cultivation and moral orientation. Neo-Confucianism goes further to identify the 'Li' and '*Qi*' of the universe, the Yin and Yang and also the Five Elements principles. Confucianism has also greatly shaped the traditional Chinese architecture that not only includes the plan layout of a traditional courtyard building but also regulates the social hierarchical order of the buildings and also the cities. Meanwhile, most Chinese are capable of holding one philosophical attitude one day and another next, or even of holding both attitudes at the same time. Many Chinese feel that every Chinese soul is really half Confucian and half *Daoist*, therefore, it is very difficult to study traditional Chinese architecture and urban design without understanding the conventional Chinese view of the relationship between man and nature, and between men.

4.2 Traditional *Fengshui* and the Chinese architecture

The above studies have introduced the primary Chinese philosophies of Daoism and Confucianism; mystical Daoism concerns the relation between man and nature, and the rationalistic Confucianism focuses on social order. Furthermore, the relationship between man and nature has greatly developed following a more practical *Fengshui* theory.

4. 2. 1 *FengShui* theory

FengShui in Chinese literally means wind and water (Lip, 1995). Since ancient China, the environmental settings and effects on buildings and the residents were very significant in Chinese architecture. It has long been established that the building must be sited and constructed to be in harmony with the natural setting of the site to maximize the benefits and minimize the negative effect that the site offers, the ancients called this aspect of environmental design *xiangdi* which is now called *kanyu* or *fengshui* (Zhu, 2001). Its origins can be dated back several thousand years to ancient China. *FengShui* was originally used to choose burial sites for the wealthy and palace locations for royalty. Men of that time studied the signs the earth left behind (a science known as geomancy), such as wind-worn trees, sharp protruding rocks or soft meandering streams. Later, the *Yi Jing* (the Book of Changes) was written, which provided the most original literature source of *Fengshui*. It is generally believed that the 'burning of books' in the *Qin* Dynasty (221B.C. –206 B.C.) had all *Fengshui* books burnt. Many researchers of *Fengshui* trace the origins of the *Fengshui* as a distinct belief system to *Zhuxi*'s thinking (1130-1200), writings and commentaries from the Song Dynast (960-1279), and he is also considered the key person of Neo-Confucianism. As the above studies indicated, Zhu Xi's work has greatly shaped and upgraded Confucianism; meanwhile, it also helped to construct the foundation of *Fengshui* theories.

'Traditionally the practice of *Fengshui* can be divided into two principle categories: the Form School and the Compass School. The Form school is based largely on a consideration of land forms and terrain, in particular mountains and water courses. Practitioners of the Compass School, not surprisingly perhaps, use a compass, called a '*lopan*', to help decide upon sites and orientations for buildings' (Mitchell & Wu, 1998: 26). Despite their differences, both the Form School and the Compass School have the same intention, to find the ideal site for the main buildings to work in harmony with nature, to ensure happiness, wealth, health and prosperity.

4.2.1.1 Five Elements and Yin Yang:

1) Five elements and buildings location

Five elements	Orientation	Colour	Planets
Wood	East	Green	Jupiter
Fire	South	Red	Mars
Earth	Centre	Yellow	Saturn
Metal	West	White	Venus
Water	North	Black	Mercury

Table.4.1 Five elements and the physical phenomena

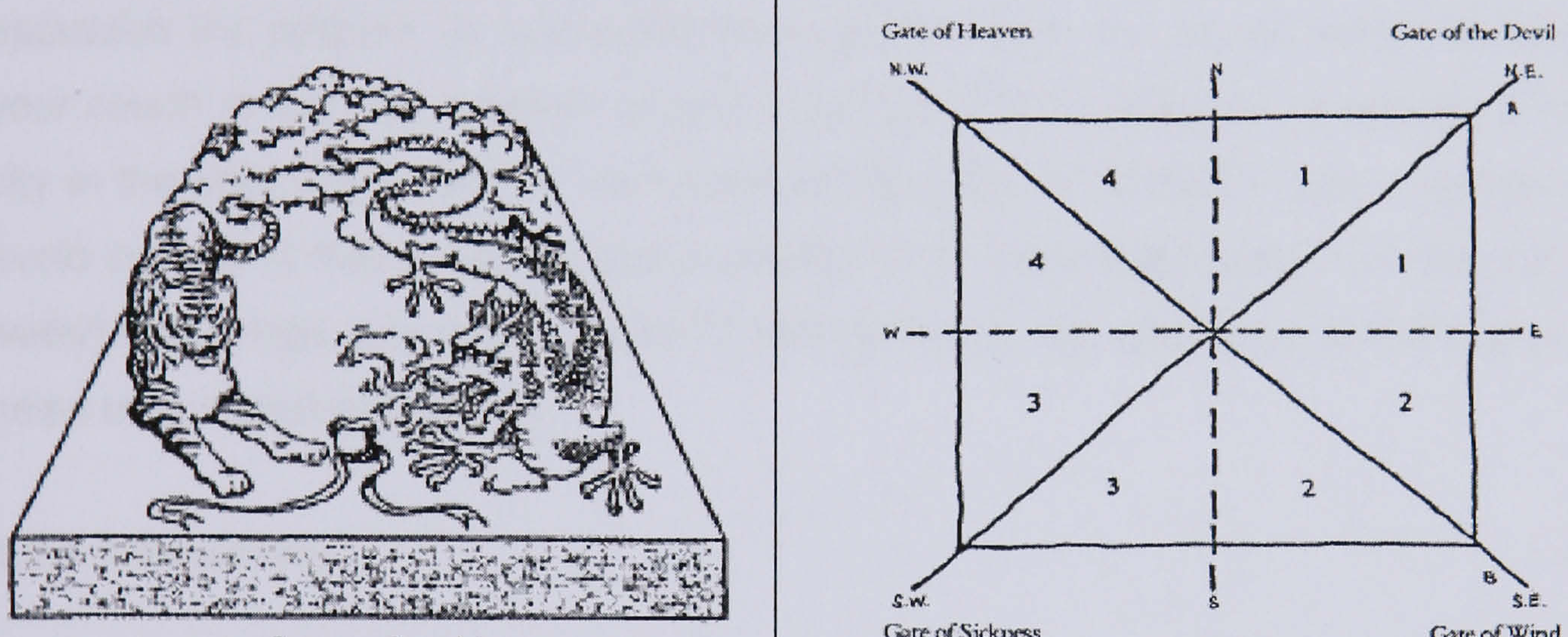
In ancient China, everything under the sky could be classified into five basic elements by its nature; the five elements called *Wuxing* (Five Elements, namely

Metal, Wood, Water, Fire and Earth). Needham (1959) pointed out that the names of the Five Elements are related to the names of the five Planets in ancient astronomy: Mercury, Venus, Mars, Jupiter and Saturn are called respectively water star, metal star, fire star, wood star, and earth star. Thus the essence of the Five Elements is considered to be linked to the relationships and movements of the planets. This reflects the fact that the ancient Chinese considered all things on earth to be influenced by and related to celestial phenomena.

According to *Ti Li Chih Meng* (Manual of Geomancy), written by *Kuan Lu* (208-255 AD), many real and abstract objects such as orientations, colours and planets may be sorted into five groups and correlated with the Five Elements (Table 4.1). This system links water with north and is represented by black, metal with west and white, earth with centre and yellow, fire with south and red, while wood belongs to east and green. Furthermore, the Five Elements are not regarded as permanent static states but giving way to one another. They can be presented in terms of either a productive or a destructive cycle, the wood destroys earth, earth destroys water, water destroys fire, fire destroys metal and metal destroys wood, and so on (Needham, 1956; Lip, 1995; Lu 2000). The productive cycle follows the opposite rule that wood gives rise to fire, fire gives rise to earth, earth gives rise to metal, metal gives rise to water and water gives rise to wood, this direction represents the productive cycle of the elements. This system certainly helps to locate all the elements inside and outside the courtyard buildings to help people work in harmony with nature, and each element in the buildings also belongs to a certain element and the specific orientation to achieve the balance and harmony of the living environment.

2) *Yin Yang*, site location and buildings placement

From the previous *Yin* and *Yang* studies in the Neo-Confucianism section, we can see that the world is controlled by this perpetual alternation of the *Yin* and *Yang*. It is this alternation that constitutes the world, the moral as much as the physical world. In *Fengshui* theory, every building, building complex and even every city has to be designed with reference to the *Yin* and *Yang* elements on or around the site. The ideal *Fengshui* space is also supposed to balance *Yin* and *Yang*. In general, Yin represents the female, the dark, the dead, and the still; Yang represents the male, the light, the living, and the moving. *Yin* and *Yang* together form one unit. According to ancient *Fengshui* texts, mountains are *Yin*, while water is *Yang*; the solid is *Yin* and the void is *Yang*. Therefore, in an ideal *Fengshui* site, an open space (Yang) is enfolded by surrounding mountains (*Yin*). Yin and Yang were not absolute or permanently static; in fact they might be described as definable phases in a ceaseless flow of change. Furthermore, in the landscape, dragon and tiger forms denote the presence of *Yang* and *Yin Qi* (energy) respectively and are most happily placed with the dragon in the east and the tiger in the west (Fig. 4.2 left). *Yin* and *Yang* are defined as the endless source of all life force in the universe. It is believed that when *Yin* combines harmoniously with *Yang* there is balance and it gives rise to positive productivity and success. This balance was thought to bring prosperity to the inhabitants (Xu, 1990). The ancient Chinese brought this model of their ideal habitat to their designs when they needed to create a man-made space, such as a house. Buildings corresponded to mountains, roads to rivers, and walls to hills. Therefore, an ideal site with the balance of the *Yin* and *Yang* can also be created inside the urban neighborhood with the metaphor from the natural world.



Source: Yong, 1988:28

Fig.4.2 The ideal location of the entrance gate and the ideal site for the buildings

4.2.1.2 *Qi* (energy) and the placement of buildings

After classifying the materials in the universe into Five Elements and further into *Yin* and *Yang* components, and having discussed the 'changing' of Yin and Yang, a further question should be asked: what is the primary shaping force controlling this 'changing' between *Yin* and *Yang* and the Five Elements. By connecting the power behind the movement into a single force, the Chinese arrived at the concept of the invisible breath of life (*Qi* literally translated into English is 'energy'), which was believed to be the cause of all change in the universe.

'*Qi*' in the previous Neo-Confucianism studies has been defined as the 'matter energy'. In *Fengshui* theory, '*Qi*, as expressed through the laws of 'Li' (organization), was the primary consideration in traditional Chinese architecture, and wind and water were the most important earthly forms carrying *Qi* (Mitchell & Wu, 1998:15). Qi can be categorized into *Yin Qi* and *Yang Qi*. *Yang Qi* was known as heavenly *Qi* and *Yin* as earthly *Qi*. The balance between *Yang Qi* and *Yin Qi* ensured an orderly world. Stephen Skinner explained *Qi* as the flow of energy and the importance of the winds and water to the Chinese thus: 'Wind and water express the power of the flowing elements of the natural environment and this power is expressed in, and derived from, the flow of energy not only on the surface, which has been sculpted by wind and water, but also through the earth' (Skinner, 1982). Therefore, consideration of the flow of *Qi* in many ways can be considered as the key to governing *Feng* (wind) and *Shui* (water). The *Qi* (the energy according to the geography of the land) of a site is assessed through the examination of the physical form of the land and the orientation of the building. *FengShui* guides us to look at how the placement of objects can bring harmony with the environment, which can be furthermore explained as how to approach the position *Qi* and avoid the negative *Qi*. It can be as simple as placing your couch in the best location in your living room or as complex as placing a whole city in the right place. One of the essential *FengShui* principles in site selection is to avoid cold wind that blows *Qi* away; another is to have water (river, ponds and rain water) that brings and accumulates *Qi* and above all, the enclosure of the space that helps to accumulate lively *Qi*.

4.2.1.3 Summary

The fundamental principles of the Five Elements, Yin Yang, and Qi have been analyzed. *Fengshui* plays an important role in providing builders with theoretical guidance and helping inhabitants to identify a good living environment to build their ideal home, and through *Fengshui* principles, to achieve an ideal place for happiness, wealth and longevity. From the above studies, the ideal location of the entrance gate has also been conventionally formed as follows: southeast to northwest direction (the direction of the prevailing cooler breeze in summer) occupies the best place, which leads to the gate of heaven, happiness, wealth and longevity. Conversely, entrance from the southwest to northeast direction (the direction of the prevailing cold wind in winter) is avoided as much as possible because this orientation represents bad fortune and also the entrance to hell (Fig.4.2 right).

The key principle of the *FengShui* theories in urban living architecture is to create an artificial place to approach the positive natural energy and avoid the negative sector, so this theory mainly relies on people's understanding of the natural world and the accumulation of traditional knowledge of nature, so some parts of the *Fengshui* theory values are invaluable because of the limitation of people's knowledge of nature in the past.

4.3 Two 'grammar books' and the traditional courtyard buildings in Beijing

After discussing the traditional Chinese philosophy of Daoism and Confucianism, the more practical ideal imperial city planning model *WangCheng* and *Fengshui* theories, there are two important architecture grammar books which have significantly shaped and regulated traditional Chinese construction. These are the *Song* Dynasty's (960-1280) *Yingzao fashi*(building standard, published in 1103) and the *Qing* Dynasty's (1644-1912) *Gongceng zuofa zeli* (Structural regulation, published in 1734). Both of these two architecture 'grammar books' were published by the central government for regulating construction work. To study Chinese architecture without understanding these standards and regulations is like studying a foreign language without understanding its grammar (Liang, 2001). Particularly, the *Qing* Dynasty's *Gongceng zuofa zeli* (Structural regulation, published in 1734) strictly regulated every detail of formal construction of the courtyard buildings in traditional Beijing. Meanwhile, the traditional conventional Chinese curved roof types have also been developed into a mature shape before the emergence of the two 'grammar books', therefore, these roof types should also be introduced before carrying out the construction manual studies.

4.3.1 The conventional Chinese roof types

The basic roof types were well developed 2000 years ago during the Han dynasty, and these roof types have been recognized as the formal roof types in both Song State Building Standard (1103) and *Qing*'s Structural Regulation (1734). They are the pyramidal roof, overhanging gable roof, flush gable roof, gable-and-hip roofs, hip roof (Fig.4.3). The pyramidal roof is conventionally used for the Chinese garden design, and not for the dwellings. The overhanging gable roof is the roof at gabled ends having purlins projecting out to support rafters, and curved weather board usually following the roof's shape which covers the purlin heads and acts as a decorative panel. The flush gable roof is a roof type where the tiles of the roof run to a stop at the end of the wall and do not project outward. The gable-and-hip roof and hipped roof can only be used by the royal family. The gable-and-hip roof has a gabled ridge on the sides and is joined with the hipped roof on its lower portion. It can have either single or double-eave decks. The hipped roof has the highest social status of all the building types, and is used only by the royal family. The hip, hip and gable roof also can be doubled (Fig.4.3:6, 8), the doubled roof types are used only by the Emperor himself. These five building types have provided the conventional and also formal building roofs for traditional Chinese architecture, which are essential to the social status of the residents.

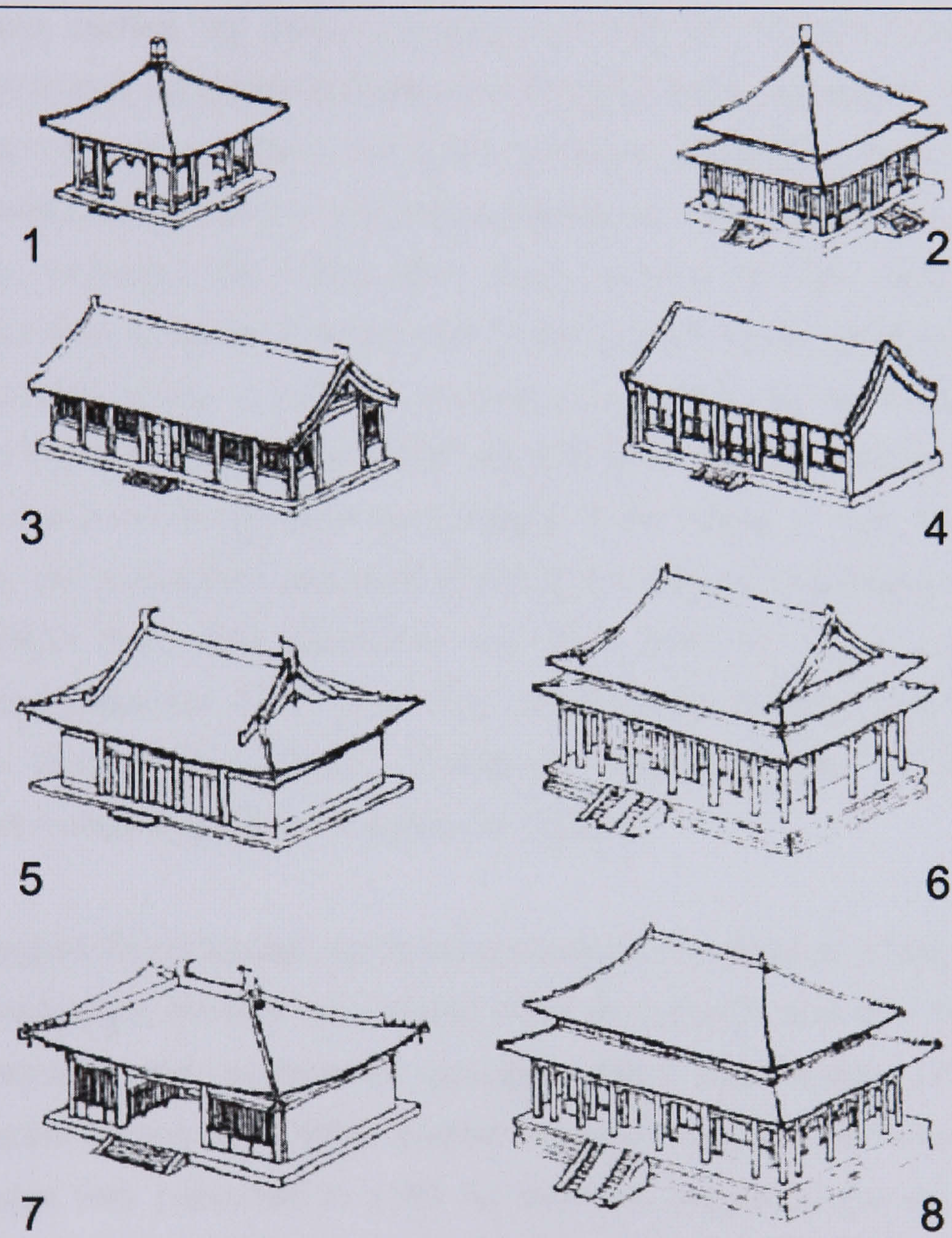


Fig.4.3 Building types, (1&2) pyramidal roof (3) overhanging gable roof (4) flush gable roof (5&6) gable-and-hip roofs (7&8) hip roof
Source: Liang, 2000; Xu, 1964

4. 3.2 *Yingzao fashi* (Building standards)

'The *Yingzao fashi*' (Treatise on architectural methods), thirty-six *juan* (chapter), was compiled by *Lijie* (ca. 1065-1110 or 1035-1108). The best known and most comprehensive work on architecture published in China' (Ruitenbeek, 1993:27).

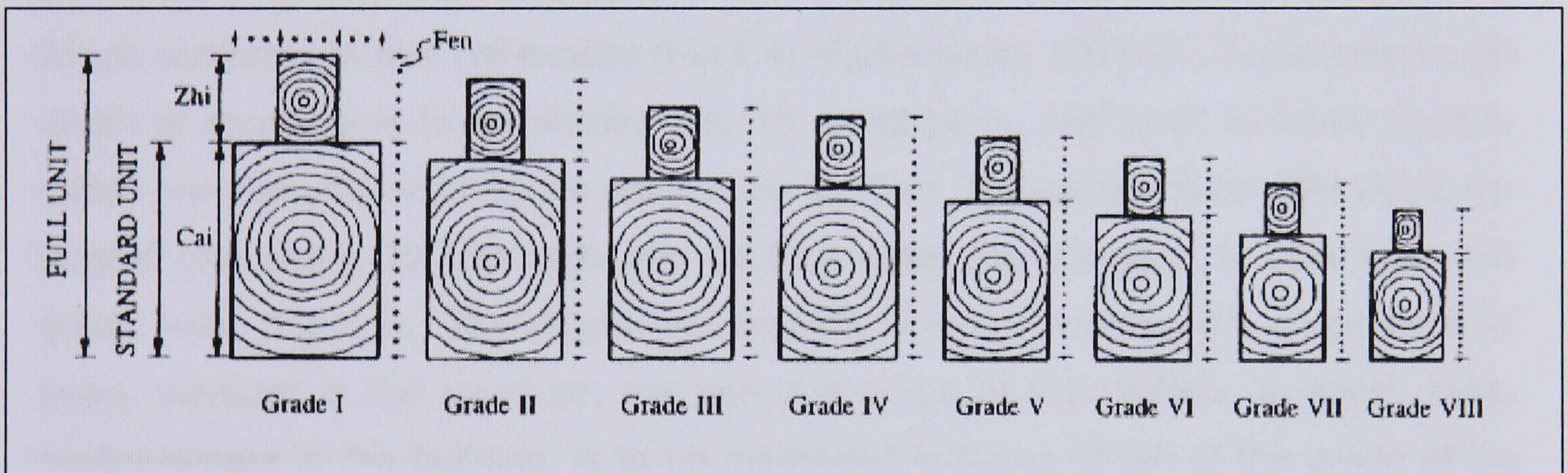
Meanwhile, 'the *Yingzao Fashi* is the oldest extant Chinese technical manual on buildings' (Guo, 1999:65). The comprehensive book that appeared was the result of the '*Wang Anshi* Reform' (1069-74). *Wang Anshi* (1021-1086) was a shrewd statesman, poet and scholar who served as premier at the court for many years. He introduced specialized studies on economy, taxation, book-keeping, law and administration into the state examination system. He insisted that officials should understand every aspect of their specialized professions. Until that time, public works projects such as canal maintenance, road construction and the erection of state buildings were carried out mainly by unpaid labourers. Wang's reform aimed at replacing this system by revenue assessments which were payable in cash for those people whom did not involve in the public projects. Therefore, the public projects work loads need a standard for calculating the labour cost. Meanwhile, owing to the confrontation between the Song and tribal powers to the north, the Song administration was not able to make use of the natural timber resources of remote areas. At Wang's urging, a guide to building construction, to be titled the *Yingzao Fashi*, was compiled between the 1070s and the year 1091. Following this, in 1097, *LiJie* received a commission from the Emperor to formulate a 'new' *Yingzao Fashi*, because 'the old codes only specified forms and locations of building elements but did not mention their size variations; and they gave too general estimates of manpower and materials. As a result, they could not be enforced and thus became meaningless words' (Guo, 2000). Therefore, the emergence of the Buildings Standard had a profound effect on economic thinking.

The new *Yingzao Fashi* turned out to be composed of a total of 3,555 items in 357 sections; about eight percent was drawn from documents and the rest based on inherited methods and established practise. Most importantly, the system of carpentry measurement, the *CaiFen* system, was now established in the new edition. The manuscript was published in 1103 for the new regulations to be promulgated throughout the country in the following year. In the thirty four chapters of manuscript, thirteen are devoted to rule governing the design of foundations, fortifications, stone masonry and ornamental carving, 'major carpentry' (structural framing, columns, beams, lintels, ties, brackets, purlins, rafters, etc.), 'minor carpentry' (doors, windows, partitions, screens, ceilings, shrines, etc.), brick and tile masonry (tiles and ornaments), painted decoration (official rank and design of ornamental painting). The rest of the text contains definitions of terms and data for the estimation of materials and labour. The last four chapters contain drawings illustrating various kinds of designs in carpentry, stonework, and ornamental painting (Liang, 1984; Zhao, 2000).

4.3.2.1 The Chinese modular and measurement system

There were quite a few ancient written records on architecture before *Yinzhao Fashi* (Building standards). For instance, 'several hundred years before Li's time, the court of the Tang Dynasty completed a national building law called *YingShanLing*. Unfortunately all volumes of this law has been lost except for fragments in Tang Lü (the Tang Code)' (Guo, 1999: 65). In the Song Dynasty, the Court was concerned with the cost of materials, the time needed to erect buildings and the building quality. *Yingzao Fashi* which in contrast with the previous construction manuals, brought in a modular system, promoted a modular design and furnished a range of standard designs for the whole building construction process.

(a) The *CaiFen* System: a module system



Size (cun)	6.0x9.0	5.5x8.25	5.0x7.5	4.8x7.2	4.4x6.6	4.0x6.0	3.5x5.25	3.0x4.5
Convert to metric Unit (cm)	19.8x 29.7	18.2x 27.3	16.5x 24.8	15.8x 23.7	14.5x 21.8	13.2x 19.8	11.5x 17.3	9.9x 14.6

Fig. 4.4 The eight grade modular system Source: Guo, 2000

In the Building Standard manual, the *CaiFen* system has been employed as a modular system for standardization and mass construction. *Cai* is a standard sized timber section used for the Gong, or 'arms' of a set of brackets (Dou gong), and further includes all timbers of the same depth and width. There are eight grades (sizes) of *cai* according to the section dimension of the width and depth (Fig.4.4), and the grades determine the type and official rank of the buildings. Thus, when a small grade *cai* is used, the entire structure is correspondingly small, whereas when larger-grade *cai* is used, the entire building is also large.

(b) The *CaiFen* System: measurement

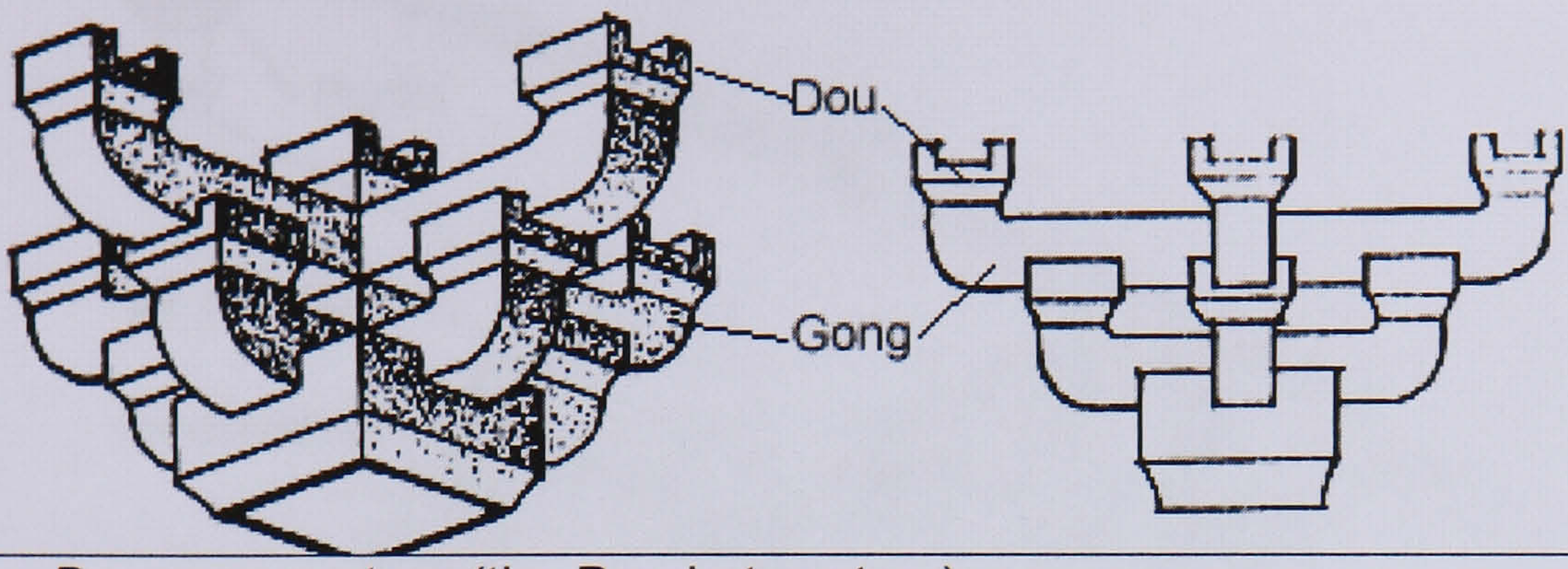


Fig.4.5 The *Dougong* system (the Bracket system)

The *CaiFen* System is also a parameter for measurement, which can be described as follows: 'In *Yingzao fashi* for the first time the measurements of all timber construction parts are given as a proportion of a standard unit or module, the *cai*. The cai (standard) is defined as a timber with fifteen parts (fen) high and then ten parts (fen) wide (Fig.4.4). The *cai* is derived from the gong or bracket, the cross-section of which conforms to one *cai* exactly (Fig.4.4) (Ruitenbeek, 1993:27). Furthermore, the depth of each *cai* is to be divided into 15 equal parts, and each of these parts is called one Fen, the width of the *cai* is to be ten Fen. The *cai* exists in eight sizes, the largest one being 29.7cm high and 19.8cm wide, the smallest 14.6cm high and 9.9cm wide (Fig.4.5). 'The height and breadth of every building, the dimensions of every member in the structure, the rise and curve of the roofline, in short, every measurement in the building, is to be measured in terms of fen of the grade of *cai* used' (Liang, 2000:99).

(c) The *CaiFen* System: Modular proportion

From the above studies, the depth of each *cai* is to be divided into 15 equal parts called fen, and the width of the *cai* is to be ten Fen, so the proportion of each *cai* is 15:10, which means many buildings elements can also be easily calculated from this 3:2 proportion. Furthermore, although the Eight Grades of *cai* have different sizes they all have the same 3:2 proportion. The Eight Grades of *cai* is basically taken from the section of the natural growing tree-trunks, and this 3:2 section ratio is an approach to the best mechanical ratio of the timber material (Zhao, 2001).

4.3.2.2 *Dougong* system: Bracket sets

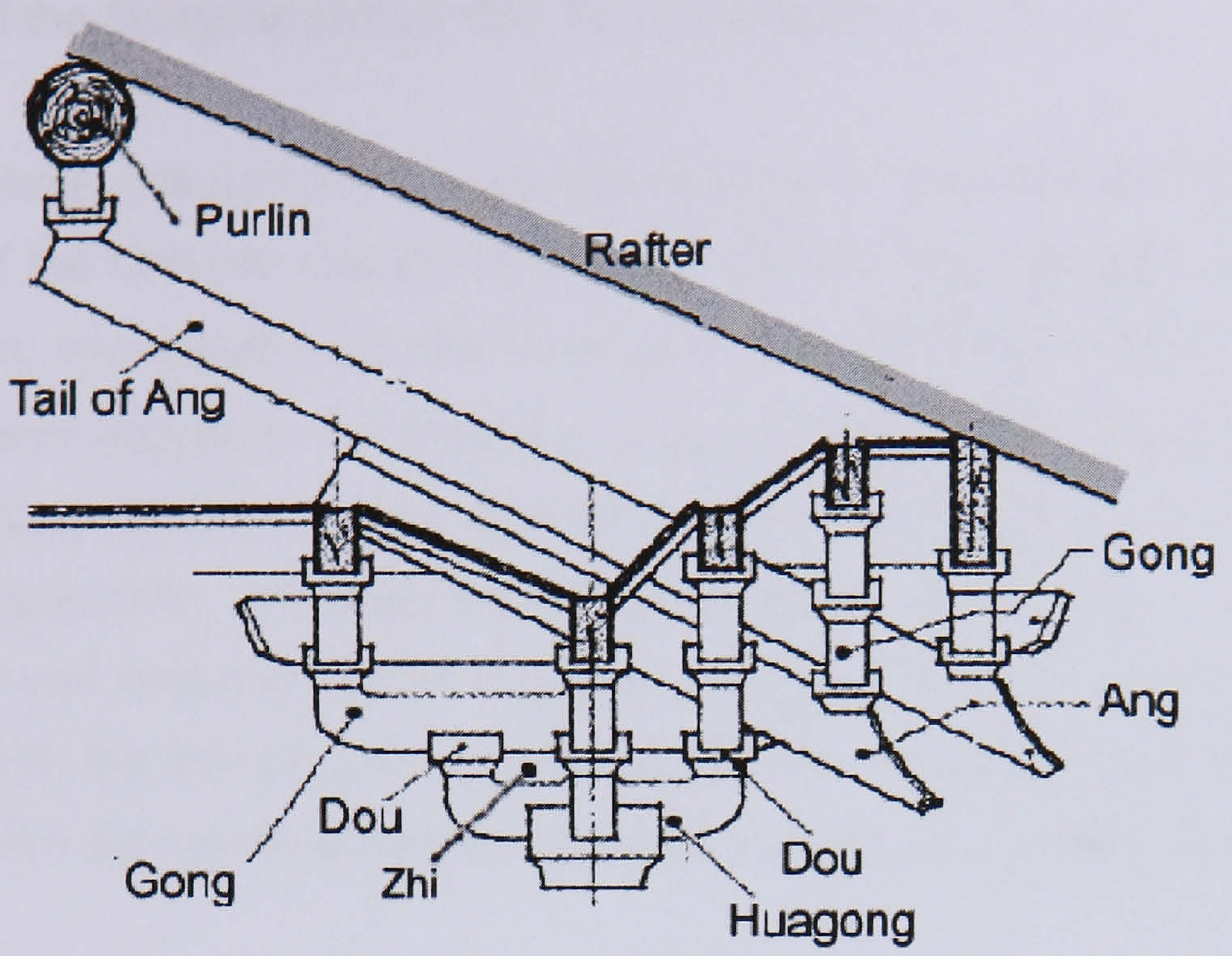


Fig.4.6 The *Ang* and *Dougong* system
Source: Liang, 2000:98

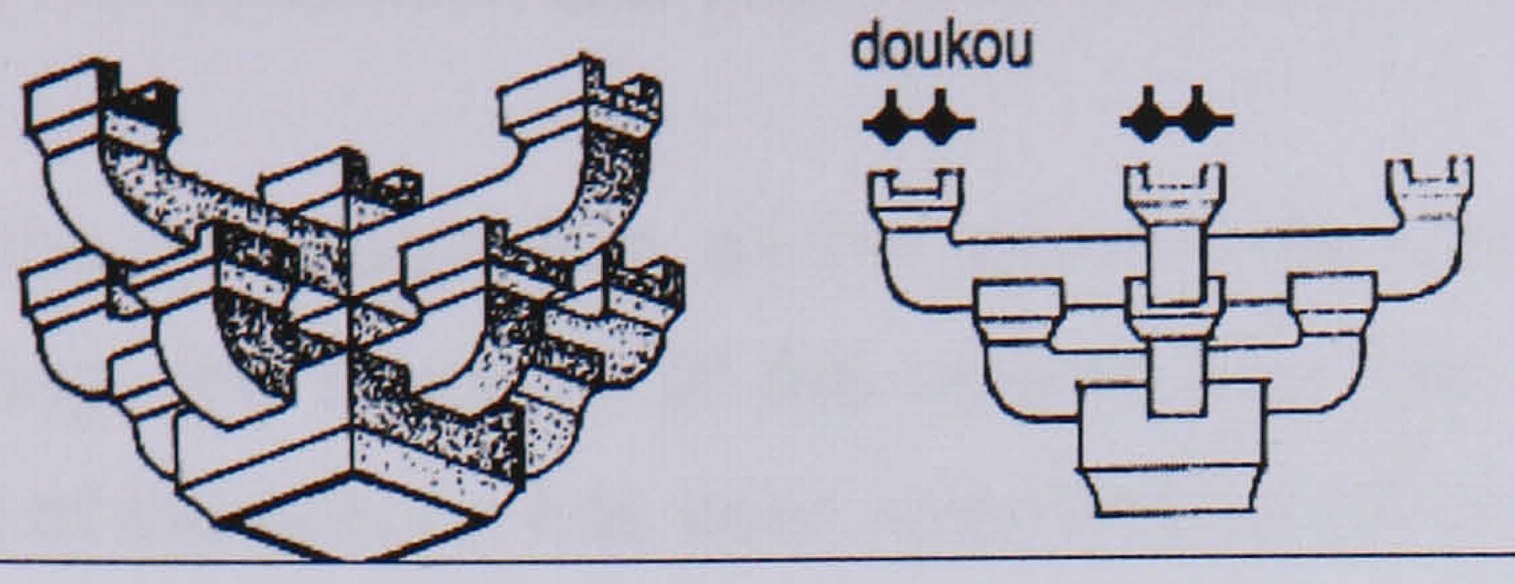
'To build substantial overhanging eaves, the Chinese invented the *DouGong* as early as the *Zhou* dynasty' (Chinese Academy of Architecture 1979:110). 'A set of tou-gung (*DouGong*), or brackets, is an assemblage of a number of *tou* (blocks) and gong (arms). The function of the set is to transfer the load from the horizontal member above to the vertical member below. A set may be placed either on the column, or on the architrave between two columns, or on the corner column' (Liang, 2000:101). *Dougong* is one of the most important building elements of traditional timber structures in China, which has been widely used for the construction of palace buildings, religious buildings, residential and civil buildings. A standard *Dougong* system includes at least included two buildings elements: Dou and Gong (Fig.4.5). Each *Dougong* is formed by a double bow-shaped Gong (arm), which supports a block of Dou (wood) on each side, fixed layer upon layer. As the above studies identified, the depth of a Gong is 15 fen and the width is 10 fen, and the distance between two Gong (arms) of *Dougong* is 6 fen，which is called *Zhi* (Fig.4.6). This supporting system bears the load of the roof. Sometimes a slanting member, known as *ang*, is placed above the *huagong* (or arms extending out from it to form cantilevers to both front and rear) at approximately 30° to the horizon. . 'The 'tail' or upper end of the *ang* is often held down by the weight of the beam and purlin' (Liang, 2000:101). The *ang* has mainly been used to adjust the extension of the roof and the height of the *Dougong* (fig.4.6). According to the status of the buildings, the size and the number of the *Dougong* groups also can be different.

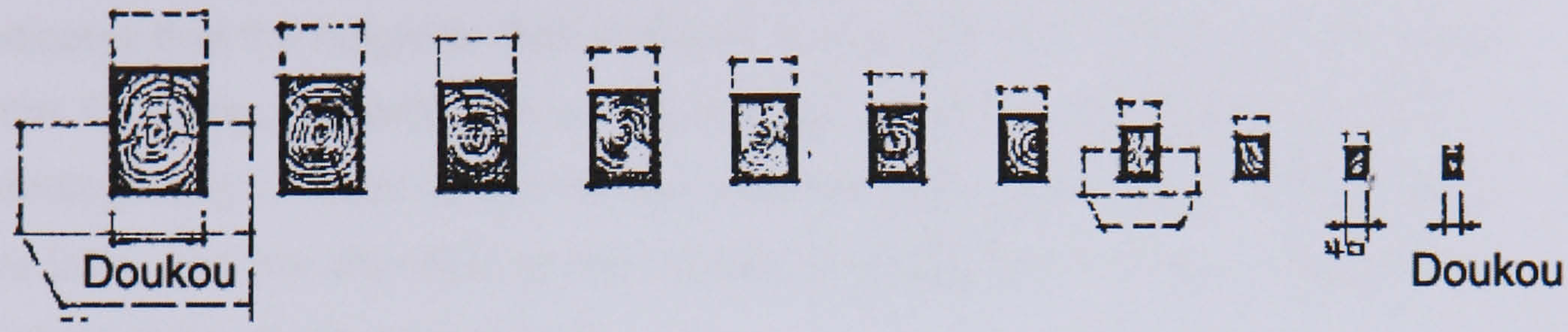
Taken as a whole, this part of the study has brought in the social background for the emergence of the Chinese modular system, which basically helped to reduce waste in construction, introduced economic thinking on time and materials consumed, and the manual also regulates the standard of the buildings according to their social status. Therefore, the basic model (8 grades) for the buildings has to be determined before the construction. The basic model then determined the choice of material, and also the scale and proportion of the buildings. The principles of the Building Standard were adopted by the following Structural Regulations manual in Qing Dynasty (1644-1911) although it did not have a direct influence on Beijing's Courtyard buildings.

4.3.3 *Gongcheng zuofa zeli* (Structural Regulations)

The version of *Gongcheng zuofa zeli* (Structural Regulations) is considered as the successor to the twelfth-century *Yingzao fashi*. The *Gongcheng zuofa zeli* was published in 1734 by the Ministry of Construction of the Qing Dynasty (1644-1911). 'The first twenty-seven chapters are rules for constructing twenty-seven kinds of buildings, such as halls, city gates, residences, barns, and pavilions. The size of each structural member in each building type is carefully specified, which is differentiated in this book from the *Yingzao fashi*, which gives general rules and ratios for designing and computation. The next thirteen chapters specify the dimensions of each kind of *DouGong* and the sequence of assembling them. Seven chapters treat doors, windows, partitions, screens, and stone, brick, and earth masonry. The last twenty-four chapters are rules for the estimation of materials and labour' (Liang, 2000:109). In addition to establishing the building modular system, *Gongcheng zuofa zeli* was first of all intended to set the standards for labors in the construction of official building projects. The costs of materials, anticipated hours for construction, wages and so forth were all strictly regulated in the manuals.

4.3.3.1 The modular system: *Doukou*





Size (cun)	6x 8.4	5.5x 7.7	5x 7	4.5x 6.3	4x 5.6	3.5x 4.9	3x 4.2	2.5x 3.5	2x 2.8	1.5x 2.1	1x 1.4
Convert to metric unit (cm)	19.8x 27.7	18.2x 25.4	16.5x 23.1	14.9x 20.8	13.2x 18.5	11.5x 16.2	9.9x 13.9	8.3x 11.5	6.7x 9.2	5.0x 6.9	3.3x 4.6

Fig.4. 7 The *Doukou* modular system
Source: Liang, 2000:111; Bai, 2000;

As the above studies indicated, the *CaiFen* system was used as the basic module for the *Song* building construction. However, in the *Qing* Dynasty (1644-1912) the *DouKou* (block mouth) that received the Gong (arm) was employed as the basic modular unit (Fig.4.7). It was equivalent to the width of a Gong, which was 10 *fen* in Song standard, and the depth of the Gong reduced from 15 fen to 14 fen. The *Doukou* system was also used as the basic module for the Qing construction (1644-1912), and also for the measurement and the proportion. The proportion was 14 fen in depth and 10 fen in width (14:10), and the standard increased to 11 grades from the previous 8 grades. The largest size of *Doukou* is 27.7cm in depth and 19.8cm in width, the smallest one is 4.6cm in depth and 3 cm in width (Fig.4.7). Furthermore, the Structural Regulation also rigidly determined the size of each building element when the modular *Doukou* was chosen.

4.3.3.2 The dimension and proportion of the buildings elements

From the Qing Regulation manual, the size and proportion of each building element was strictly formulated, and there were basically two types of regulation, the buildings with *Dougong* (bracket system) and the buildings without *Dougong*, all the formal residential buildings had to follow these design principles. The following studies will briefly introduce the dimension and also the proportion of these two types of buildings.

(a)The dimension and proportion of the column

From the Qing regulation, all the columns are equal height. For the buildings with the *Dougong*, the diameter of the column has been specified as 6 *Doukou*, and the height of the column has been specified as 70 *Doukou* (with the height of *Dougong*), which indicates that the height to diameter ratio of a column is 11. For those buildings without the *Dougong*, the width (a) of the *Mingjian* (middle bay[2]) should be chosen first according to the social status of the residents, then the height of the eave column is 0.7a, and the diameter of the column is 0.08a, and the ratio between the height and diameter of the column is 11.

(b)The dimension and proportion of 'bay' and 'jia'

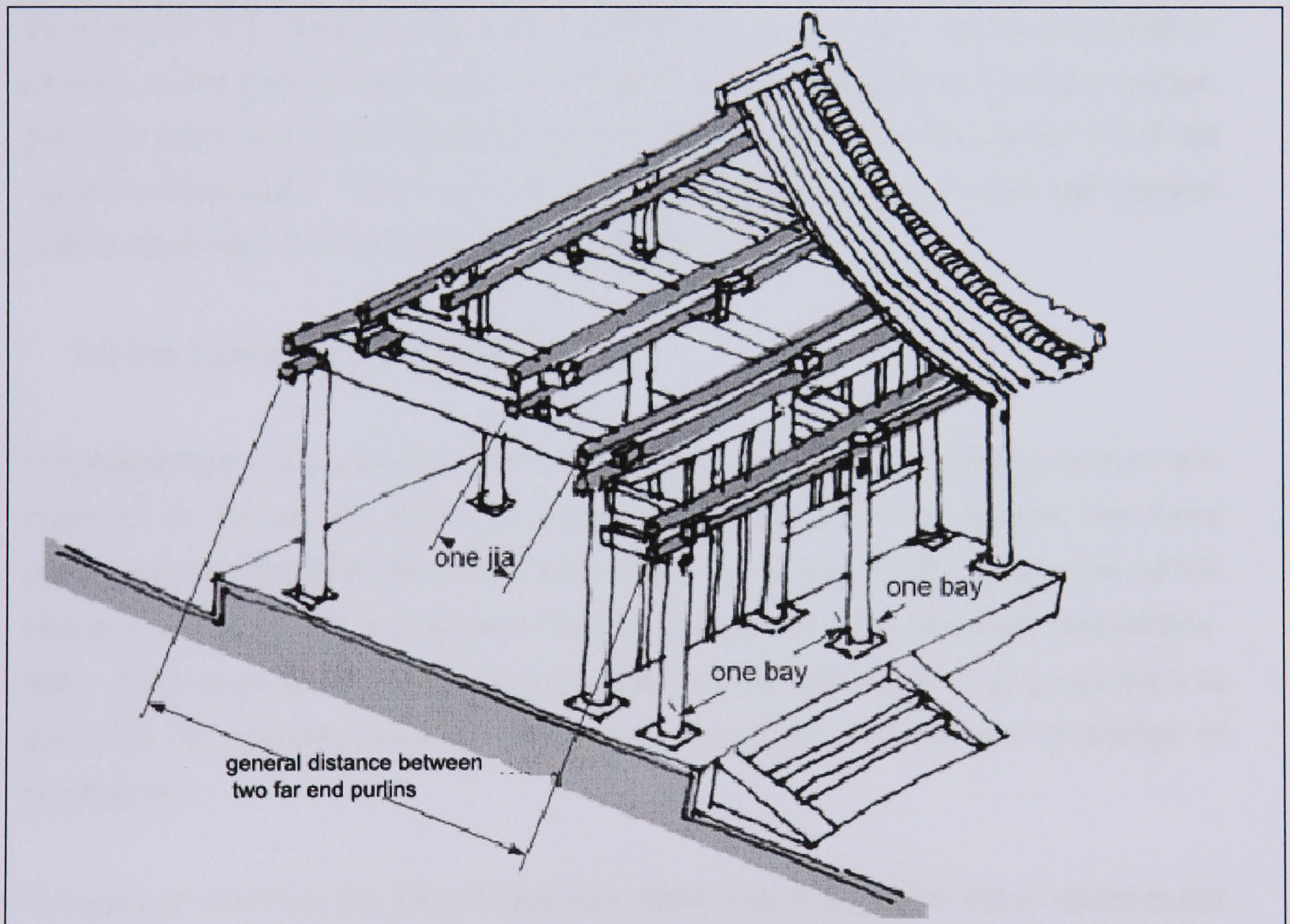


Fig.4.8 The 'bay' and 'purlin'

Chinese structures began with the common *jian*, *kaijian* (bay), and *jia* (purlin), these spatial units of measurement give buildings their plan and shape, the *jian* (bay) and *jia* (purlin) are the fundamental dimension of width and depth of the buildings. A *jian* (bay) is the span between two lateral columns or pillars, which sometimes constitute

[2] See following 'bay' definition

a room, although often a room is made up of several *jian* (bay). The term *Jian* (bay) is also used to describe the horizontal compartmentalization or sectioning of building space across the façade. The number of the *Jian* (bay) normally used an odd number system, e.g. 1, 3, 5, and the *Jian* (bay) which is located in the middle of the building is named *Mingjian* (Middle bay). The depth of the dwelling is described by the terms *jia* or *kaijai*. Each jia refers to one of the stepped roof purlins, the horizontal longitudinal timbers needed to support the common rafters of a rising roof, the slope and curvature of a roof ultimately depend upon the relative vertical placement of purlins.

From those buildings with *Dougong*, the distance between two groups of *Dougong* (bracket system) is strictly specified as 11 *Doukou* centre to centre, and therefore, the *Jian* (bay) in width and the *Jia* (purlin) in depth of the building must be determined by multiples of 11 *Doukou* (Fig. 4.8). The *Mingjian* (middle bay) has an additional 11 *Doukou* to the normal *Jian* (bay). For those buildings without the *Dougong* system, the *Jian* (bay) next to the *Mingjian* (middle bay) will in turn be decreased 1/8 of the *Mingjian* dimension[3]. Generally, the ratio between the general bays and general purlins dimension is 8:5 (Liang, 2000; Bai &Wang, 2000).

(c) The beams and the curved roof

Compared to the 3:2 ratio from the Song standard, the ratio of the beam section was changed to 5:4 or 6:5 (width to height), which betrays and ignores the basic mechanics and the strength of the timber materials (Liang, 2000). Meanwhile, all the beams are straight; the arched beam has no place in the *Qing* Structural Regulations. Also, many aspects of the Structural Regulation are not scientific because there is generally no scientific proof but rather more about the experienced knowledge of construction.

The curved roof from the Qing Regulation starts from the bottom and is raised purlin by purlin, which is called *jujia* (lifting the purlins). 'The pitch of the Ch'ing [Qing] roof thus obtained is generally steeper than that of the Sung [Song] roof, giving a convenient clue for identifying and dating' (Liang, 2000:118). Furthermore, the curved ratio of the roof can be 1:2 for a small building and 7:10 for the large building (fig.4.9).

[3] The rules also apply for those buildings that have more than three Jian (bay).

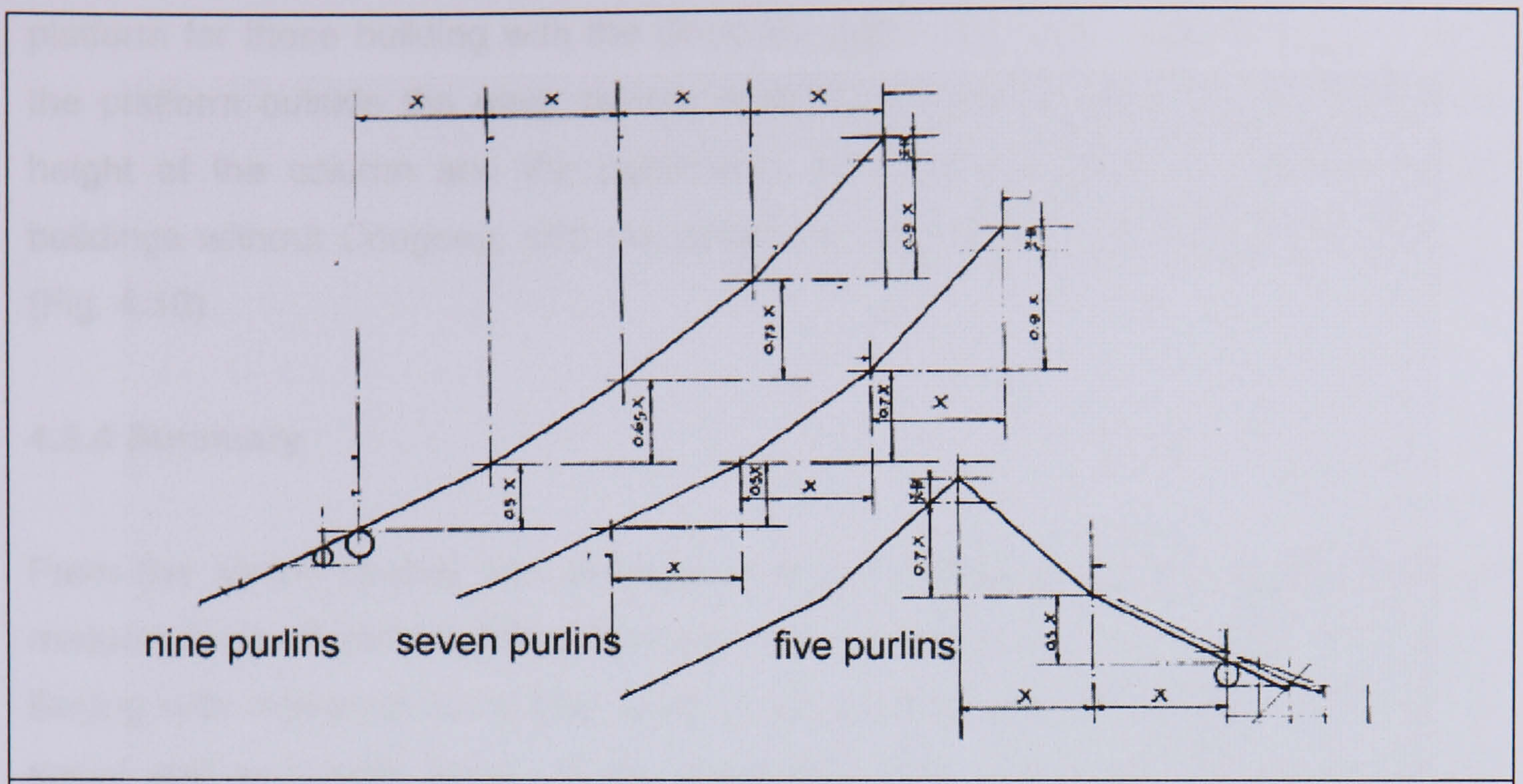


Fig. 4.9 The calculating of the raising of the pitch roof
Source: Liang, 1934

(d) The platform

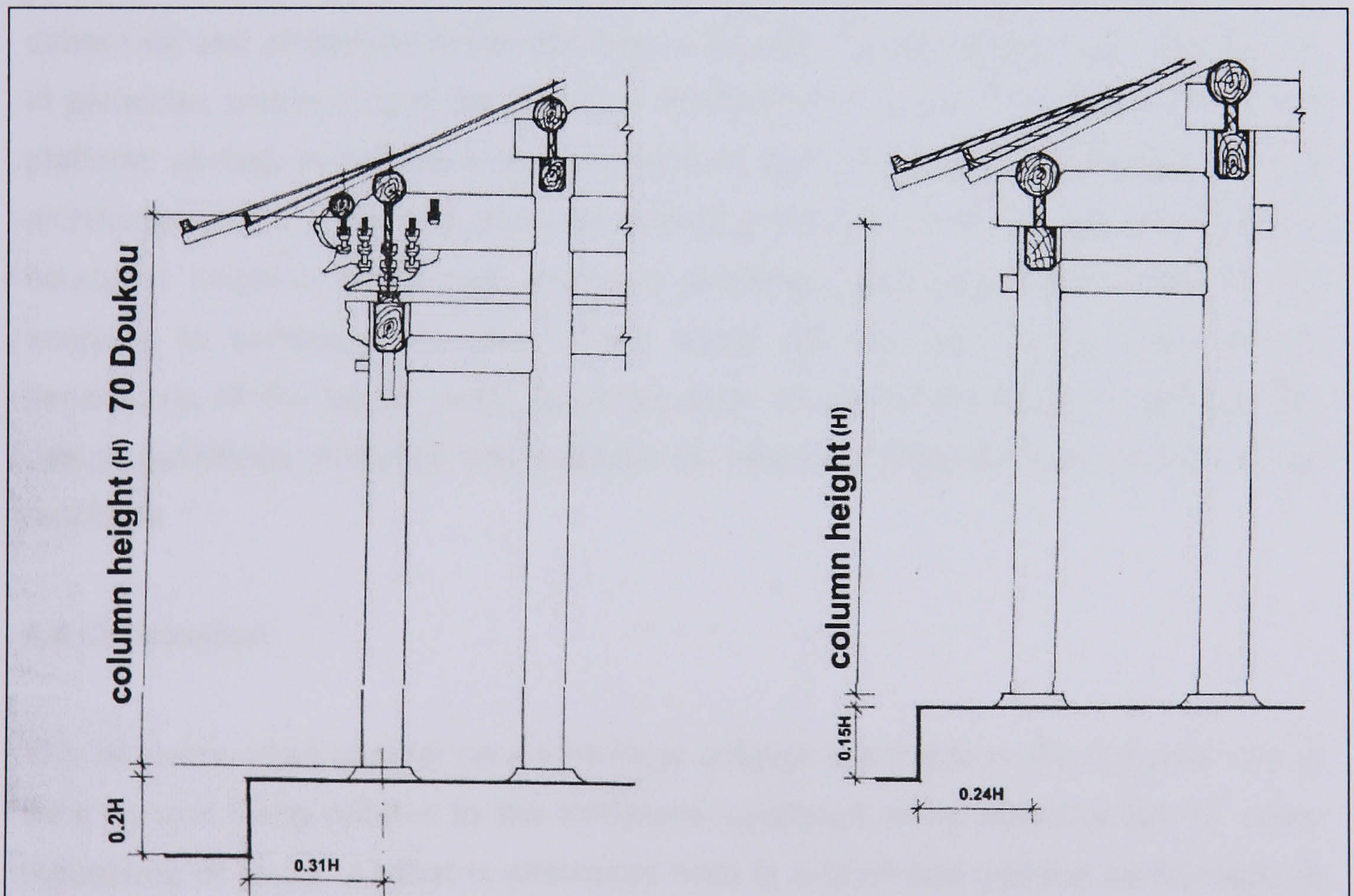


Fig.4.10 The platform
Source: redrawn based on Bai & Wang, 2000:33

As previous studies indicated, the height of the eave columns has been defined as 0.7a ('a' is the width of the middle bay). From the regulations, the height of the platform for those building with the *Dougong* system is 0.14a, and the extension of the platform outside the eave column is 0.217a- here the proportion between the height of the column and the platform is 5:1. The proportion is 20:3 for those buildings without *Dougong*, and the extension outside the eave column is 0.168 a (Fig. 4.10).

4.3.4 Summary

From the above studies and analysis, it is not difficult to get the proportion and measurement of each building element of a courtyard buildings group dwelling in Beijing with reference to 'a' (the width of the central bay, which also indicated the social and economic status of the residents). This systematic framework of the traditional Chinese architecture 'grammar book' helps the understanding of traditional Chinese courtyard dwellings as a whole. This part of the study has mainly focused on the text book as a set of design guidelines, which start from the basic and creative 'Chinese modular system', the principles of the supporting *Dougong* system, to the dimension and proportion of the buildings elements. The Qing Structural Regulations in particular, which include the columns, the 'bay' and 'purlin', the roof and also the platform, all help to provide a basic dimension and proportion of traditional Chinese architecture. This part of the study will provide a theoretical background for the future courtyard neighbourhood and courtyard dwellings ecological values studies and analysis. In particular, this part of the study will also help to get the physical dimensions of the larger scale buildings such as *Fuwangfu* mansion through the design guidelines (standard and proportions) when the physical measurement is not available.

4.4 Conclusion

This is a very small chapter on a very large subject, a subject on the Chinese way of thinking and living relative to the traditional courtyard living environment for many thousands of years. All that is attempted here is a brief and general introduction to the primary shaping forces on the traditional Chinese architectural living environment which starts from the primary Chinese philosophies of Daoism and Confucianism and their influence on traditional Chinese architecture. Furthermore, the *Wangcheng* (Imperial city) ideal city model theory and the *Fengshui* theory and their influence on the city planning, choice of site and also the placement of the buildings have been introduced, which will help to achieve a better understanding of the following research on the courtyard neighbourhood in Beijing. Chinese modular and structure systems have also been introduced, which has not only provided dimension and proportion to the traditional Chinese construction but also indicated a deep economic thinking in the Chinese way of construction because of the economic considerations when the module system emerged. This part of the study also tried to understand the social-culture, environment and economic background of each primary shaping force rather than just briefly studying it. Such an attempt will not only help to provide the research theoretical background but can also help to get the right information for that unreachable physical evidence such as the large scale buildings of 1st to 10th lanes of *Dongsi* neighborhood.

The old neighbours all said, wouldn't it be wonderful if Small Well Lane could have a storyteller to tell their story…Li, (1981:24)

Chapter 5: The place studies on 1st through 10th *hutong* (lane) of *DongSi* neighbourhood

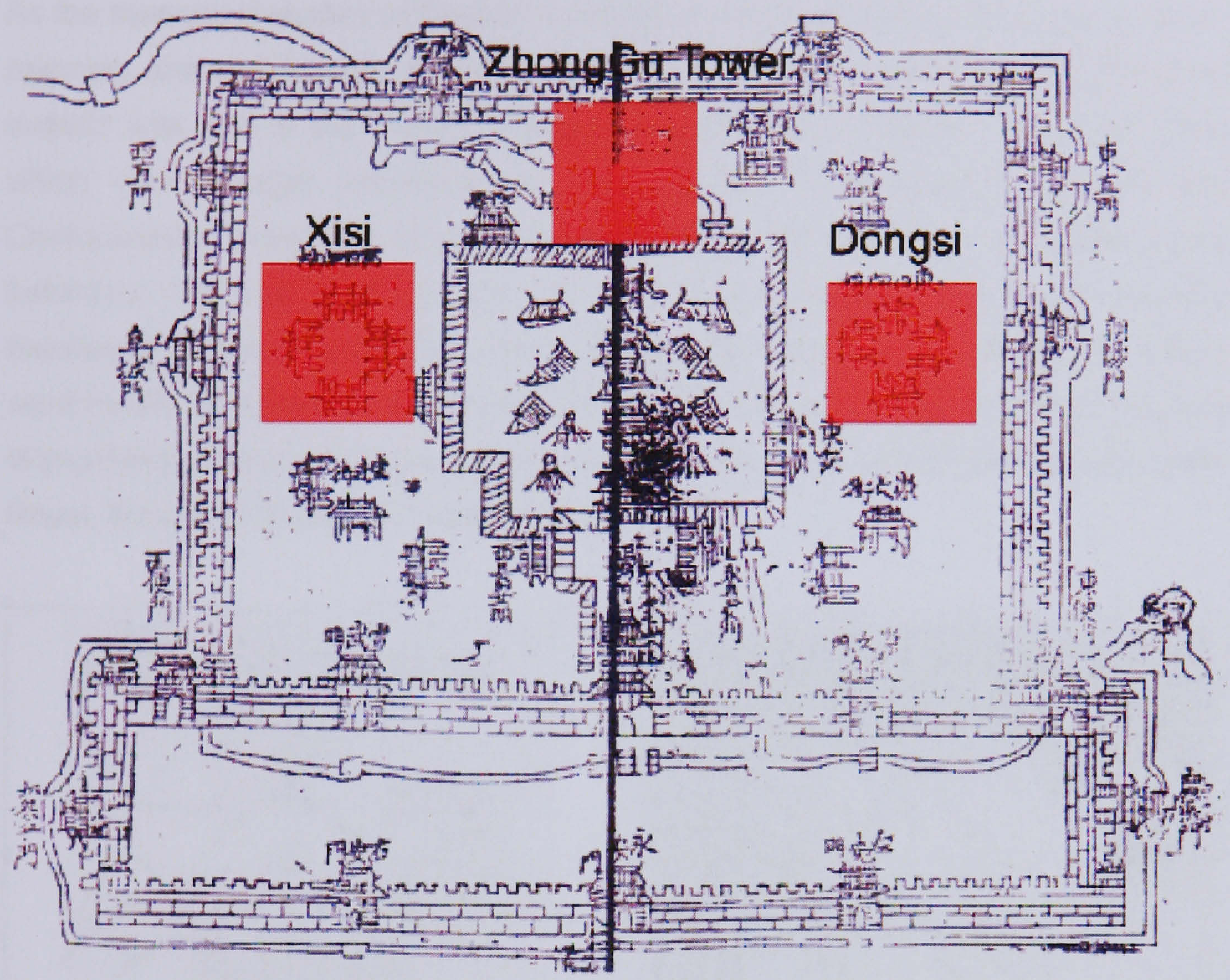


Fig.5.1: Beijing city map *Dongsi* and *Xisi*
Sources: *Wan*, 1593

Dongsi 1st to 10th lanes emerged as an identifiable place in Beijing during the original construction of *Yuan* (1276-1368) *Dadu* (great capital city) in 1267 (Steinhardt, 1990). For many hundreds of years, the relatively stable physical boundaries of the city and also 1st through 10th lanes allowed the urban social culture contexts continuously to be developed, constructed, and accumulated, which helped to construct the identity of the neighbourhood as well as wider Beijing. On the basis of a broad understanding and analysis of the historical urban context, and also by disclosing the urban design values from the traditional living quarters of 1st through 10th lanes in *Dongsi*, this section of the place studies will firstly introduce traditional Beijing as an ideal city model before the urban neighbourhood and courtyard dwellings studies. This introduction of the city will also help to explore and recover the original social culture and historical context of the neighbourhood, which will help to explain1st through 10th lanes of *Dongsi* neighbourhood in time and place (Fig.5.1).

5.1 The historical studies of traditional Beijing city

As the theoretical studies in Chapter 4 indicated, for many thousands of years, urban planning and architecture design in China was not a specialist field of study, but instead was part of the overall religious, imperial and vernacular culture of China which was strongly influenced by two schools of philosophy: Daoism and Confucianism. These two schools philosophy have strongly shaped people's social behaviour and also their relation to the built environment. The urban planning theories of traditional Beijing are mainly shaped by Daoism and Confucianism which were mostly embodied in the traditional planning theories of *FengShui* and the ideal *Wangcheng* (Imperial city) as stated in the classical texts of *Zhouli:kaogongji* (*Zhou* Ritual: Record of traders 11th century B.C.).

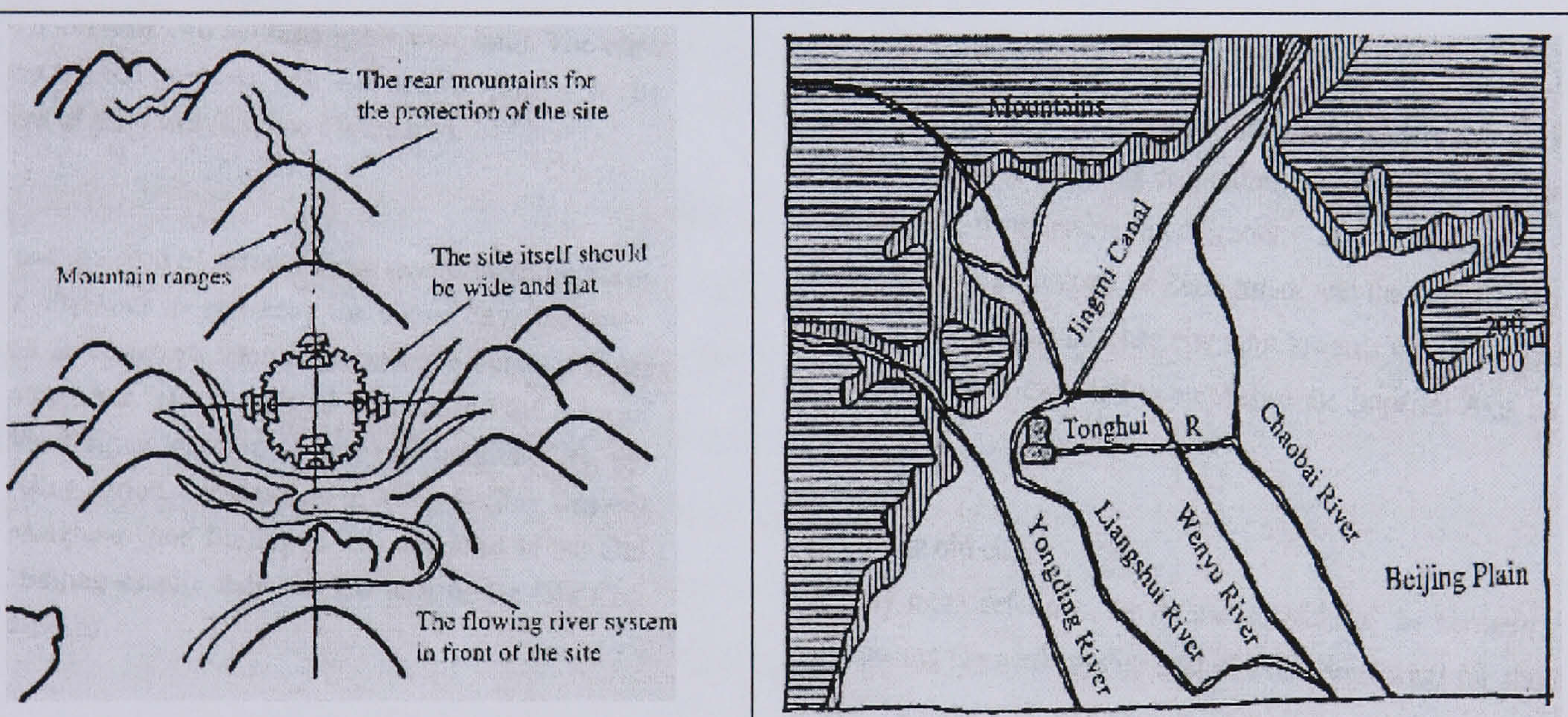


Fig 5.2 The ideal site model (left) and the real city site of Beijing(right)
Source: Liu, 2001:110

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On the basis of the early Chinese urban planning theories of ideal *Wangcheng* (Imperial city), three imperial cities were built on the same ideal site from the principles of *Fengshui* and also followed the same principles of the ideal city model from *Zhouli:Kaogongji* (*Zhou* Rituals: Record of traders) in current Beijing. The site is surrounded by the *Yanshan* Mountains on the west, north and east while the small alluvial plain of the *Yongding* River lies to its southeast. Meanwhile, 'in the planning of the *Yuandadu*, one of the great achievements was the advantage taken of the existing waterway systems which consisted of the north-south Great Canal, the

Yongding River and other lakes and rivers (Fig. 5.2), incorporating them into a well-planned water system for trade and travel' (*Hou* and *Jin*, 1978). Therefore, the site chosen for traditional Beijing was strongly shaped by *Fengshui* principles; traditional Beijing was chosen as the capital because of its location and physical environment.

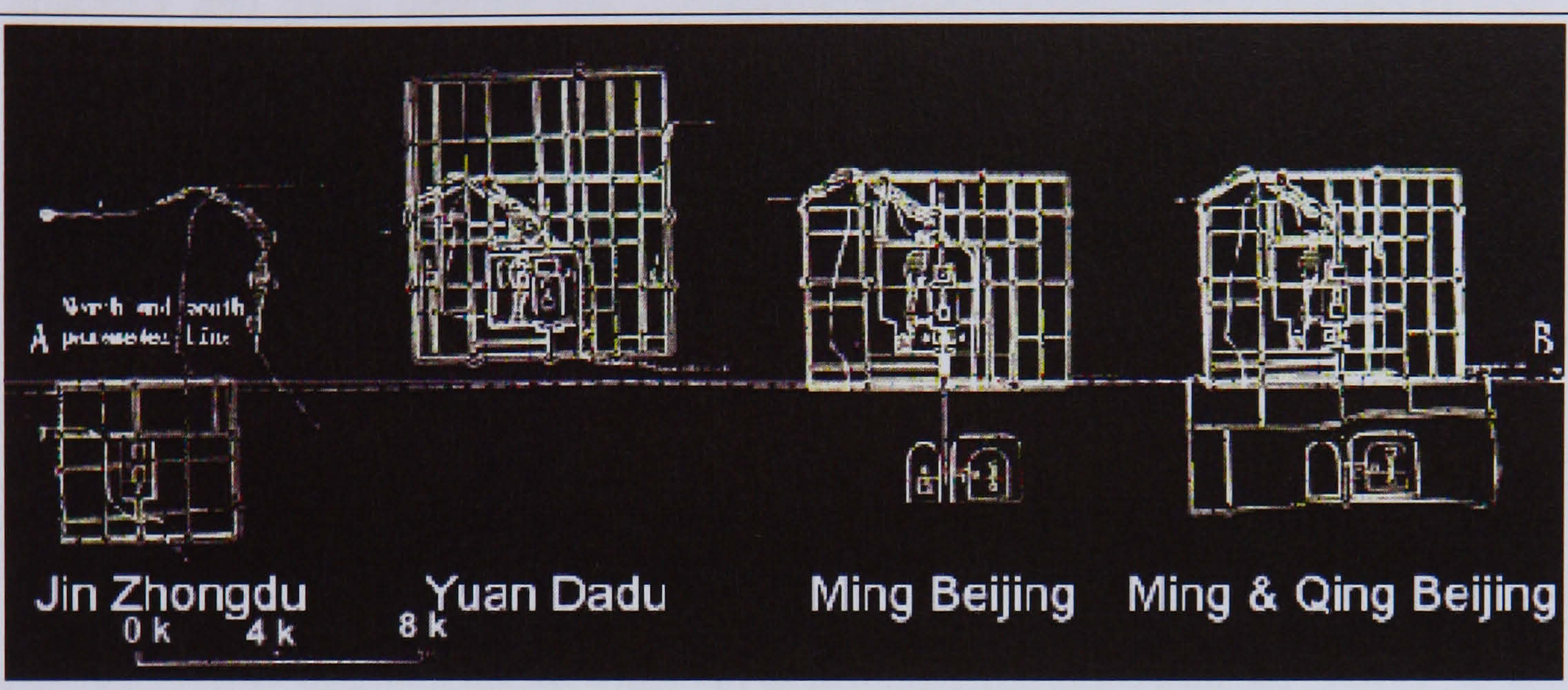

Fig.5.3 The transformation of traditional Beijing
Source: Liang, 1999
Note: *Jin* Dynasty (1125-1234), *Yuan* Dynasty (1276-1368), *Ming* Dynasty (1368-1644), *Qing* Dynasty (1644-1911)

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Jin (1125-1234) *Zhongdu* is the capital of the kingdom of the 'Golden Tartars' (Fig.5.3). The perimeter of *Zhongdu* was about 10 miles in diameter. In 1215 *Zhongdu* fell to the Mongols of *Genghis Khan*, and a new city *Dadu* (great city) with a perimeter of twenty miles was built (Fig.5.3). 'It had many resemblances to later Peking (Beijing), but the layout was more regular. It was almost a complete square with 12 gates, 3 on each side, with towers over each gate and at the four corners of the wall' (Boyd, 1962:61). Clearly, *Dadu* was constructed following the ideal *Wangcheng* (imperial city) principle (also see Chapter 4.1.2.4), therefore, 'for almost as long as the imperial city buildings, some of their locations, and certain spaces within the city have been standardized and prescribed' (Steinhardt, 1999:2). Marco Polo's description of the city of *Dadu* and palaces after 1275 when he arrived can help us further understand the quality of the urban space of this ideal imperial city:

It is twenty-four miles round, that is that on every quarter it has a face of six miles, and is exactly square by line…there are moreover twelve principal gates, and above each gate is a very large palace and fair, so that on each side of the walls are three principal gates and five palaces, because there is yet another palace very fair and large for each corner of the city. In all these palaces are many great and wide halls in which the armies of those who guard the city dwell. Moreover I tell you that the whole city is set out by line; for the main streets from one side to the other of the town are drawn out straight as a thread, and are so straight and so broad that if anyone mount on the wall at one gate and look straight one sees from the one side to the other the *gate of the other side, opposite to that, and they are so planned that each gate is seen as the others along the town, by the roads. And everywhere along the sides of each main street are stalls and shops of every kind. And there are about the city many palaces beautiful and great, and many beautiful inns, and many beautiful houses in great abundance. And all the pieces of land on which the dwellings are built throughout the city are square and set out by line, and on every piece there are spacious and great palaces with corresponding courts and gardens...and in the middle of the city there is a very large and high palace in which is a great town clock, that is a very great bell, which sounds three times a night* [1] *(Steinhardt, 1990:155).*

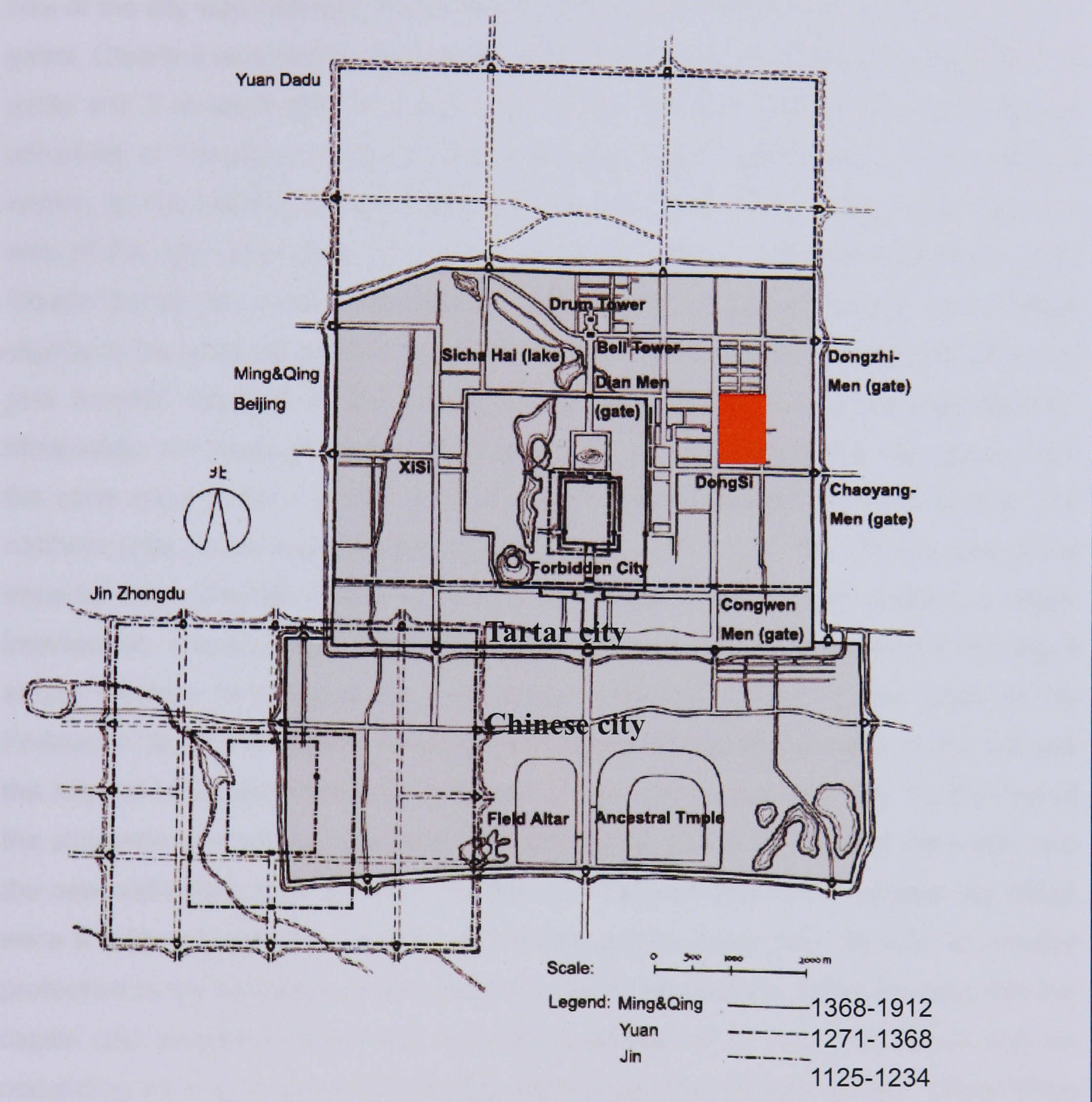


Fig. 5.4 The plan of historical Beijing
Source: *Wu*, 1999

From Marco Polo's description of the *Yuan* Capital, a clear image of the imperial city emerges; the enclosed city wall and twelve city gates (three on each side) and thoroughfares exactly matched the ideal imperial capital city planning principles.

[1] Moule and Pelliot, 1938: 212-213. The 'palaces', which Polo mentions in the first part of the description, are gate-towers with palatial-style roofs.

Following the north and south central axis of the city, from south to north, there are government institutions, the imperial palace, the strategic market place, and further to north are the Bell and Drum tower.

In 1403 Beijing was established as the capital of the Ming Dynasty following the collapse of the Mongol *Yuan* Dynasty (1271-1368). The boundaries of the city were more curtailed to the north than *Dadu*, slightly enlarged to the south, and the total size of the city was reduced; the perimeter of the new walls was 12.5 miles, with nine gates. Clearly it was much more flexible than the previous imperial cities that had 12 gates and 3 on each side, and the layout of the city was shaped by one of the key principles of *FengShui* which is *zangfengdeshui* (hide from the wind and seek the water), so the traditional Beijing city only has two gates at the north, west and east side of the city rather than the former three, to diminish the cold wind from north Siberia during the winter. The palace, and the Drum and Bell towers, were rebuilt slightly to the west so that the new north-south axial line went directly over Coal Hill and avoided interruption by the *Sicha Hai* lake (Lake of Monasteries)(Fig.5.4). Meanwhile, the imperial palace (Forbidden City) was located at the city centre, with the state court in front of the imperial palace and the market place behind it. The northern gate on the eastern wall (*DongzhiMen*), and the northern central gate of the Imperial City (*DianMen*) also extended two large avenues and defined a major intersection. It contained a drum tower and a bell tower behind, together forming a strong northern terminus of the central axis of Beijing. Further to the south of the Forbidden city, the Ancestral Temple of the imperial family was located on the left and the Altar of Land and Harvest on the right of the central axis (Fig.5.4). By the end of the sixteenth century, the population of Beijing had grown far beyond the walls, and the new walls were built (finished in 1552) in the south side of the original city which were 9 miles round with 7 gates, and known as the 'outer city' (fig.5.4), to provide protection to the residents. In the outer city, the three northern gates (leading into the capital city) projected three main north-south streets. All of them intersected with an undulating east-west street (linking the eastern and the western gates). These three lines each connected a northern and a southern node. In each of them, between and around the two ends, shops and stalls gathered and spread along the linear streets. Generally, the *Qing* Dynasty (1644-1912) made no fundamental change in the shape and form of the city, but a clear social classification was created by the *Qing* authority; the *Manchus* monopolized the Inner City, which became known as the Tartar City, and the Outer City was called the Chinese city (Fig.5.4).

For the *Ming* and *Qing* Beijing, the long lines or avenues followed the orthogonal shape and the cardinal orientation of the whole city. The two longest thoroughfares in the Capital city were north-south ones, parallel to the central axis (Fig.5.4). The long lines were linked directly to the city gates. The interactions of these lines often formed significant nodes for local urban life, especially commercial activities. In the eastern half of the capital city, the southern gate (*ChongwenMen*) and the central gate (*ChaoyangMen*) of the east wall 'projected' the two largest avenues (north-south and east-west), and formed an interaction which helped to create a major commercial node in eastern Beijing, a point around which shops and street markets gathered (known as *Dongsi* or 'eastern market'), which was identified by *Dongsi* archways. The case study neighbourhood (1st to 10th lanes of *Dongsi*) is located in the northeast *Dongsi* archways (Fig.5.4, Fig.5.5). Meanwhile, *Xisi* (western market) is located at the symmetrical place of the west side of the inner city. Therefore, the eastern four and the western four with the strategic market place (which are located at the back of the Forbidden City) have created three commercial centres to Beijing.

From the above studies, we can see that traditional Beijing is mainly shaped by the traditional planning theories of *FengShui* and the ideal *Wangcheng* (Imperial city) which was disclosed in the classical texts of *Zhouli:kaogongji* (Zhou Ritual: Record of traders). 'Thus among many other ways in which Peking (Beijing) is typical of Chinese cities, it is so in its comparatively modern date, being essentially of the Ming and Ch'ing (Qing) dynasties; also because it is a creation rather than an accretion, but a creation deliberately based on and closely resembling many previous cities' (Boyd, 1962:62). Generally, the ideal of a traditional Chinese city should keep the positive 'Qi' (energy) and avoid the negative 'Qi' (energy) created by the *Feng* (wind) and *Shui* (water), and this fengshui principle can be achieved by choosing the ideal site of the city which faces water and has a mountain at the back, and by locating the entrance gate at the southeast of the courtyard buildings, and so on. The ideal *Wangcheng* (imperial city) model further regulated the urban form of traditional Beijing, which basically created the walled city with the central north-south axis which was identified as the imperial palace (Forbidden City). Furthermore, in the intersections which were created by the main roads that led to the nine city gates, these intersections normally were the commercial centre of the city, and *Dongsi* 1st through 10th lanes is identified as one of these intersections (Fig.5.4).

5.2 The physical location of the neighbourhood

As the above Beijing historical studies indicated, *Dongsi* was one of the three main market places of traditional Beijing located in the east of Beijing and also sited at the interaction of two of the largest avenues (north-south and east-west). These in turn linked the southern gate (*ChongwenMen*) of the south wall and the central gate (*Chaoyangmen*) of the east wall, which were marked by *Dongsi* archways. It was a point around where commercial buildings, street markets, imperial mansions, warehouses, temples and temples fairs and festivals gathered (known as *Dongsi* or 'eastern market') (Fig.5.5).

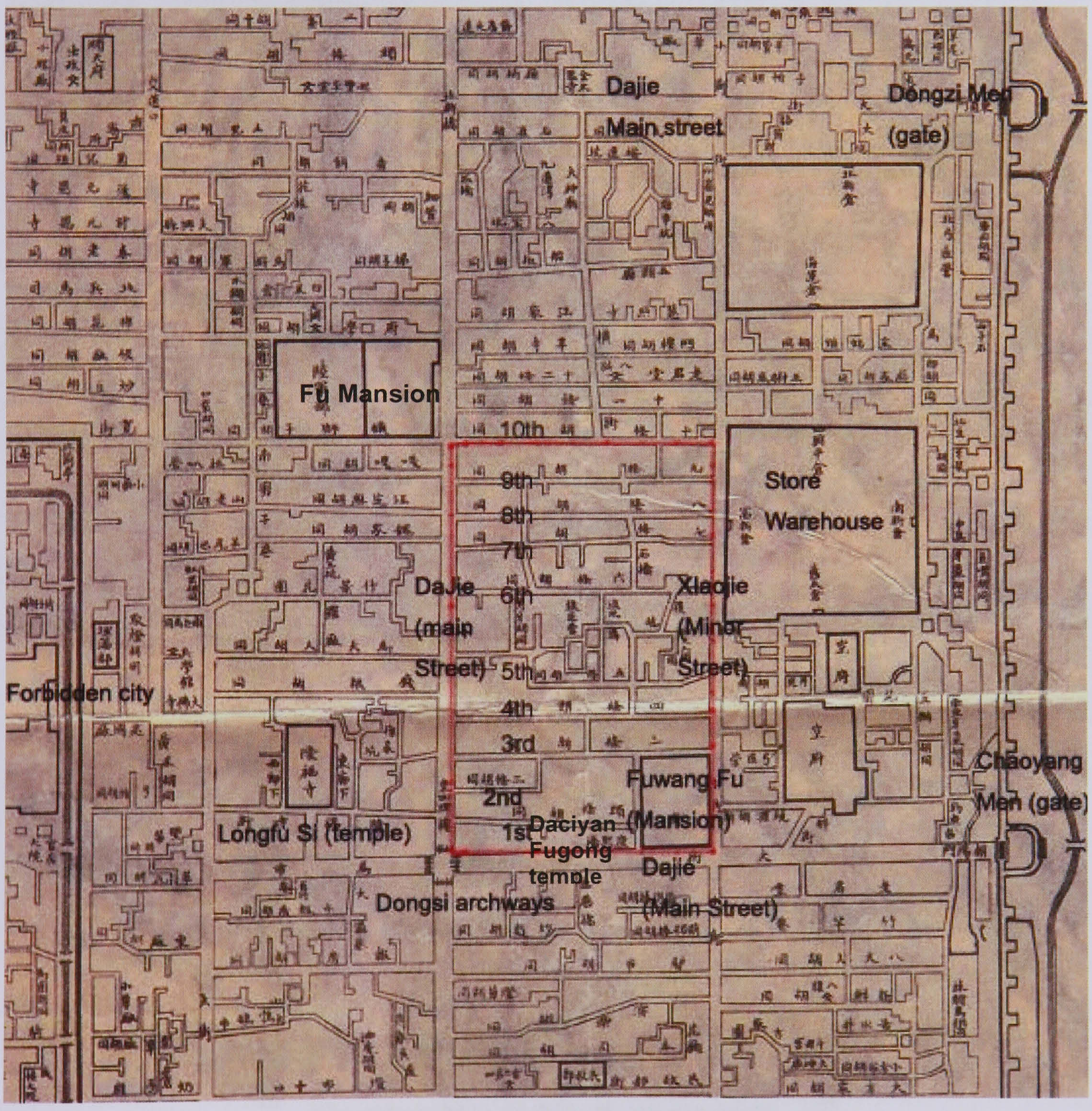


Fig.5.5 The location of 1st through 10th lane of *Dongsi* Neighbourhood
Source: *zuixin* Beijing *jingsi quantu* (the newest Beijing detailed map1908)

Travelling from south to north, *Dongsi* 1st through 10th lane is a series of 10 east/west lanes numbered northwards in sequence from *Dongsi* archways in the south. The south boundary of the site is *Chaoyangmen Nei Dajie* (main road), the north side is the 10th *hutong* (lane), to the west is *Dongsi Beijie* (main road) and the east end is *Chaoyangmen NeiBei Xiaojie* (minor road), and the parcel area of the neighbourhood is about 65.7 hectares. Furthermore, the core area of this neighbourhood (from 3rd lane through 8th lane) is where good quality courtyard dwellings are located and has been classified as one of the 25 conversation areas in Beijing (Fig.5.6, inside the red line) in 2003. The conservation area is 48.8 hectares with the population of 18,006 and 6681 families (IPPR design institute survey in 2003). However, this study will regard the whole neighbourhood from 1st though 10th lanes as a whole, and try to recover and explore the historical urban contexts and social culture contexts which can provide a basis for the following urban place studies.

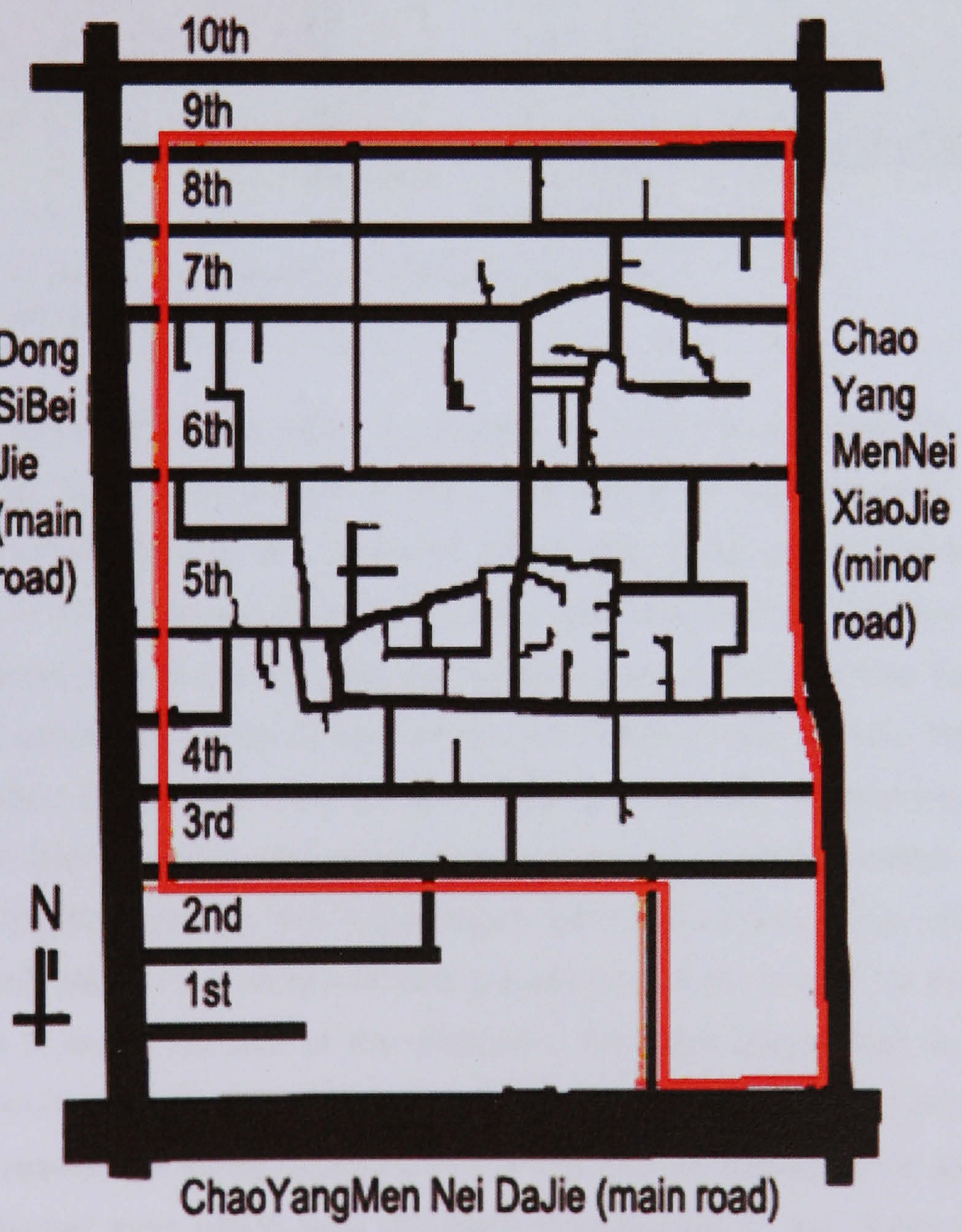
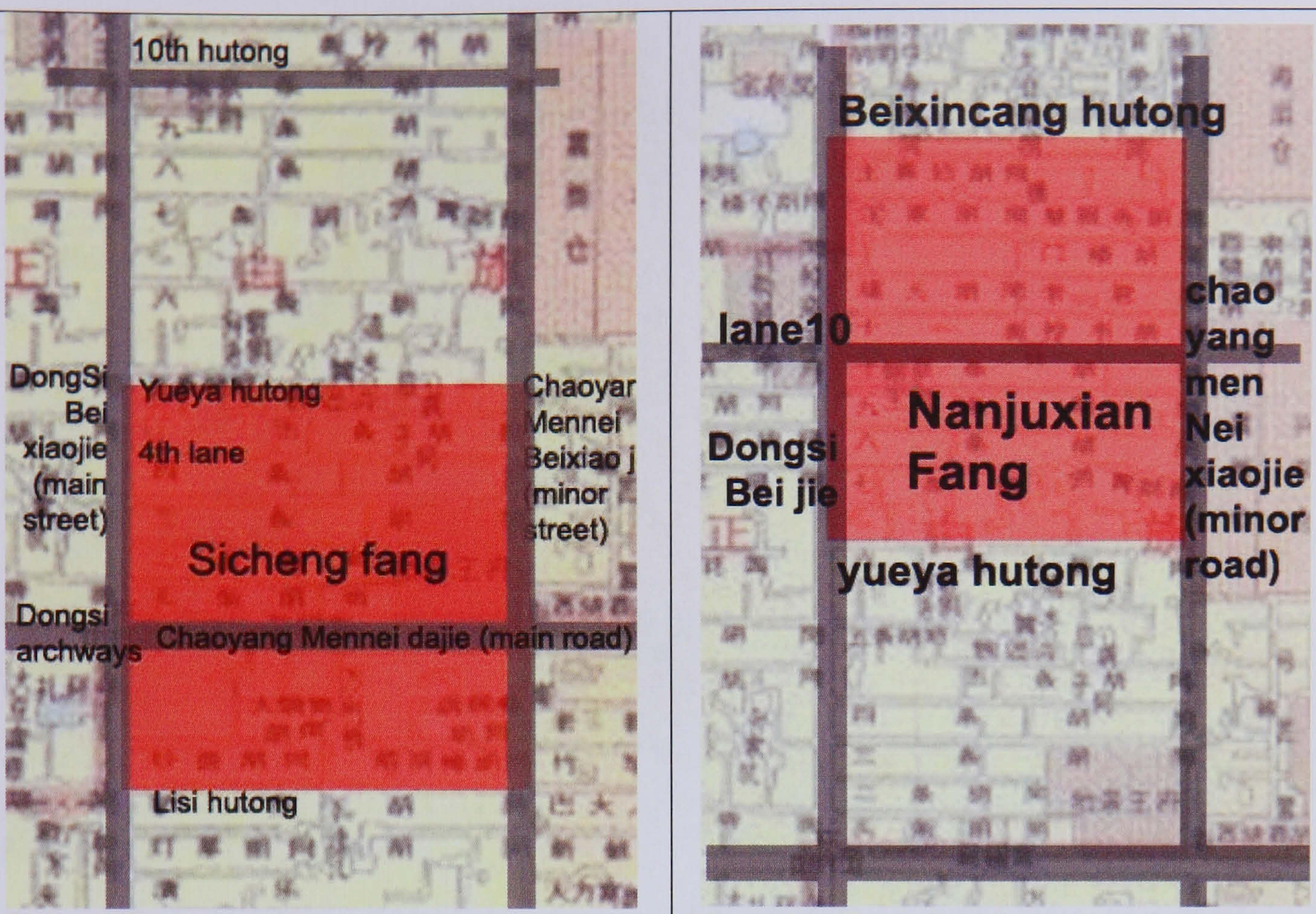


Fig.5.6 1st to 10th lane of *Dongsi* neighbourhood
Scale: 1:10000 0 m 200m 400m

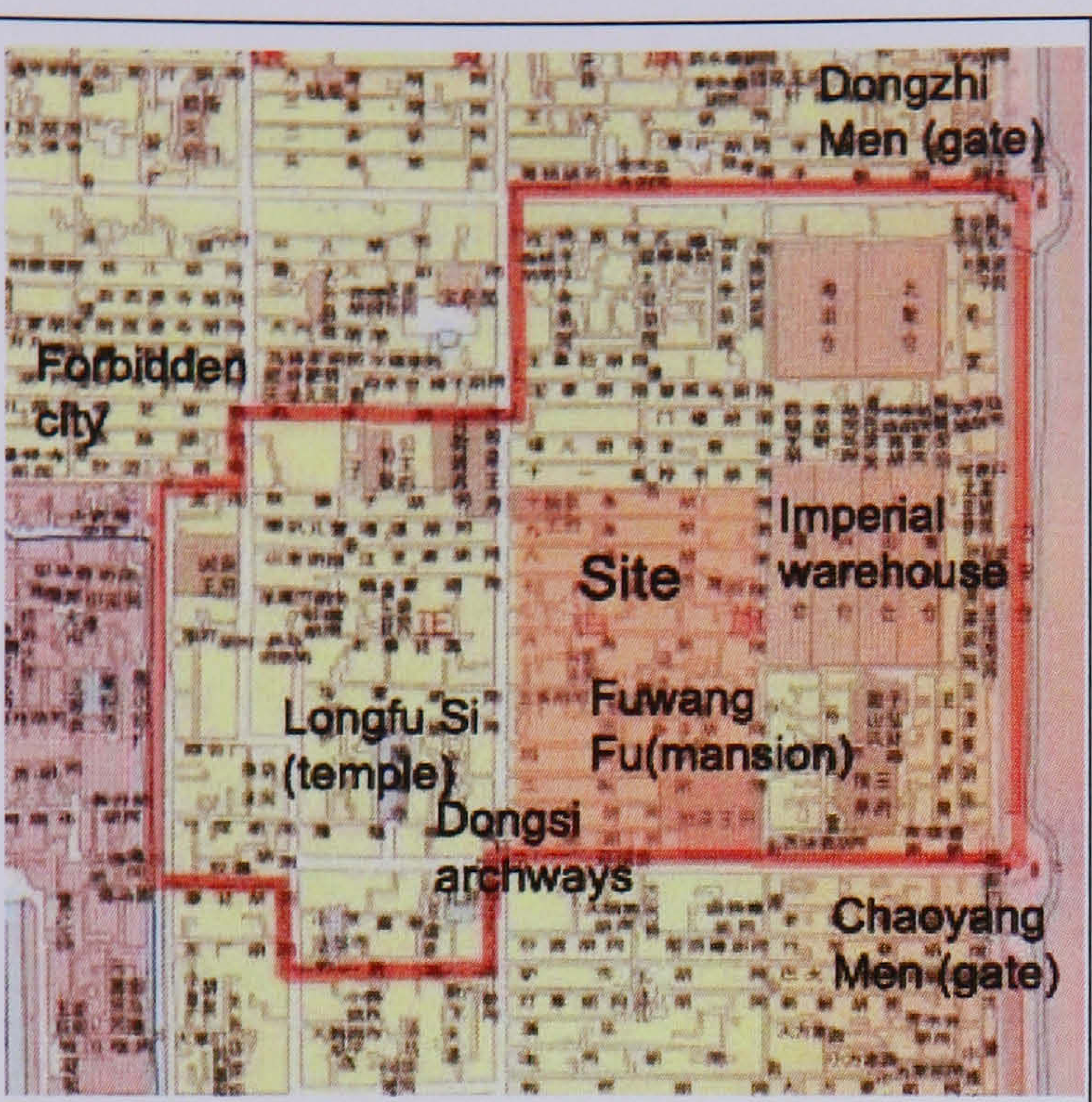
5.3 Historical urban context



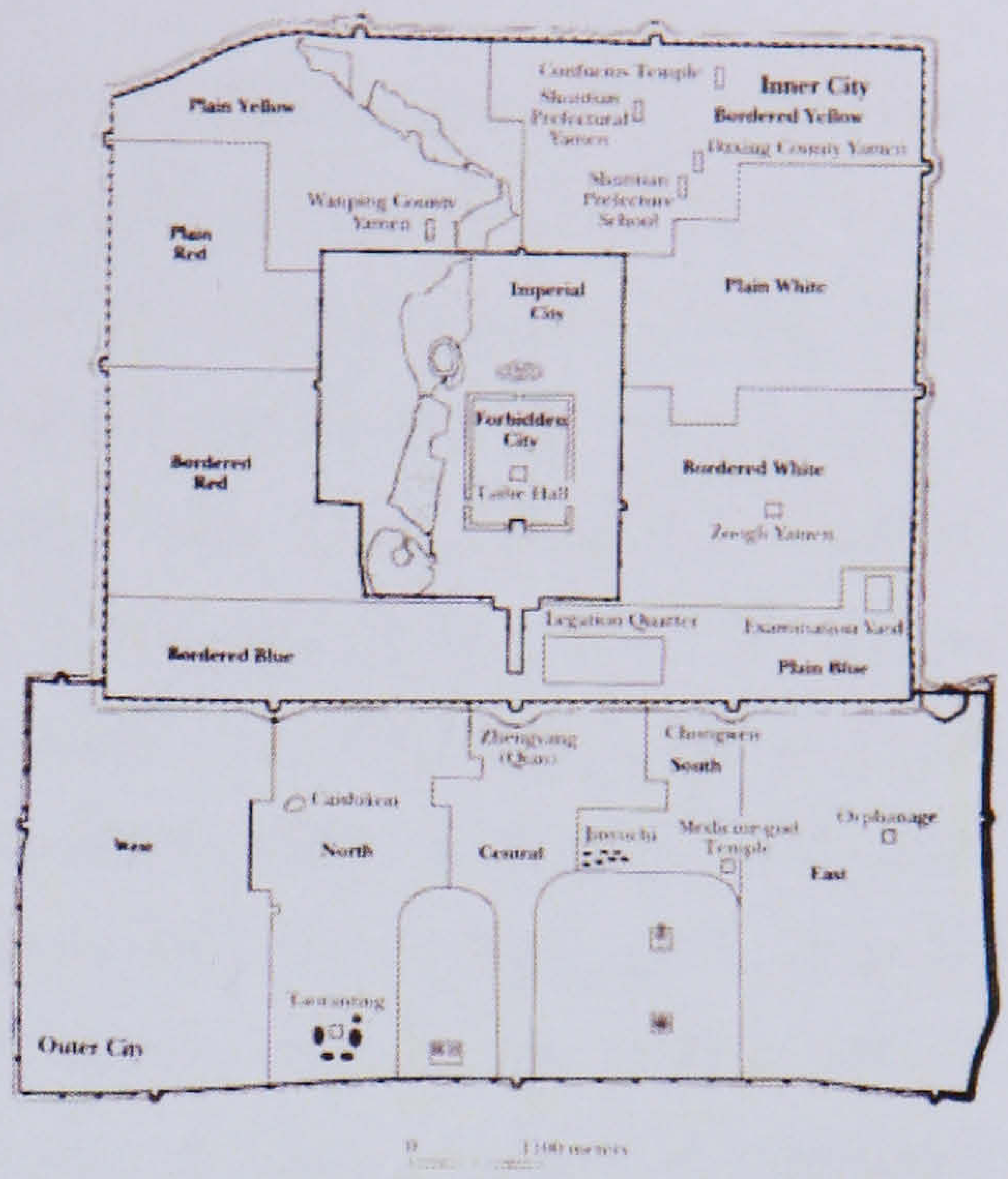
Sicheng Fang (ward) Nanjuxian Fang (ward)

Fig. 5.7 The *Sicheng Fang*(ward) and *Nanjuxian Fang*
Source: Qing Qianlong map:1750

According to literature (Chan, 1991; Fu, 2004; Liu, 1990; Song, 1369; Wu, 1999), the construction of *Yuan Dadu* began in 1267 and lasted for two decades. Beijing has then served continuously as the capital of China after all the major construction work was finished in 1553. *Dongsi* (East Four) as a site, was planned originally as one of the three market places surrounding the imperial city of *Dadu* in the Yuan Dynasty (1271-1368), and identified by *Dongsi* archways. Furthermore, as *Hou Renzhi* (1979) described, when *Dadu* was built, a strict code was issued concerning the size of allotments for the residents who were moving from the previous nearby *Jin* dynasty (1125-1234) capital, and the 'the high-ranked were called first. Each unit was 8 *mu* (1*mu*=667sqm). Where the allotment was greater than 8 *mu* in size, or the household was not able to make full use of the allotment, the extra space had to be given to commoners who could then build their own smaller size dwellings (*Liang*, 1999:77). Most of the residential living quarters in the old city of Beijing were similar to the *Dongsi* residential area which was originally constructed in the Yuan dynasty and inherited through the Ming and *Qing* dynasties. *C.K.Yang* also contributed similar findings and explained 'the traditional Chinese city as a congeries of essentially similar, internally differentiated 'neighbourhood unit', each containing both business firms and residents, both rich and poor' (Skinner, 1977:528).



The red line represents the border of White Banner



The Eight Banner system in Beijing in the inner city

Fig. 5.8 The banner system

The identification of the first four lanes of the neighbourhood started in the early 1400s as part of the *Sicheng Fang* (Sincere Thought ward)[2] while Beijing was being laid out as the new capital for the *Ming* Dynasty (1368-1644), the plot of *Sicheng Fang* was located on the east side of the *Dongsi Nan xiaojie* (street), from *Lisi hutong* (south side of the *Zhaoyangmen Nei Dajie* Road) to north *Yueya Hutong* (near lane 5 area), and to the west was *Dongsi bei xiaojie* (minor road) (Fig.5.7 left). Lane 5 through 10 was also constructed at the same time. This area belongs to *Nanjuxian Fang* (ward), which is located at the west side of the *Chaoyangmen Nei Beixiaojie* (minor road), and from the north side of *yueya hutong* to the *Beixincang hutong* area (Fig.5.7: right). Furthermore, the Banner system emerged in the first decade of the *Qing* Dynasty (1644-1911) when *Manchu* conquerors forced Han residents to relocate outside the inner city (Fig.5.8 right). It became the housing for members of the Bordered White Banner Corps[3]. Meanwhile, the *Fang* (ward) system still basically remained as before, but the boundary of the *Fang* (ward) system decreased socially, culturally and physically after the emergence of the Banner system in the *Qing*

[2] *Fang* (ward) is the basic neighbourhood unit of traditional Beijing and many other traditional Chinese cities. All together there are 36 *fang* (ward) in Ming and Qing Beijing. Traditionally, each fang was marked by an archway.

[3] The *BaQi* (Eight Banners) were administrative divisions into which all Manchu families were placed. They provided the basic framework for the Manchu military organization. The *BaQi* are indicated by the Plain Yellow Banner, Bordered Yellow Banner, Plain White Banner, Bordered White Banner Plain, Plain Red Banner, Bordered Red Banner, Plain Blue Banner, and Bordered Blue Banner. Some of them reflected pre-existing lineage or tribal connections in their membership, while others deliberately overrode such connections in an effort to create a more centralized military force. The banner system remained in existence until the fall of the *Qing* Dynasty in 1911.

Dynasty (1644-1911).

The historical physical architectural elements of the neighbourhood, the archways, mansions, Taoist temple, traditional shops, and courtyard dwellings all had a rich historical and social cultural context. *Fuwang Fu* (mansion) is one of the most important relics inside 1st through 10th lane of *Dongsi* neighbourhood; it is a classical courtyard buildings group which strictly follows the *Qing* Dynasty's Building Regulations manual (*Gongcheng zhuofa zheli*), which was built for the 13th son of Emperor *Kangxi* (1654-1722). Today it is located at No 137 *Chaoyang Mennei DaJie* (main road). The major buildings were built in the seventeenth century and occupied the site of 1st through 3rd lanes. *Fuwangfu* mansion has three major north to south axis (see also plan studies in Chapter 7.3.5) which include the central formal mansion buildings for the imperial family but also include a group of courtyard buildings for the family relatives at the west axis, the storage and service buildings are placed at the east side axis. A front yard helped to link them all together. *Dongsi* archways and *Daciyan Fugong* Taoist temples also have rich historical and social culture values (see the following social culture foci studies section).

Meanwhile, there are also many historical narratives and notable people connected to this neighbourhood. On lane five there is a courtyard dwelling of *Xu Shichang* (1855-1939) who was the president of the Republic of China between 1918 and 1922 during the warlord period. Lane 7 has a courtyard dwelling once used by warlord *Yan Sixian* (1883-1960) who ruled Shanxi Province between 1912 and 1949. No 63 courtyard dwelling of Lane 6 has an interesting story to explain why there are no old trees on the lane; the *Dowager* Empress *Cixi* (1835-1908) feared an assassination attempt when she stayed at the residence of Manchu noble *Chongli*'s (No 63), and she therefore had all the trees cut down. Lane 8 is famous for its contemporary writer *Ye Shengtao* (1894-1988) dwelling (No 71) and also contemporary town planner *Zhu Qiqian* (1872-1964) dwelling (No 111). In lane 10 there is a courtyard dwelling which was used by *Meilanfang* (1894-1961) who is one of the most famous Chinese opera actors. Together, all these stories, legends and personalities have greatly enriched the historical context to the neighbourhood.

From the above historical studies of the neighbourhood, physically, for many hundreds of years, the neighbourhood has always been identified by the *Dongsi* archways, *Daciyan Fugong* Taoist temple, *Fuwangfu* mansion and so on. The physical territory of the neighbourhood is relatively stable, but the social cultural context in history has been continuously developed and re-constructed. Traditional events, festivals, fairs and markets may vanish, but new ones may emerge, and the historical stories and sayings have continued to accumulate until today. Furthermore, the boundary of the neighbourhood could not only be formed by the physical factors which include the main road, minor road and lanes, but also the social culture domains such as the ward system and the *Qing* Eight Banner system. Meanwhile, the physical and social culture/uses boundaries factors are not completely separated from each other. For example, lane 10 is not a significant physical boundary to the neighbourhood, but this lane acted as the linking road between the Forbidden City and the imperial warehouse, and helped to strength the north boundary of the neighbourhood. This part of the historical studies also indicated that there was no conventional open public space such as the public square and gardens inside the neighbourhood.

5.4 Clarifying the urban elements

After a brief study on the historical urban context of the neighbourhood, the physical urban elements of the site and the surrounding area should be classified to help to understand the neighbourhood in a wider urban context. Question 1 in the focus groups studies: What is the most representative place (landmarks and urban nodes) of the neighbourhood?' can give a valuable description and a brief classification of the neighbourhood, particularly from the old residents living inside the neighbourhood before the major transformation/demolition work that started in 1950's. *Dongsi* archways have been mentioned 7 times from the focus group work, which suggests that it is the most dominant urban landmark of the neighbourhood even though it was demolished in 1954.

Liu (1): It should be *Dongsi pailou* (archways) and *Fuwang Fu* (Mansion), a long history.
Zhang (1): Yes, *Dongsi pailou* (archways), that *Pailou* is like a book of history which has stood here for around 600 hundred years, whatever happens, we should not have destroyed it, no one could bring it back.
Wang (2): *Dongsi Pailou* (archways), I had a chance to see it. Although I was very young at that time, I still remember it.
Yang (4): *Dongsi Pailou* and *Longfusi* Street.
Wang (4): There was a *Dongsi Pailou* before 1950's, it was destroyed then because it was a barrier to transportation. Not just the building was destroyed, even the city wall was destroyed because of the transportation problem.
Wu (5): *Dongsi* archway, but it was demolished when I was a child. As he (Mr. *Tian*) said, the courtyard is also in our deep memory; we played and also grew up here. And today our grandson also plays with his friends here.
Liang (7): *Dongsi Pailou*(archways) and this *Hutong*, archways had been destroyed, but the *hutong* is still here. Every day, I walk around and chat with my friends, sitting and watching.

The private courtyard has been mentioned four times, and *Fuwang fu* mansion, the hutong, the nearby *Longfu si* temple and the street all have been mentioned 3 times, which indicates that these buildings are the fundamental urban elements of the neighbourhood.

W (2): In this *hutong*, 8th lane, I played with my friends in this street, grew up in this street. I remember it very well..
Zhu (3): Yes, *Longfusi* (temple) is a very good place to go. I also go there to explore and buy the antiques, it is a place worth going to.
Guo (3): For me, it is this courtyard, however, it is significantly different from today's courtyard. There were plenty of plants and this courtyard was full of fragrance when I first moved in (1950's).
Wang (3): *Fuwang Fu* (Mansion). As a young girl, I went there with my friends and then just got lost; it is very large place and also has temples there inside the courtyards.
Zhu(3): My own courtyard. I transformed this courtyard into my own favourite. I planted the garden, transformed that corridor into a reading room. It is a nice place to live.
Tian (5): I think it is my own courtyard here; this is the place where I grew up, it has a lot of memories.
Ma (6): *Longfusi* (temple). There were a lot of shops there and also all kinds of restaurant there.
Zhang (7): The nearby *Fuwang Fu* (Mansion). We always went there and played there, it was like the children's secret world.
Rong (7): This *Hutong*. Lots of old friends; we could share happiness and sadness together.

Then traditional shops (2 times), *Meilanfang's* garden (1 time) also have been mentioned in the focus groups studies.

Wang (1): *Meilanfang's* garden, we always went to play there. It was open to the public at that time, and it was turned into a tube station on 10th lane, but only that pavilion will be kept.
Zhang (2): For me, it is the surrounding shops. There are plenty of old and also very famous shops such like *Tongren Tang* (Chinese medicine shops), *Kongyiji* Restaurant. They are very famous and represent this area. I always go there for shopping, it's very convenient.
Zhao (4): I think is the surrounding traditional shops, there is very traditional Chinese medicine shop which called *Tongren tang*, very famous.

From the above focus groups' responses, the representative places (urban landmarks and nodes) for each resident are rather personal, but these materials can still provide insights as to the structure of the urban place from a phenomenological point of view. However, the focus groups can only recover the living urban context and also the urban context in their memory. Lynch's (1960) model of the structure of urban perception can provide a convenient starting point for understanding the key elements of urban space that exist in history. The physical elements of the urban form of this neighbourhood can be classified according to the five urban elements theory: urban paths, edges, districts, nodes, and landmarks, which will help to stimulate the following urban contexts studies and analysis.

Paths: Apart from the four important main neighbourhood boundary roads and lanes that form the boundaries of the neighbourhood, the neighbourhood has also been physically linked with the city north-south central axis by *Chaoyangmen Nei Dajie* (main road) (Fig.5.9). Lane 10 has also played an important role to link the Forbidden City with the Imperial warehouse. Furthermore, Lane 1 is another important path which links the neighbourhood with *Lognfusi Jie* (street) and is identified by the *Longfusi* temple street east end archways (Fig.5.9). The east end of lane 1 and 2 stop at *Fuwangfu* mansion, and are linked with lane 3 by the vertical sub lanes. Lane 5 is a winding lane that directly linked the *Dongsi Beijie* (main road) and *Chaoyangmen Nei Xiaojie* (minor road), from the left side of the neighbourhood. It turned south and then east, with many sub lanes linked with lanes 4 and 6 (Fig.5.6). 'Each square plot is limited by fine, busy streets, so the whole city is laid out in squares like a chessboard and arranged in so perfect and masterly a fashion that no description can possibly do justice to its beauty' (Bouvier, 1972:50). Meanwhile, the sub lanes inside the neighbourhood between two horizontal paralleled lanes also help to achieve a legible place and also increase the quality of penetration to the neighbourhood.

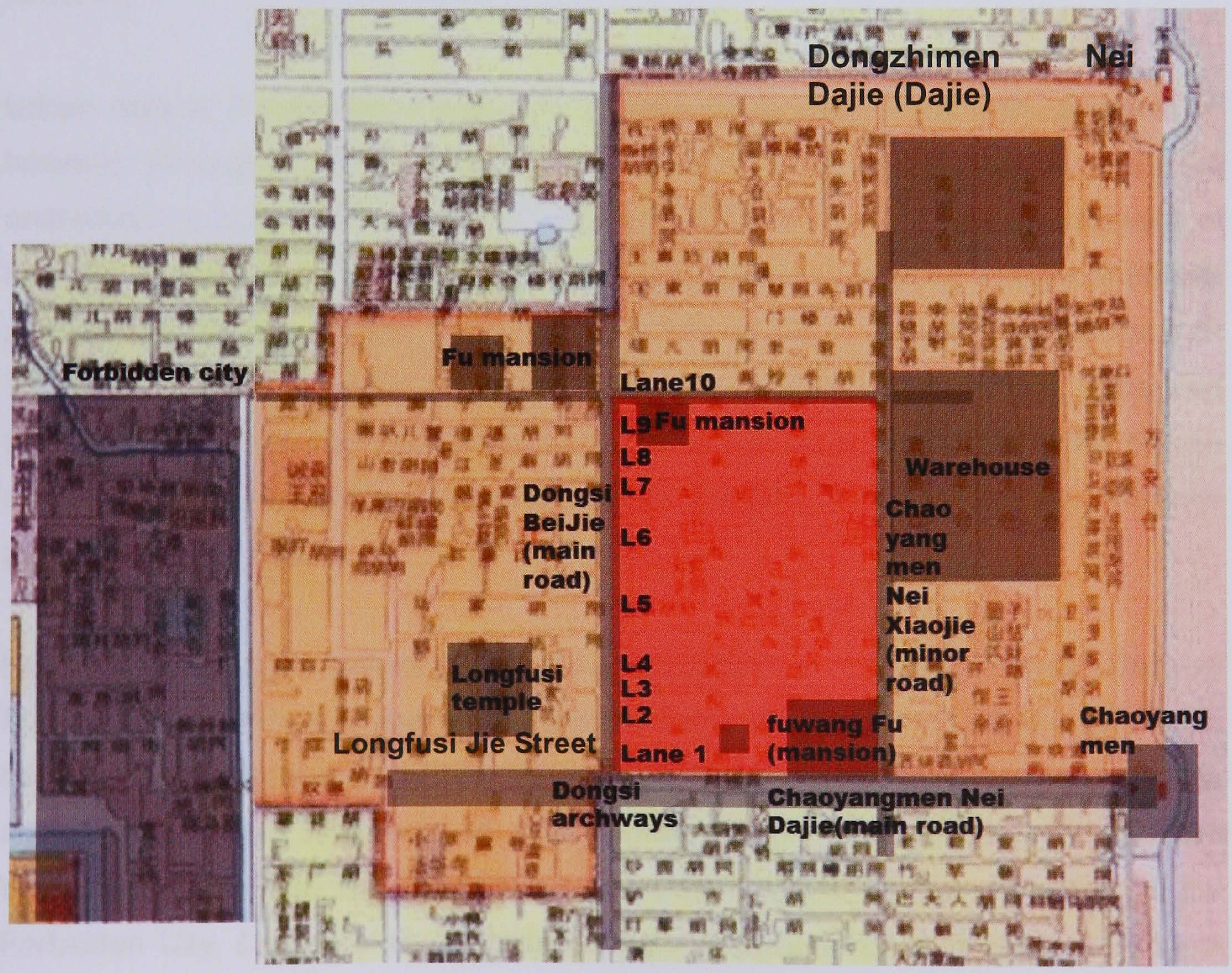


Fig.5.9 The edges of the neighbourhood
Sources: *Qing* Authority:1750
Note:1 *Daciyan Fugong* (Taoist temple)
2: The colour orange represents the *Dongsi* district

Edges: The studies in Chapter 3 have indicated that the urban edges have been used to record distinct limits to the neighbourhood with different patterns of use and visual characteristics. Therefore, the commercial street *Chaoyangmen Nei Dajie* (main road) and *Dongsi Beijie* (main road) are the most important edges to the studied field. *Chaoyangmen Nei Xiaojie* (minor road) between the east side imperial warehouse and the studied neighbourhood is another important urban edge to the neighbourhood. There is no fundamental difference between both sides of lane 10, which has been traditionally used as the direct link road between the Forbidden City and the imperial warehouse, therefore, many shops have been created along both sides of this lane as well. However, contrasting with the other neighbourhood edges, lane 10 is still a vague urban edge to the neighbourhood (Fig.5.9).

Urban district: As the above studies indicated, 1st through 10th lanes traditionally belong to the border of White Banner district in *Qing* dynasty (1644-1911), and here the common characteristic of the district mainly focuses on the social cultural domains.

Urban nodes: the *Dongsi* archways that have been used to mark the intersection between *Chaoyangmen Dajie* (main road) and the *Dongsi Beijie* (main road), the archways of *Longfusi jie* (east side of the Temple Street), the front public courtyard of *Daciyan Fugong Taoist* temple (inside the neighbourhood) and the *Longfu* Si temple (outside the neighbourhood) all can be identified as the main urban nodes for both the local residents and the visitors. These urban nodes with rich physical, social and cultural contexts are the main strategic foci for public gathering, commercial, leisure activities and so on, which were traditionally identified by the archways, entrance gate, buildings and so on.

Landmarks: *Dongsi* archways (Fig.5.10), *Longfusi Jie* (street) archway, *Daciyan Fugong Daoist* temple, *FuwangFu* mansion, and the *Fu* mansion at lane 10 (which can only be recognized in 1750's map) all can be viewed from a distance and also acted as a 'point reference' to the neighbourhood. Furthermore, some urban landmarks outside the neighbourhood such as the *Jing* Hill located at the back of the Forbidden City, *Duanqirui Fu* Mansion, *Longfu Si* temple, *Chaoyang Men* (gate) all can be seen from the neighbourhood and also can act as important reference landmarks in the neighbourhood. All these landmark buildings provide a strong identity and direction to the urban neighbourhood. From the focus groups studies, the landmarks for the local residents of the neighbourhood can be personal, 'a product not of their visible physical characteristics, but of meaning or use' (Stevens, 2006:810). From these personal indications points, it is easy to say 'I am outside the city', 'I am inside the city' (Cullen, 1960), 'I see the building's roof of *Fuwang fu* mansion', 'I am approaching *Dongsi* archways', 'I am passing *Dongsi* archways', 'I see the *Jing Hill* of Forbidden City' etc. Furthermore, the *Chaoyang Men* (gate) and *Dongsi* archways have also been used to necessarily control the urban space (Fig.5.11).

Generally, the focus group studies and also the urban five physical elements have provided the fundamental physical urban structure of the neighbourhood, both conventionally and dynamically. This part of the recovery of the physical urban elements of the neighbourhood provides an important base for the following social culture values studies of this neighbourhood.

Chaoyang Men
Source: Fu, 2003:65

Chaoyangmen Nei Dajie (main road) view from *Chaoyang Men* (gate), Beijing in1872
Source: Durham University oriental museum exhibition in 2004

Dongsi archways: View to *Chaoyang Men* in 1950's
Source:http://bj.house.sina.com.cn/exhibit/oldbj/13.shtml

Fig.5.10 The urban landmark buildings

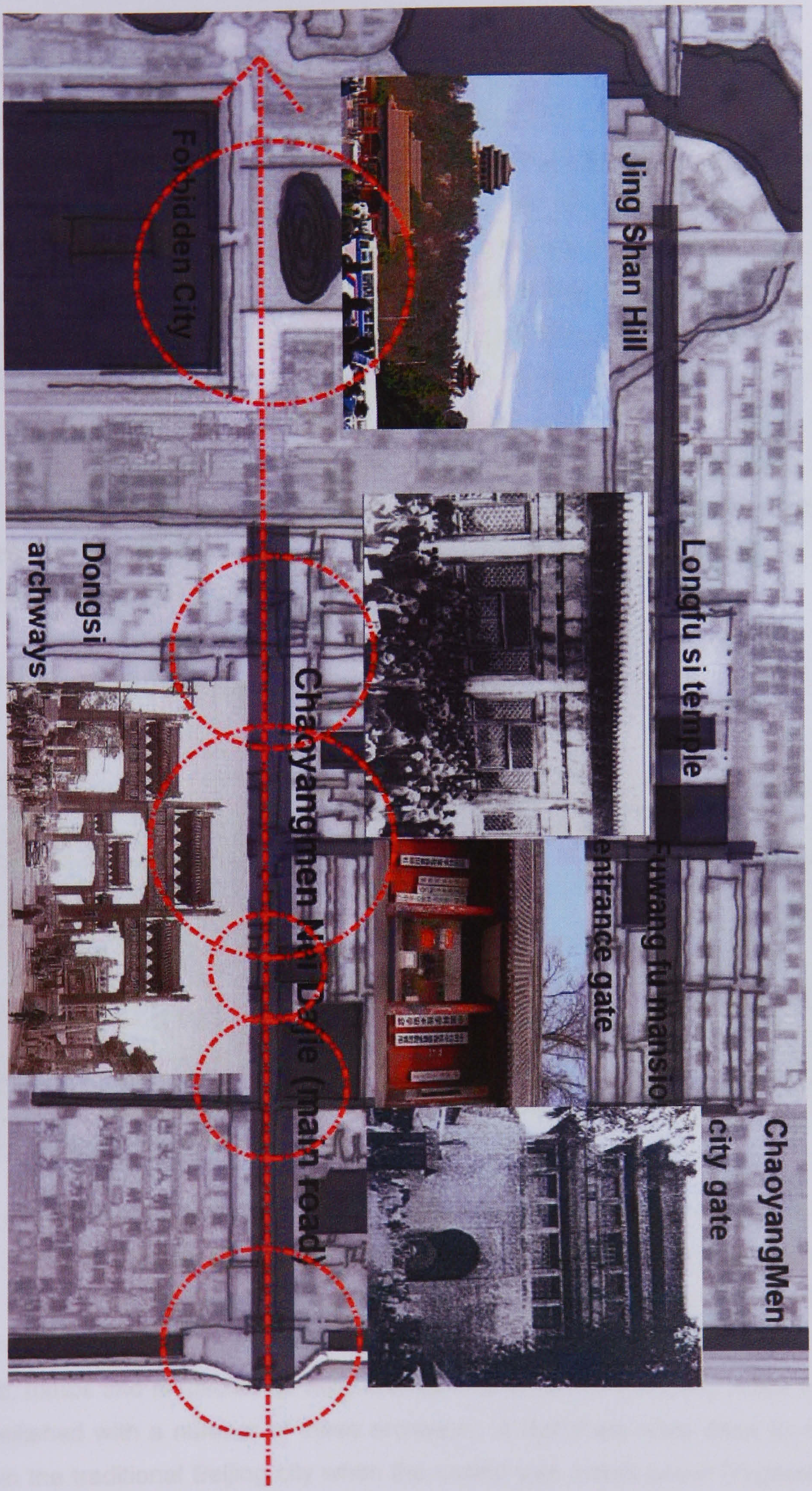
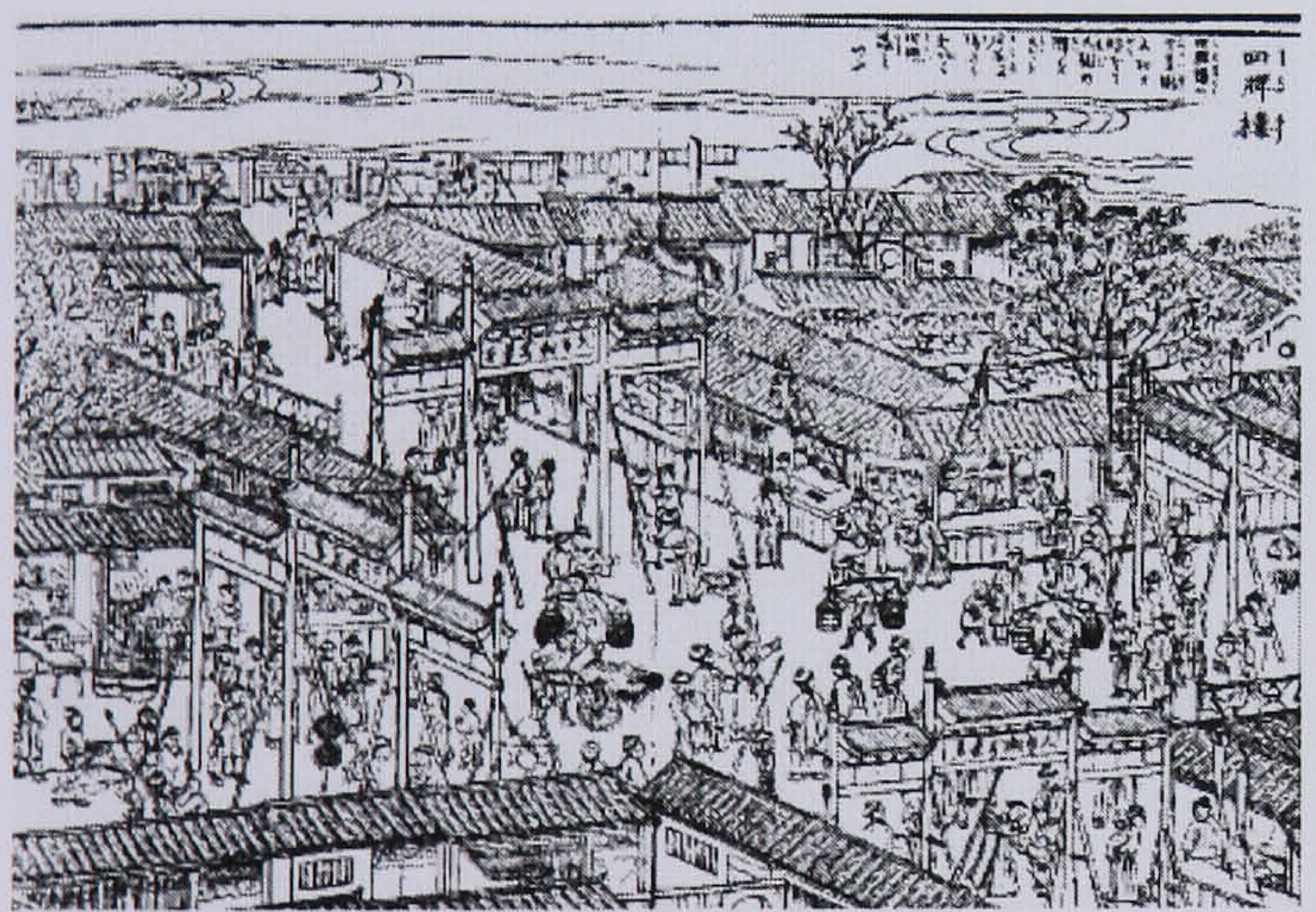


Fig.5.11 External route links from the *Chayang Men* (gate) to the central axis

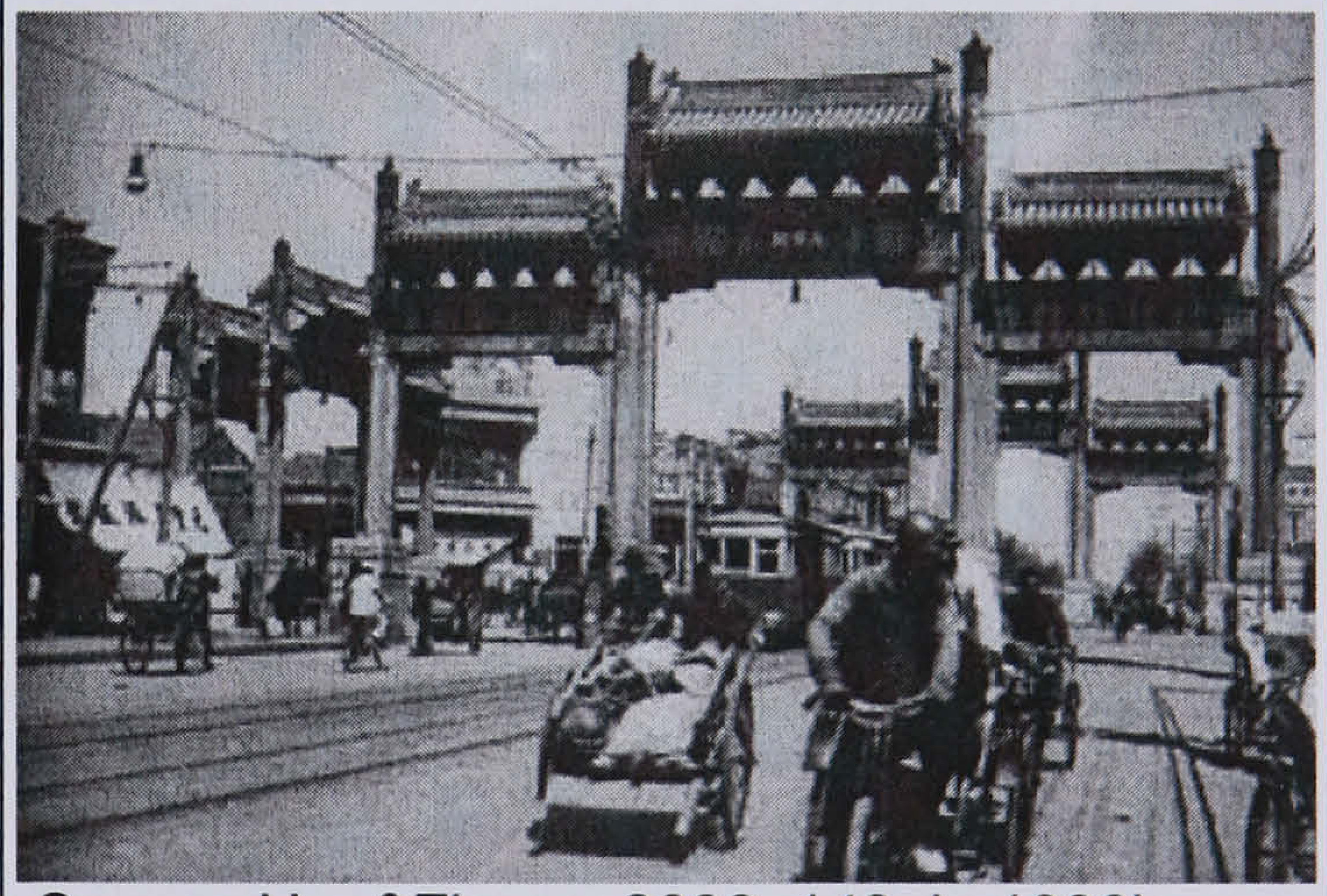
5.5 Social culture contexts studies

As the above studies indicated, *Dongsi* area was one of the three economic centres of the ancient city of *Dadu* (Beijing) and was identified by the *Dongsi* archways of the *Yuan* dynasty (1271-1368). The craft, commercial and international businesses were much more developed during this period. During the first years of the *Ming* dynasty (1368-1644), the government built thousands of commercial buildings to encourage people to live and work in the *Dongsi* area, in the imperial warehouse which included the granaries (large amounts of grain were brought in from *Zhejiang* Province to the capital to serve the imperial palaces and gardens) and goods stores in the late *Ming* and early *Qing* Dynasty (1644-1911). The holding of the *Daciyan Fugong* (Taoism temple) fair and *Longfusi* (temple) fair have all greatly enriched activities in the neighbourhood socially, culturally and economically. Meanwhile, the rich culture and prosperous economy also attracted many businessmen to live in *Dongsi* area both for economic reasons and rich social cultural reasons.

5.5.1 *Dongsi* archways



Source: Dongye(Japanese),pained in 1800's



Souces:Hua&Zhang, 2000: 149, in 1930's

Fig.5.12 *Dongsi Pailou* (archways)

The *Dongsi* Memorial archways were first built in Beijing during the Yuan Dynasty (Fig. 5.12). Archways can be made of wood, brick or stone, with or without glazed tiles, often carrying inscriptions on the middle beams. Archways normally stood where thoroughfares, crossroads, shrines and temples, government offices, bridges, parks, tombs and mausoleums were located and so on. Almost every major road was embellished with a number of these archways, in fact there were once as many as 120 in the traditional Beijing city when the capital was rebuilt under Emperor *Yongle* (reigned 1403-1424) in the Ming Dynasty. *Dongsi* memorial archways and *Longfusi* temple street archway were tall-roofed gateways that towered over the city's streets and carried inscriptions to propagate the nearby wards and also the road they marked. *Dongsi* archways were used to identify the *Sicheng Fang* ward (east side), *Renshou Fang* ward (west side), *Baoda Fang* ward (north side) and *Mingzhao Fang* ward (south side). Furthermore, four archways were erected over these two main roads, the northern and southern archways also bearing the inscription 'Great City Street'. In the Ming and *Qing* dynasties, the north-south road running through these two arches was still called *Dashi Jie* Street (Great City Street and currently called *Dongsi Beijie*). The eastern archway was also inscribed with the words *'Luren'* (Perform Benevolent Deeds) and the western gateway with *'Xingyi'* (Perform Righteous Deeds). The four gates together became known as *Dongsi Pailou* (Eastern Four Archways). However, a house in the neighbourhood caught fire in 1699, spreading to all four gateways and destroyed the *Dongsi* archways; they were rebuilt in the same style soon after the fire. The traditional *Dongsi* archways were demolished in 1954 because of the modern transportation requirements.

Generally, archways are one of the most important urban landmarks which have shaped the urban space both physically and socio-culturally. Archways also work as an important spatial transition point to the urban space, which clearly helps to indicate our geographical position in the urban built environment. The Archways also had important social culture significance; they helped to identify the urban neighbourhood and many other important urban buildings and urban spaces in traditional Beijing. Meanwhile, the inscriptions, the form of the buildings and the colour applied a unique visual, social and cultural context to the neighbourhood, and also added richness to the urban space.

5.5.2 Temples and temple fairs

As the studies in Chapter 4 indicated, Daoism was not just a way of Chinese thinking about the universe, but also a practical religion, using '*Wuwei*', 'inner calm', 'working in harmony with nature' and so on. *Daciyan Fugong* Taoist temple was built for Taoist practice and has existed for six hundred years. Meanwhile, the nearby *Longfu si* Buddhist temple also performed similar uses and existed for many hundreds of years. Furthermore, the temples did not just act as the foci of religious worship, but also attracted social and commercial gatherings of varying sizes. Temples and temple fairs and festivals were regularly organized at these locations, on monthly and annual cycles with key dates specified on the calendar. For most of the time, the temple was open to the public for anyone to come in, to consult one's fortune and to pay tribute to the Gods individually. Meanwhile, the temple fairs in Beijing were also a show of popular culture in traditional Beijing; temple fairs provided an event for people, gathering and training a large number of people such as folk artists, local operas, acrobatics, juggling, minstrels, storytelling, songs and dances performers for these events. At the same time, they attracted huge numbers of visitors who came to entertain themselves. The temple fair was the epitome of local culture. 'As the urban population grew under the Qing, so did the number of temples, increasing by ten or twenty each decade, from 440 within the walled city in 1644 to 636 in 1800. Growth was slower in the nineteenth century, and I can count just 700 temples in 1880. Altogether, including the suburban areas, I have identified more than 2,500 temples that can be documented in Peking between 1400 and 1900' (Naquin, 2000:19-20).

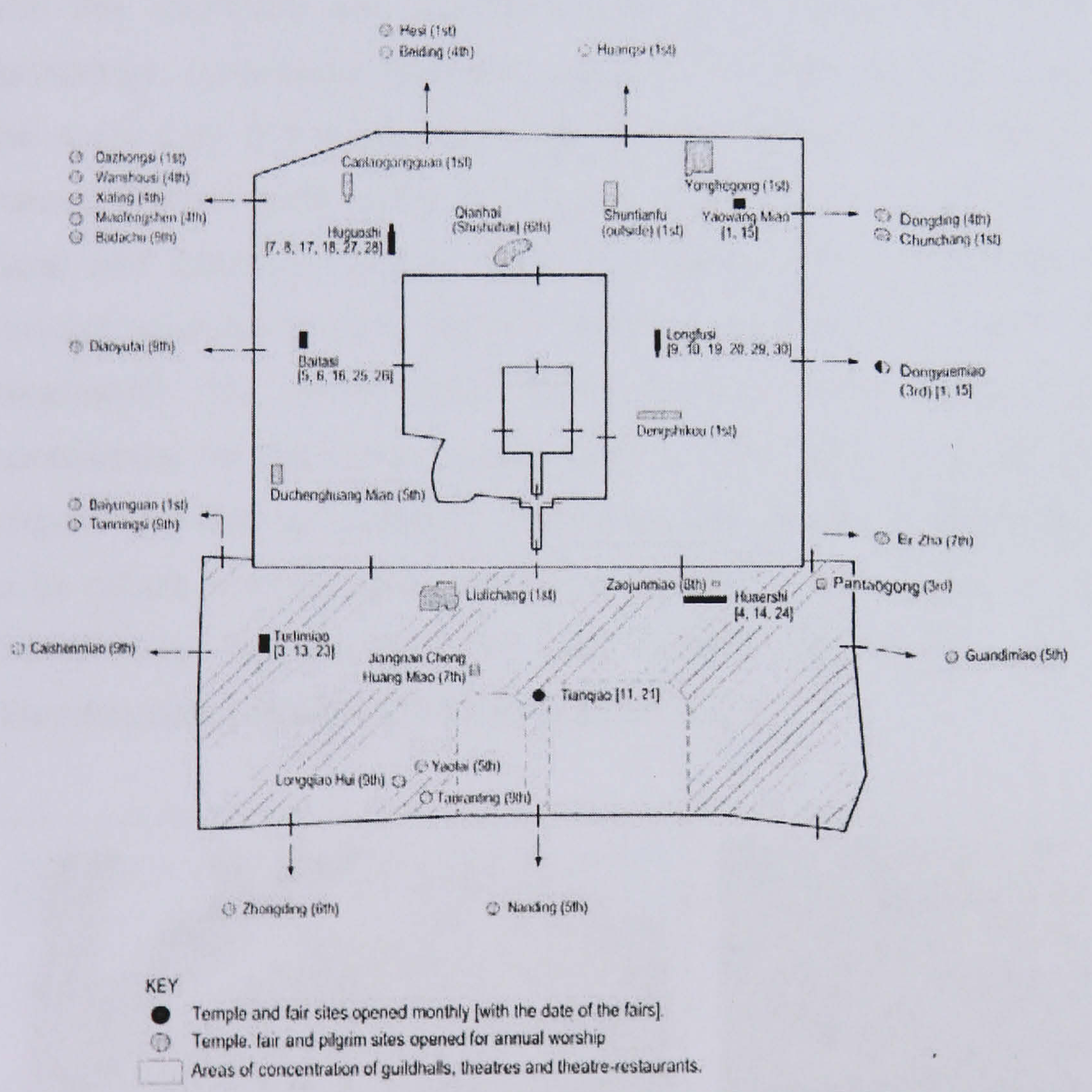
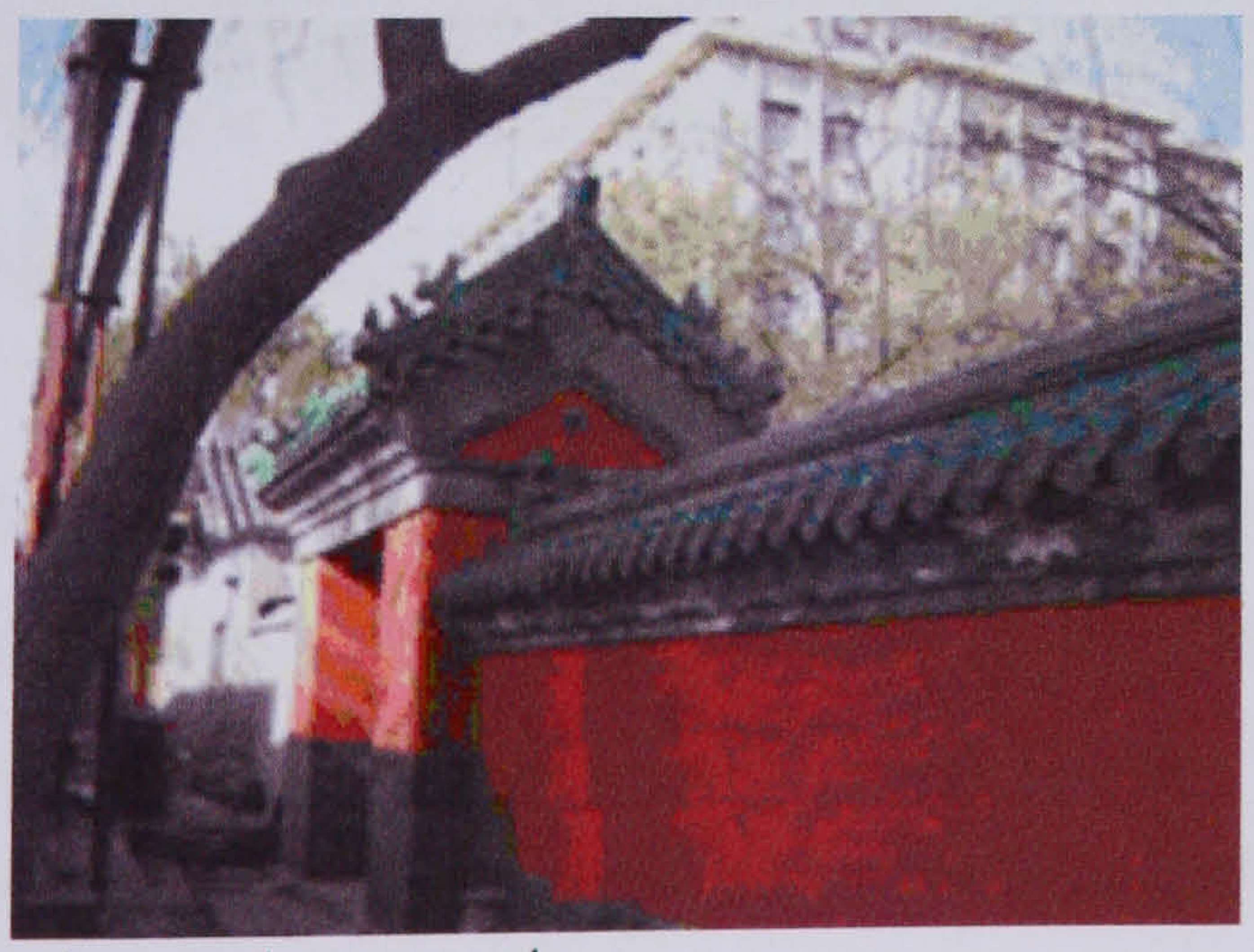


Fig.5.13 The temple fairs in traditional Beijing
Source: Zhu, 2004:81

Locations for holding temple fairs in Beijing were rather scattered, so that they were usually within walking distance of the local residents. There were two types of temple fairs, regular and irregular. The former was held at a fixed time for instance, on a fixed date or two consecutive days in every ten days. Peddlers had their fixed stalls too. The most representative temple fairs of such a fixed nature in the early 20th century were the fairs of the Eastern *Longfu Si* Temple and the Western *Huguo Si* Temple.In addition to these, there were fairs at the White Pagoda Temple, Peach Palace, *Dongyue* Temple, etc (Fig.5.13).

5.5.2.1 Taoist temple: *Daciyan Fugong*

Daciyan Fugong Taoist temple was located behind the *Chaoyangmen Nei Dajie* (main road), and was originally built in 1481 in the Ming Dynasty (1368-1644). From the literature (*Tian*, 2001), it is clear that the courtyard temple had two north-south orientated axis. The seven bay main entrance gate faced *Chaoyangmen Nei Dajie* (main road). When you entered the first courtyard, you would come to the bell tower and drum tower which were located on the east and west sides of the first courtyard. Three bay main buildings were then located at the north side of the first courtyard, and this courtyard was normally open to the public for the temple fairs, public gatherings, commercial activities and so on. A five bay main mansion was located at the north side of the second main courtyard (Fig.5.14). There are three important natural (Taoist) gods inside the temple; the *TianShen* (Heaven God), *DiShen* (Earth God) and *ShuiShen* (Water God), and these *Daoist* gods represented those who brought good fortune and dispelled bad fortune from the country and also the person. Meanwhile, the temple also attracted many visitors and prayers after it was constructed. In the Qing dynasty (1644-1911), this Taoist temple was temporarily transformed into an education institution, until Qianlong Emperor ordered the temple to be rebuilt in 1771, and opened the temple fair on the first day of each New Year. Traditionally, this temple fair was famous for selling second hand clothes (transformation studies will be in Chapter 9. 2.1).


A minor entrance gate

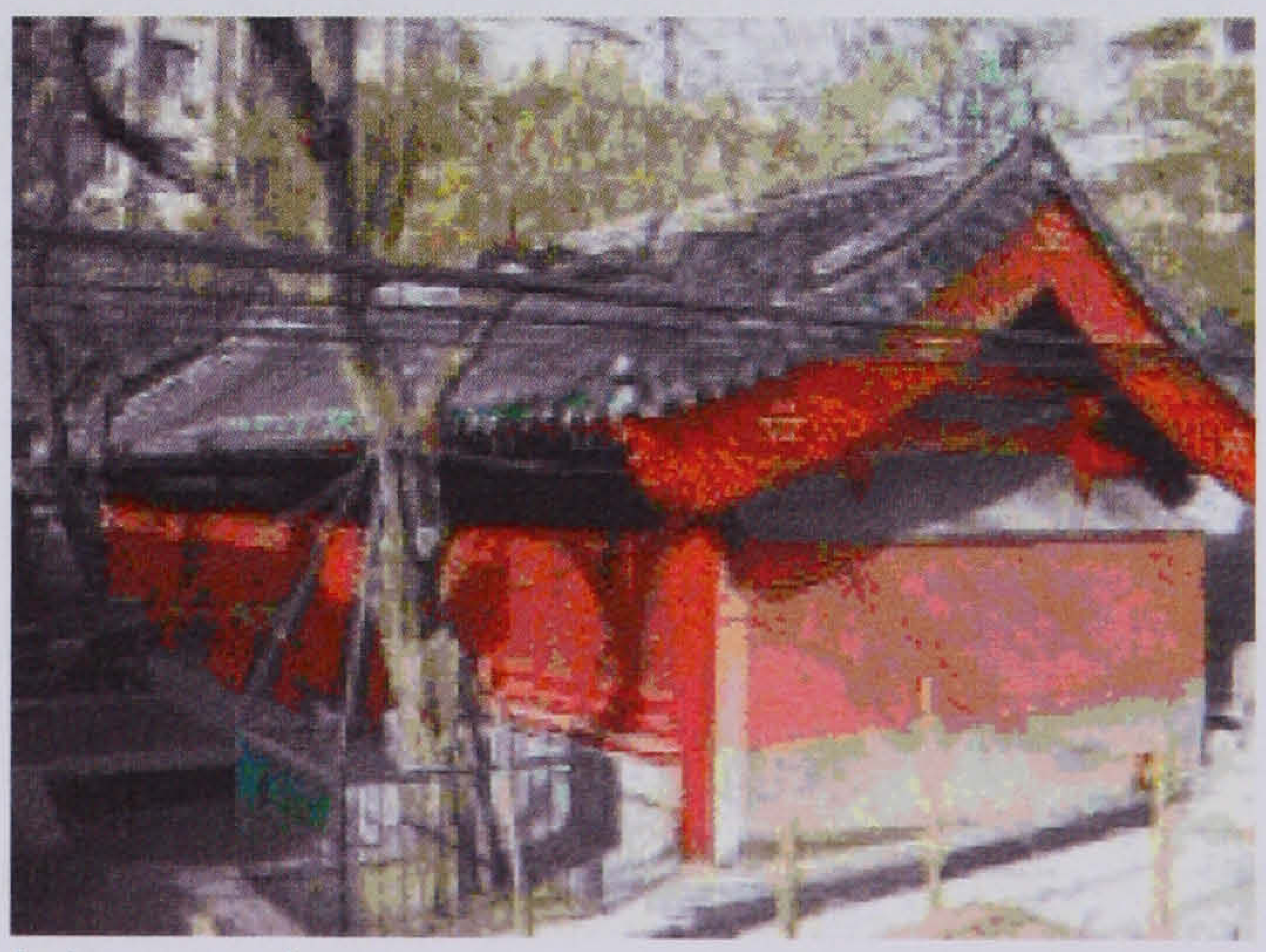

Main mansion

Fig. 5.14 The ruins of *Daciyan Fugong* (Daoist mansion)

5.5.2.2 Buddhist temple: *Longfu Si* temple

Longfu Si (temple) was located at the west side of the case study area, and linked with the neighbourhood by *Longfusi* Street Archway which was located at the intersection of *Longfu Si* (temple) Street and *Dongsi Beijie* (main road) (Fig.5.15). The temple fair strongly shaped the studied area both social-culturally and economically. Therefore, this part of the study will also briefly introduce the *Longfusi* temple and also its social-cultural context, which will help to explain part of the neighbourhood's wider socio-culture context.

The *Longfusi*, Temple of Abundant Blessings, founded in the *Ming* Dynasty (1368-1644) in the eastern section of the Northern City, was much larger than any temple so far mentioned. The history of *Longfu Si* Buddhist temple can be traced back to 1425 in the Ming dynasty (1368-1644) when it was first constructed following the authorization of the *Ming* Emperor, and then rebuilt in 1731 in the *Qing* dynasty (1644-1911) and named *Dongmiao* (East temple). The temple was once destroyed by fire in 1900's, but the place, including the temple fairs survived until 1960's before it was transformed into a public market.

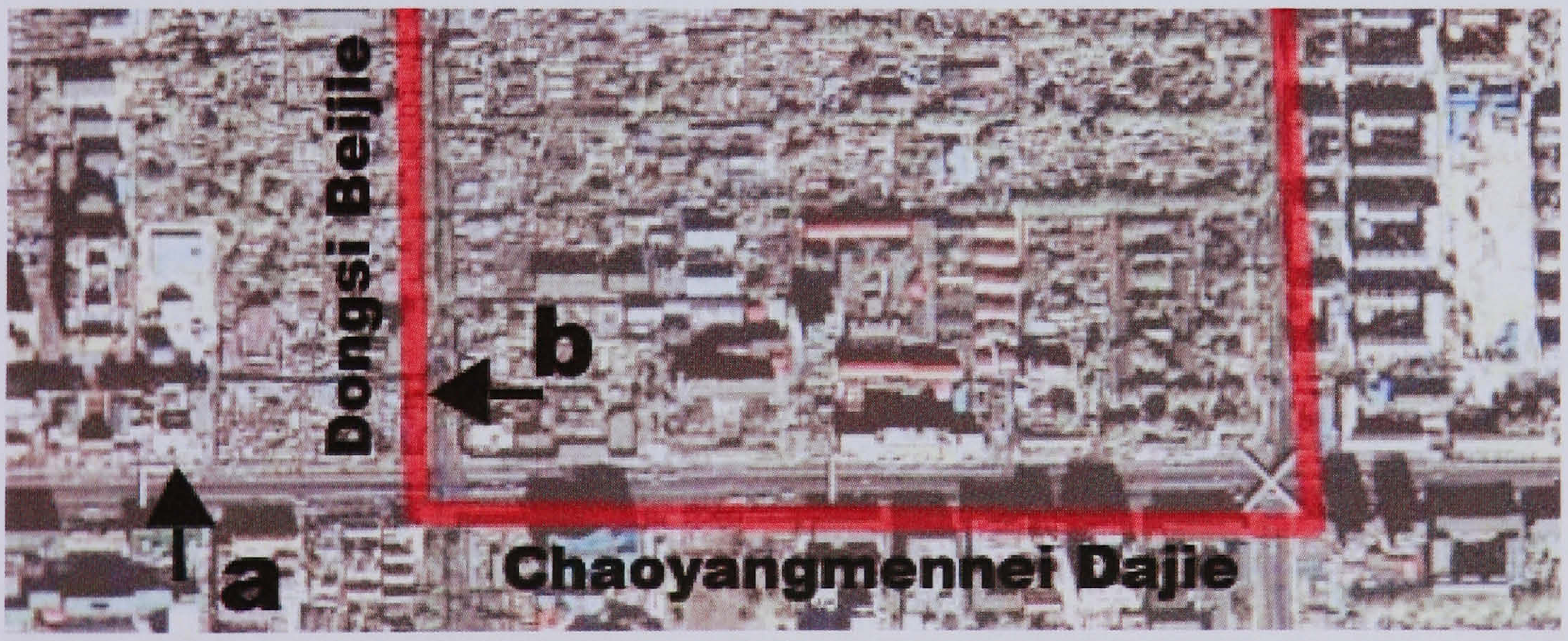
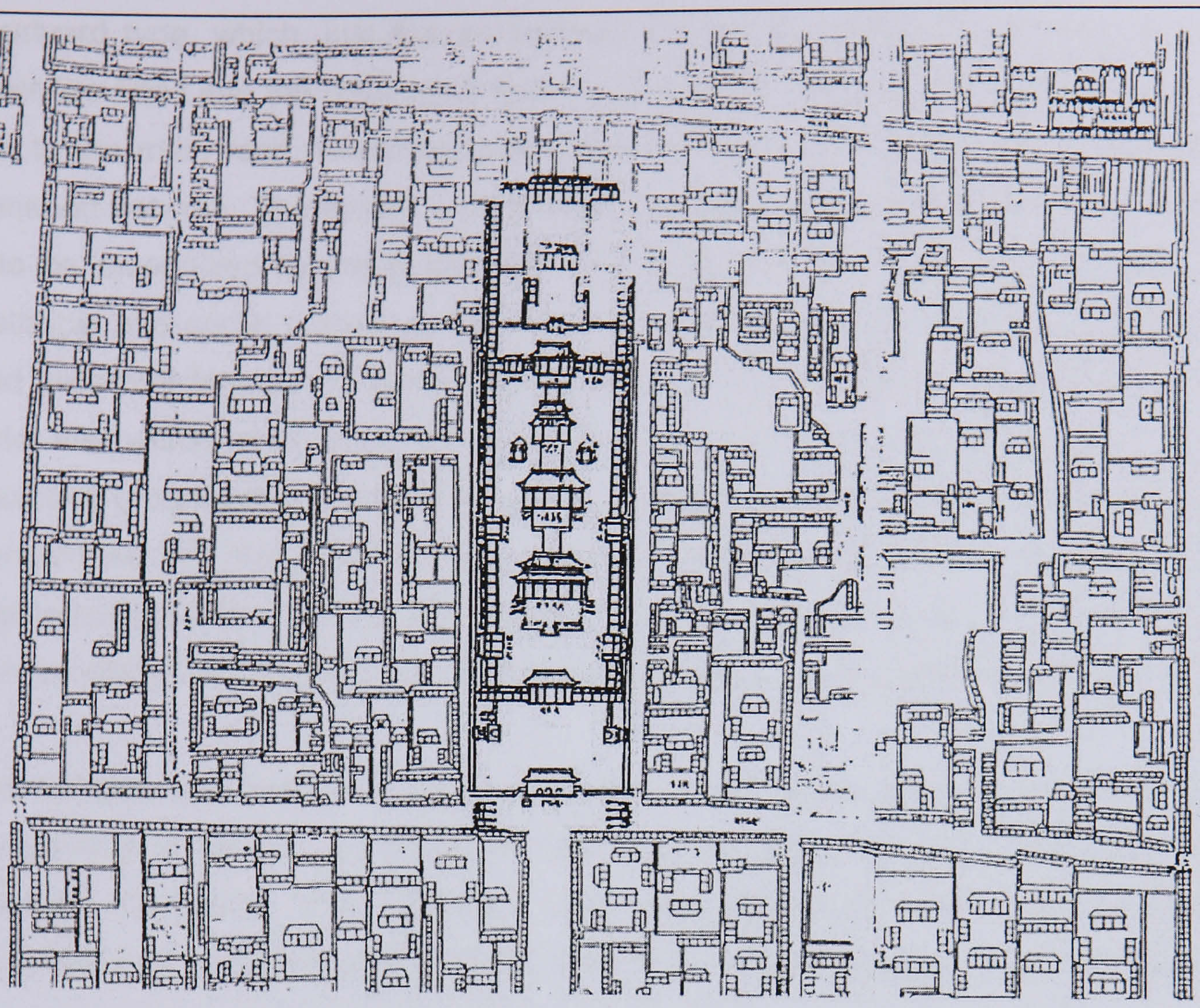


Fig.5.15 *Longfusi* temple

The most important function of a temple was the religious use, on a god's birthday, when clerics were busy in one of the temple's halls or courtyards, visitors filled the remaining space. Such holy days involved crowds, goods, parades, and entertainment as well as rituals known as 'temple fairs'. Descriptions of these festivals were phrased in clichés about people gathering like clouds, coming in unbroken processions, filling the lanes and clogging up the streets, and clamouring and crowding into the courtyards. Sometimes the crowds were indeed so great that the god's birthday came to be celebrated over a period of days, even weeks. The scale of *Longfu Si* Temple Fair exceeded all temple fairs in Beijing and was held on every 9th and 10th, every 19th and 20th and every 29th and 30th of each Chinese month (Fei, 1924). There stood two sets of wooden *pailou* (ceremonial archways) outside the main entrance gate, and the entrance to the *Longfusi* temple street was also identified by the archways (Fig.5.15: top). It is very difficult to find evidence or a description of the temple fairs before 1900, but a sketch from a survey in 1936 before the demolition of the temple and temple fairs can provide a vivid image of the temple fair; 'stalls were set up not merely in every central and side courtyard, but also up and down the street that ran in front of the temple. At that late date, it had more stands (946) than any other periodic market. Clothes, jewellery, and food sellers were the most numerous, but one could buy furs, fish, flowers, potted plants, antiques, watches (even in the eighteenth century), snuff bottles, and little dogs' (Naquin , 2000:631). Meanwhile, *Wen Ouhong*, a renowned playwright of Peking opera who went to *Longfu Si* (temple) fairs in 1930's, has contributed a vivid description of the neighbourhood:

*The main ground of Longfu Si has three pathways. When you enter the main entrance and follow the central pathway, you come to the ruins of a Buddhist hall. Here there is a large but neat market. Displayed on the first level which is close to the entrance, are things like baskets, dustpans, chicken feather dusters, steamers, washing boards. On the levels behind it are places for performances. In between those performing arenas are stalls selling doughier, a fermented drink made from ground beans, pig head meat, bean curd with sauce, cakes, pan-fried sausage, broth, etc. On the final level there are fortune tellers, palm readers; vendors selling foreign cigarette pictures, etc. On the western pathway, as soon as you enter the gate, you will see a stall selling rice cakes. Next to it is an arena selling golden fish. To go further north along this pathway you would come to several fairly large stalls selling 'antiques'.There are a few stalls selling unique articles. One is specialized in shuttlecocks. One stall sells string holders of Chinese fiddles. They are carved bone or ivory and bamboo, looking most exquisite and refined. Another stall sells something called 'cotton cats'. Cotton is used to make cats and dogs to be pasted on a piece of paper. It is rather fun. Another sells snuff bottles with pictures painted inside. Apart from ordinary figurines, there are stage scenes of Peking operas. One could even recognize the renowned actor Tan Xingpei in costume (*Naquin, *2000).*

In addition, *Longfusi* temple also acted as an important repository for holding stone inscriptions, book collections, garden exhibitions in the spring and summer months, and it further provided relief to the poor, was used as guilds (the gathering place in the capital for visitors from the same place in China) and so on. For the above studies, temples and temple fairs played a special role in tying Beijing together and linking it outward. Salesmen and entertainers accompanied religious festivals, promoting cultural as well as economic integration.



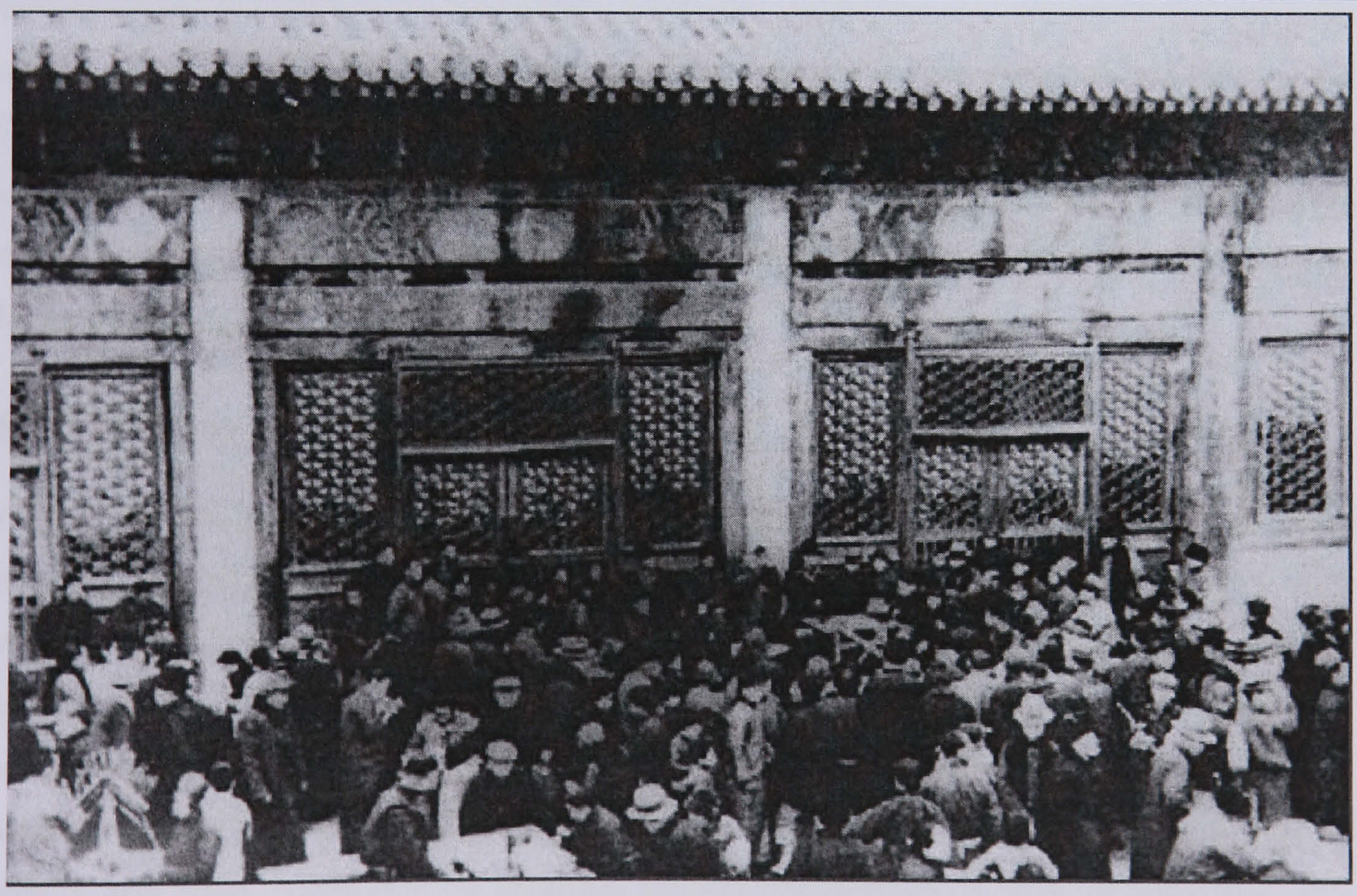


Fig 5.16 *Longfu si* (temple) Street (top), *Longfusi* temple with its surroundings in 1750, (bottom) photo in 1930's
Sources: top: *Xinyayuan* Institue (1940); bottom Wang,Z., Fan,J.W. & Chen, J.B.(2002)

From the above studies, we can see that the temples also used the quadrangle courtyard type, which, just like an ordinary courtyard building (larger scale), could easily be fitted into the urban grid system. The temple always had a strong or direct link to the main road, which secured a good integration with the rest of the urban transport network. The temple was normally identified by the archways which helped it to be recognized by the public and meanwhile, the archways also indicated the historical and social culture contexts of the temples. Courtyards were an essential and important feature of Chinese temples. They were the empty spaces inside the outer wall within which halls were built. They varied in size and shape but provided enclosed grounds that could be put to a variety of uses. The temples can easily be transformed into the palaces, lecture rooms and many other uses, and even the residential buildings, 'in fact, the design of palaces, temples, and residences was in general similar and indeed, in use, they were quite interchangeable' (Lip, 1993:123).

The temple fairs were the most important public social event, and the temple compounds were also an important urban public space for public gathering in a Chinese traditional city. 'Temples were overwhelmingly the most important component of public space in Chinese cities in the late imperial era, and they had, as a consequence, an importance at least as great as churches, mosques, and synagogues elsewhere in the world' (Naquin, 2000: xxxi). The temples and the surrounding streets always formed a local social, cultural and economic centre. Particularly at the time of the temple fairs, the boundaries in the area were thrown open. At the *Longfu si* temple, the fair spilled from the inner courtyard to the front courtyard, the front recess space, and the streets nearby and further onto the sides of large avenues nearby.

5.5.3 *Hutong*

Hutong (lanes and sub lanes) was the basic path for the neighbourhood. *Hutong* was a word first used in the *Yuan* Dynasty Opera *Dandaohui* (Guan, 1240 -1310). There are different sayings about the origins of *Hutong;* the most common saying is that the word '*hutong*' originates from the word '*hottog*' which means 'well' in Mongolian, where the villagers dug out a well and inhabited the area around it, which itself has a very strong community context formed by the social behaviour. During the growth of towns and cities, wells dug by villagers formed the centres of new communities (Wu, 1999). The other saying interprets *Hutong* as a word from the *Yuan* Dynasty's pronunciation of City *HaoTe* and then translated into Chinese as *Hutong*. According to the archive document, there were 413 *Hutong* in the Yuan dynasty (1276-1368) in

Beijing, and 1170 during the *Ming* Dynasty (1358-1644), increasing to 2076 during the *Qing* Dynasty (1644-1912) (Zhu, 1982). Here in the 1st through 10th lanes of *Dongsi,* neighbourhood *hutong* (lane) has been used as one of the most important public places for residents to live in and communicate with each other. The enclosure space that was provided by the row of different types of the front buildings and entrance gates was also able to create a place to hold the peddlers, communities, social activities, play grounds and so on.

'In the *hutong*, which generally follow the grid pattern on which Peking was designed, only doorways break the flat wall surface. Topped with a trim of tiles, more or less ornamental according to the size of the house inside, the doors themselves are often of a plain wooden beauty, opening to reveal a screen of wood or ceramic which conceals the courtyard beyond, preserving the privacy of the house' (Cameron & Brake, 1965:35). Along a *hutong* such as lane 8, there were different types of entrance gate, which gave a strong identity and richness. Except for in the main lanes from lane 1 to lane 10, there were also many smaller *hutong* (sub lanes) helping to link these main *hutong* together. These sub lanes have different interesting names, such as *yueya* (moon) *hutong* near lane 5, *banqiao hutong* (slab bridge), *shiqiao* (stone bridge) *hutong* and *liushui xiang* (flow water bridge), which may indicate that there was a water course nearby (at the east side of lane 4 and lane 7). Generally these names of sub lanes followed the name of the local famous nobles, officials, markets, temples, shops, geographical sites and so on. The north-south oriented sub lanes encouraged the visitors and residents to explore the place, and also helped to achieve a good quality of penetration to the neighbourhood. The *hutong* also played an important role in allowing all kinds of door to door services to approach each household, such as the water supply and rubbish collection and it also allowed the pedlars to sell their products and provide their service as well. Generally, the *Hutong* was the most important reception place for all kinds of courtyard dwellings whether of the rich and poor, the noble or ordinary resident; they all used the same *hutong*.

5.5.4 The entrance gate

Traditionally, the entrance gate was the most important and also the only linkage point to the external urban environment. The entrance gate normally indicated the social and economic status of each courtyard dwelling. The entrance gate type, decoration, orientation, location, materials, painting, and colour all helped to provide a social cultural foci for each courtyard dwelling (see detailed studies in Chapter 7.3.6).

5.5.5 Summary

This part of the social culture studies has identified four types of social culture foci: the *Dongsi* archways, Temple fairs, *Hutong* and also the courtyard entrance gates. These four types of social culture foci are the main social culture generator inside traditional Beijing; the archways identified the place and gave the social cultural context to the nearby place, the temple fairs created times and places when and where people of all kinds could meet and mix, even if their purchasing power varied greatly. Then *hutong* provided the social gathering place for the local residents and communities, and was the place where rich and poor could meet. The *Hutong* was also used as the most important place for the daily supply route to each family. Finally, the entrance gate to each family provided a social focus for each family, and also created the gate community. The combination of these social culture foci helped to create a fluent and harmonious urban living environment.

5.6 Conclusion

Generally, *Dongsi* 1st to 10th lanes was a neighbourhood that could be physically identified by the historical buildings such as the *Dongsi* archways, *fuwangfu* mansion, *Daoist* temple, traditional shops, gardens, *hutong*, the courtyard dwellings and so on. However, the social culture contexts that accumulated for many hundred of years played an even more important role in constructing the identity of the place. From the above historical and four major social culture foci types studies, the place of the neighbourhood can be summarized as follows: archways and the social culture context, the temples and the temple fairs, *hutong* and the social activities, the entrance gate and the social culture context. Furthermore, the ward system, the Eight Banner system in the *Qing* dynasty (1644-1911), *fuwangfu* mansion, and traditional shops were also mentioned in the focus groups studies or the historical studies. Meanwhile, the guild hall, teahouse, theatres, academics of classical learning, baths and so on have all been mentioned in many other studies and research on the social culture values of traditional Beijing (Fu, etc,2004; Su, 1964; Wu, 1985 &1999; Zhang, 1990; Zhao, 2004). However, it is hard to find direct evidence for this part of the study because of the heavy transformation of the neighbourhood, through it may be recommended for further studies. In general, these social culture foci and also the physical buildings were not separated or isolated from each other in reality; they interacted with each other and helped to achieve a good quality of fluid and coherent urban space which was composed of urban landmarks, urban nodes, temple fairs, festivals and markets, traditional shops, communities, *hutong,* the courtyard buildings and so on.

Chapter 6 Urban morphology studies of 1st through 10th lanes, *Dongsi* neighbourhood

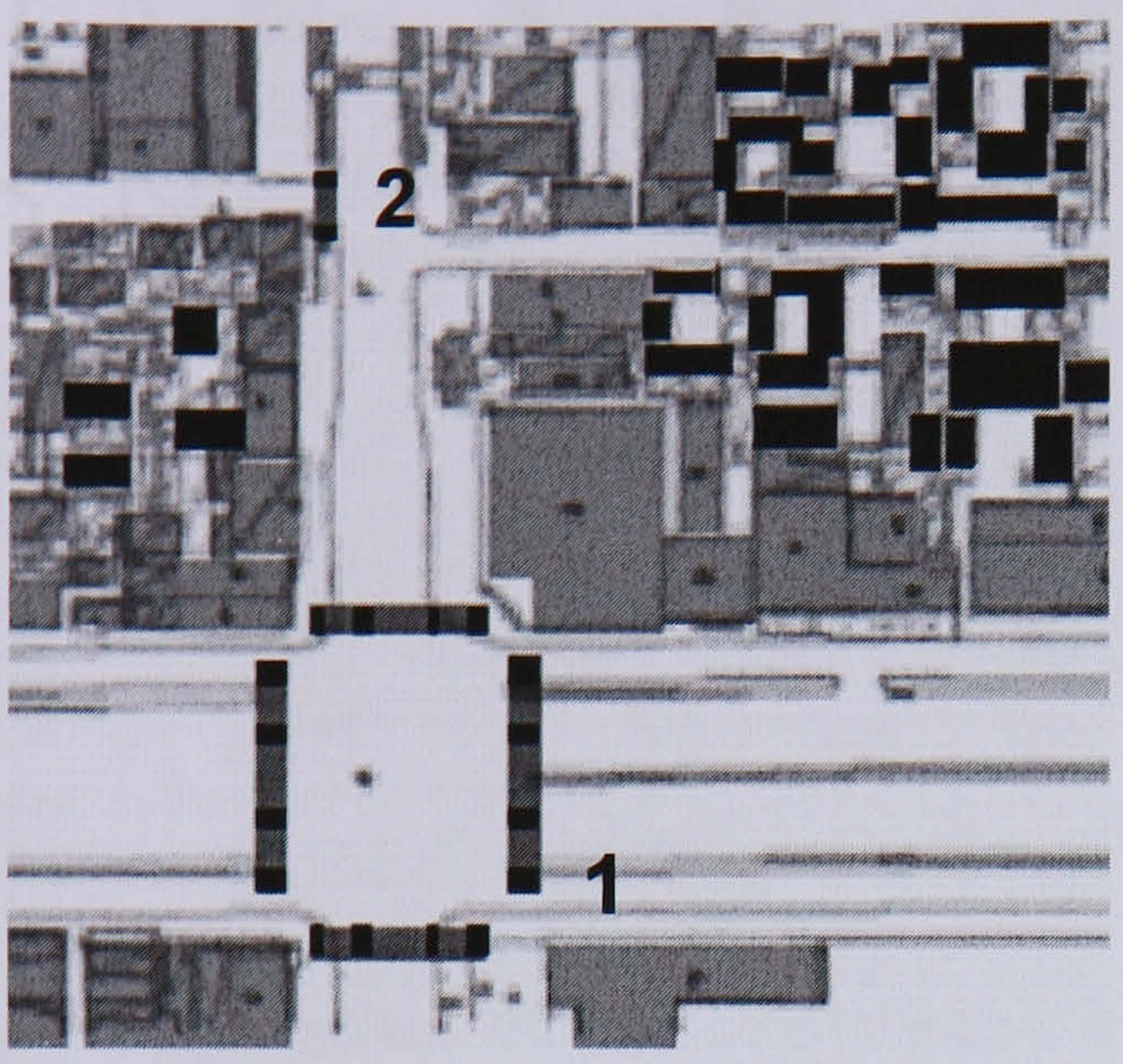
As the urban place studies indicated in Chapter 5, when Beijing was first built in the *Yuan* dynasty (1276-1368), a strictly ideal Imperial City model (*Wangcheng*) was applied to its construction. Each neighbourhood, the size of allotments for the dwellings, the uses, the street patterns, the building patterns and also the spatial hierarchal patterns were strictly regulated and defined by planning codes. Chapter 5 classified these physical urban elements into urban district, paths, edges, nodes and also landmarks based on Lynch's five urban elements. Four types of social foci, including archways, temples, *hutong* and entrance gates have also been studied. However, we know surprisingly little about the detailed fabric that this ideal urban model has created, even although there has been abundant data for hundreds of years, because few scholars have carried out detailed micro urban studies. Currently, as a result of the Chinese traditional urban studies, 'generalizations have been insufficiently grounded in hard data, and plausible assertions have become received wisdom through repetition' (Skinner, 1977:521). Therefore, this part of the study will go further, to concentrate on the physical urban patterns, urban forms and shapes, and also the urban morphological elements and analysis based on evidence from the investigated site, which includes a two dimensional figure ground study on the general urban patterns, and also the urban morphology studies which include the plot patterns, courtyard building types, uses arrangement, street patterns and also the spatial hierarchy studies.

6.1 Figure ground studies

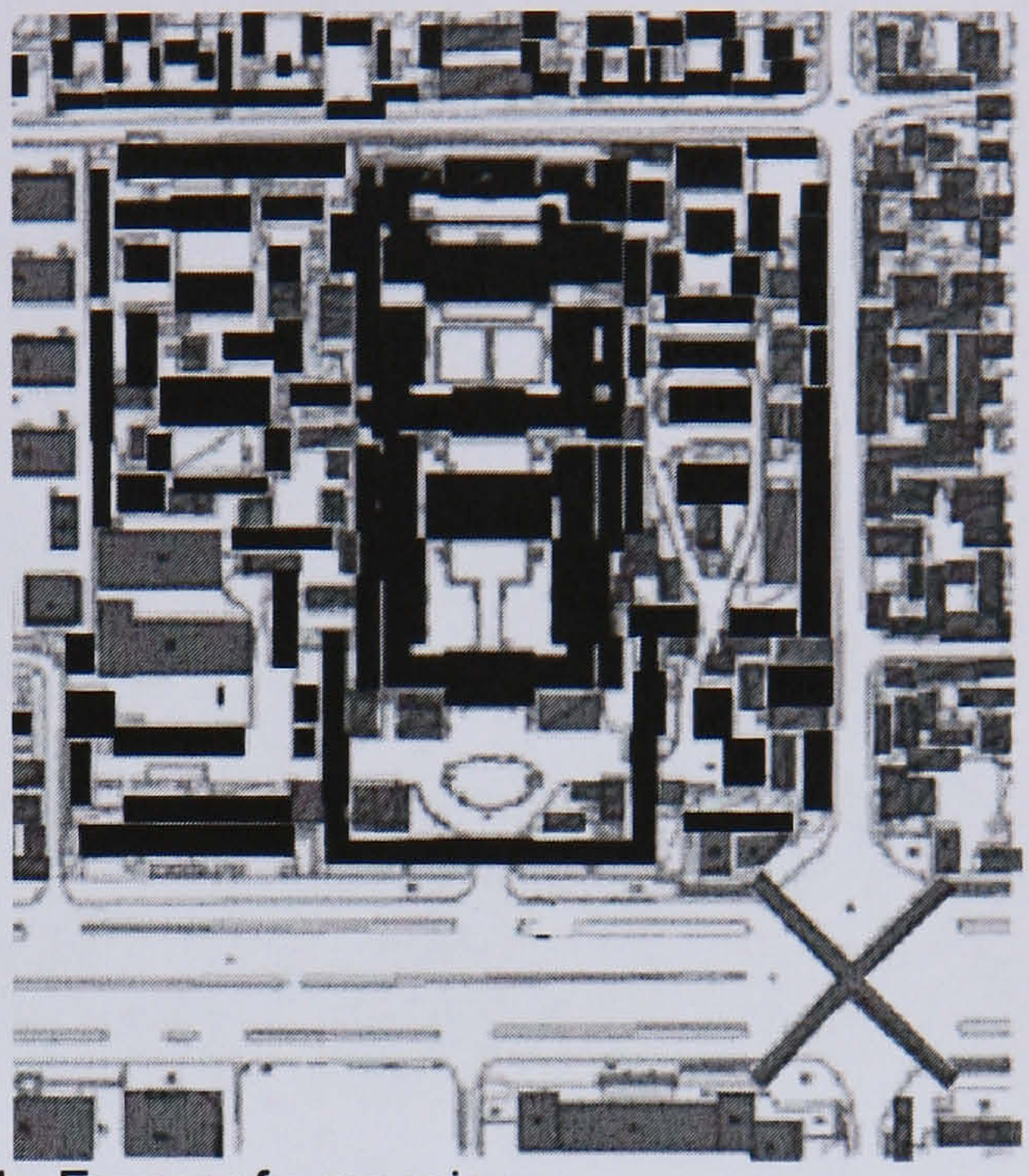
Following the principles of Trancik's (1986) urban fabric studies, the two dimensional urban voids and solid figure ground drawing will help and clarify the general urban structure, urban patterns, and also the urban spatial shape and orientation and so on. In this part of the figure ground studies of 1st through 10th lanes of *Dongsi* neighbourhood, the edge-defining buildings, courtyard building entrance gates, walls, columns and other buildings and buildings elements have been identified as the figures which are indicated in black on the architectural plans[1]. The entry foyers of the courtyard buildings, verandas, courtyards, yards, lanes, sub-lanes, and the main

[1] Some of the new temporary extensions such as the newly built kitchens and showers inside the courtyards will not be included in this figure ground map, but the newly built permanent buildings such as shops, schools, and office buildings will be indicated in grey。

and minor roads have been identified as the voids which were left in blank (Fig.6.1).



1: Position of Dongsi archways and 2 Longfusi temple street archway



b: Fuwangfu mansion

Fig.6.1 The urban solid at 1st to 10th lanes, *Dongsi* neighbourhood
Notes:1: the urban solids have been indicated in black
2: Grey indicates the newly built buildings

Furthermore, according to the locations, scales and forms of the urban solids, the urban solid of 1st through 10th lanes could be classified as follows: (1) The dominant monumental buildings such as *Dongsi* archways and *Longfusi* temple street archway. These buildings provided a clear visual and social culture foci to the neighbourhood because of their significant location in the neighbourhood (located at the entrance of the street or the intersection of the main roads) (Fig.6.1: a); (2) The predominant scale of courtyard buildings such as *Fuwangfu* mansion and also the Taoist temple. These buildings are easily identified from the figure ground map because they normally have a much larger scale than the surrounding urban solids. However, it is very difficult to show all the drawing details of this building type because of the heavy transformation, particularly to the Taoist temple (*Daciyan Fugong*) which has been nearly completely demolished. However the *Fuwang Fu* (mansion) figure ground drawing can still help to give a clear indication of the buildings' scale (Fig.6.1: b); (3) The ordinary urban courtyard buildings. These building groups have formed the recognizable, repetitive, coherent textures of the neighbourhood; (4) Another urban solid is the edge-defining buildings which mainly are different types of shops. These four types of urban solid have worked together to compose different types of urban voids inside the neighbourhood (Fig.6.2).

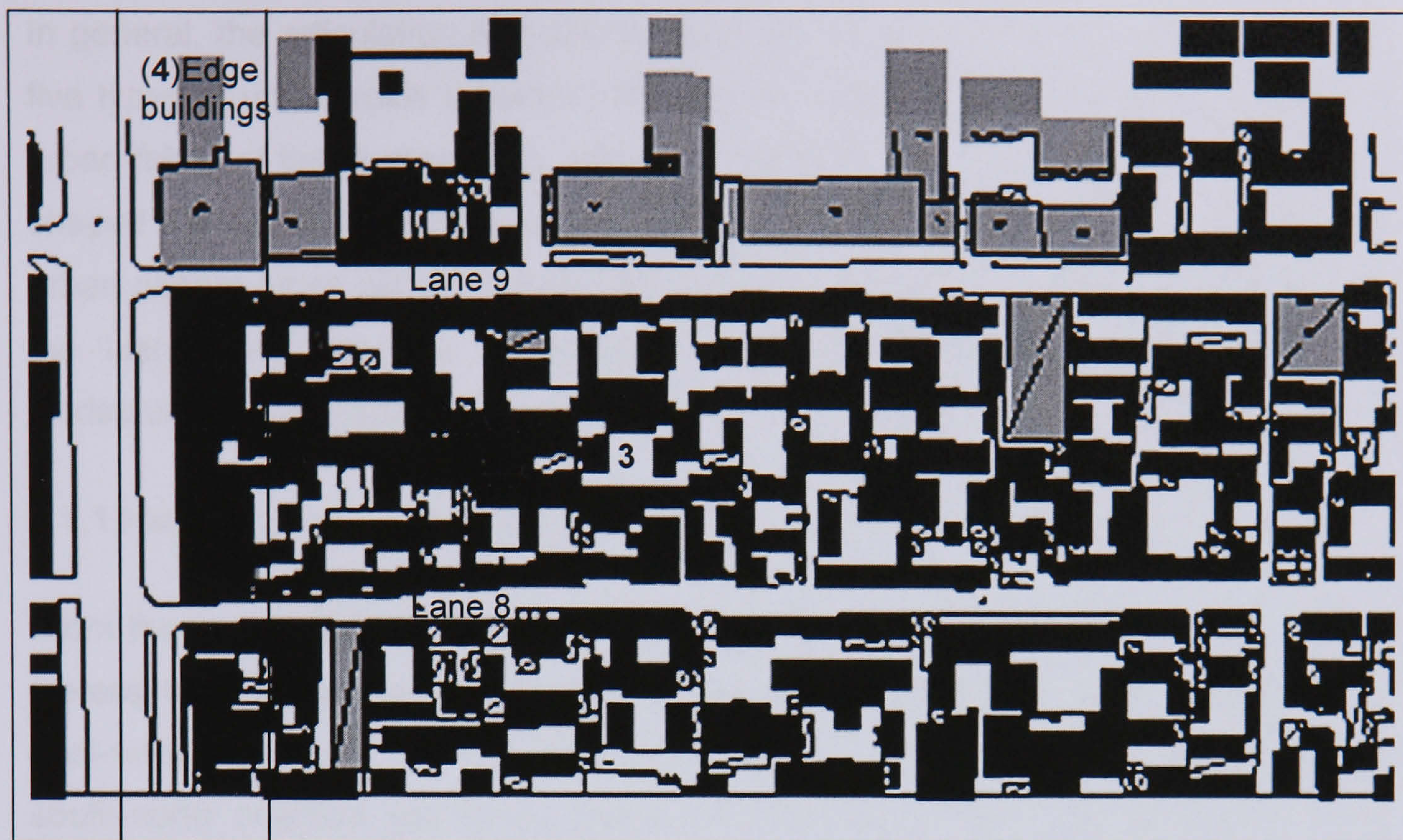


Fig.6.2 Urban solids types 3 and 4

In contrast to the urban solids, there are also certain definable urban voids that were formed by the previous 4 types of urban solids. According to the degrees of openness to the sky and also the relationship to the urban solids, five types of urban voids can be defined as follows: (1) The first is the primarily hierarchal transportation network of the neighbourhood which includes the main road, minor roads that were enclosed by the archways and the edge-defining buildings, and also lanes and sub lanes that were enclosed by different types of courtyard buildings; (2) The inner urban void which was enclosed by *Dongsi* archways. This inner space gives a strong social and physical identification to the urban space; (3) The 'concession space' and also the front public courtyard space which was located at the front of the temples buildings. 'In the very front of the complex, there was usually a front courtyard which opened for the temple market and religious performance. Outside the main entrance gate of the religious temples, there was usually some form of urban 'recess spaces', defined by the gate, walls, fences and arches, which related the temple further into street nearby' (*Zhu*, 2004:86). These 'concession spaces', always linked with the main road or minor roads, helped to provide a place for public gathering, and allowed the holding of the social cultural and commercial activities; (4) The fourth urban void is the inner block yard, or courtyard space enclosed by the courtyard buildings; (5) The entrance foyer space between the lanes and the inner private courtyard dwellings which were created by the entrance gate.

In general, the articulation and differentiation of these four types of urban solid and five types of urban voids together have composed the basic urban patterns and the urban fabric of the studied area, and have also established the physical sequences, shaped the visual orientation and spatial transition among places. Two fundamental urban pattern types can be drawn from these two dimensional figure ground studies; the 'hierarchal urban grid' urban patterns, and down at the courtyard level is the 'series urban void' pattern.

6.1.1 Hierarchal urban grid patterns (Neighbourhood):

From the main road of the *Chaoyang Mennei dajie* and *Dongsi Beije* (24 Bu[2], 36.5 meters) to the minor road of *Chaoyangmen Neixiaojie* (12 Bu, 18meter) and then to east-west oriented 1st to 10th lanes (less than 6 Bu, 9 meters), and finally to the south-north oriented sub lanes (around 4 meters), a clear hierarchal urban grid pattern has been created. This urban structure has been broadly used in traditional Beijing and many other ancient Chinese cities.

This hierarchal study indicates that the urban voids were well linked, from the exterior space of the city to the interior of the city, from the city entrance gate to the archways, from archways to the neighbourhood, from main lanes to the sub-lanes, finally from lanes to each courtyard and yard. This urban structure layout clearly helps to achieve a smoothly spatial transition between public space and the private space, and at the end of this urban voids system is the internal courtyard and yard. This hierarchal urban grid system has created a well connected transport system with no 'dead ends'. All the main lanes inside the neighbourhood are east-west oriented, which helps to link the west *Dongsi* Beijie (main road) and the east *Chaoyangmen Nei Xiaojie* (minor road) together, and the orientation of the main lanes has worked perfectly with the south/north oriented courtyard dwellings. The sub lanes also played an important role in linking the main lanes together. In particular, the narrow winding passageways in the middle of the neighbourhood from lane 5 to lane 7 provided more alternatives for walking, and this layout enhanced the permeable quality to the neighbourhood and also helped to create a compact urban form. Furthermore, all the urban voids were identified whether by the archways, or the edge buildings, courtyard entrance gate, the veranda and so on. The studies also suggested there was basically no completely open urban space (voids) or free standing buildings (solids) in this urban hierarchal grid system. The studies from Madanipour on urban place also suggest

[2] The width of the main road, minor roads and also the main *hutong* still followed the conventional planning figures (Steinhardt, 1999:154)

similar findings in traditional Chinese urban spaces; 'political institutions and control dominated the centre of the traditional Chinese city. There was no public square in the classical Chinese city, as the government or emperor discouraged public gatherings' (2003:205). Liu also suggested that the absence of an open town square was the main difference between the Chinese and Western cities (Liu, 1989). Therefore, the main characteristic of the urban space is that all the hierarchal urban voids have been enclosed by different types of urban solids rather than the contemporary freestanding buildings and urban space. Meanwhile, the most important urban landmark buildings and the edge-defining buildings have been located alongside the main roads and the minor roads.

6.1.2: Series of urban voids (courtyards)

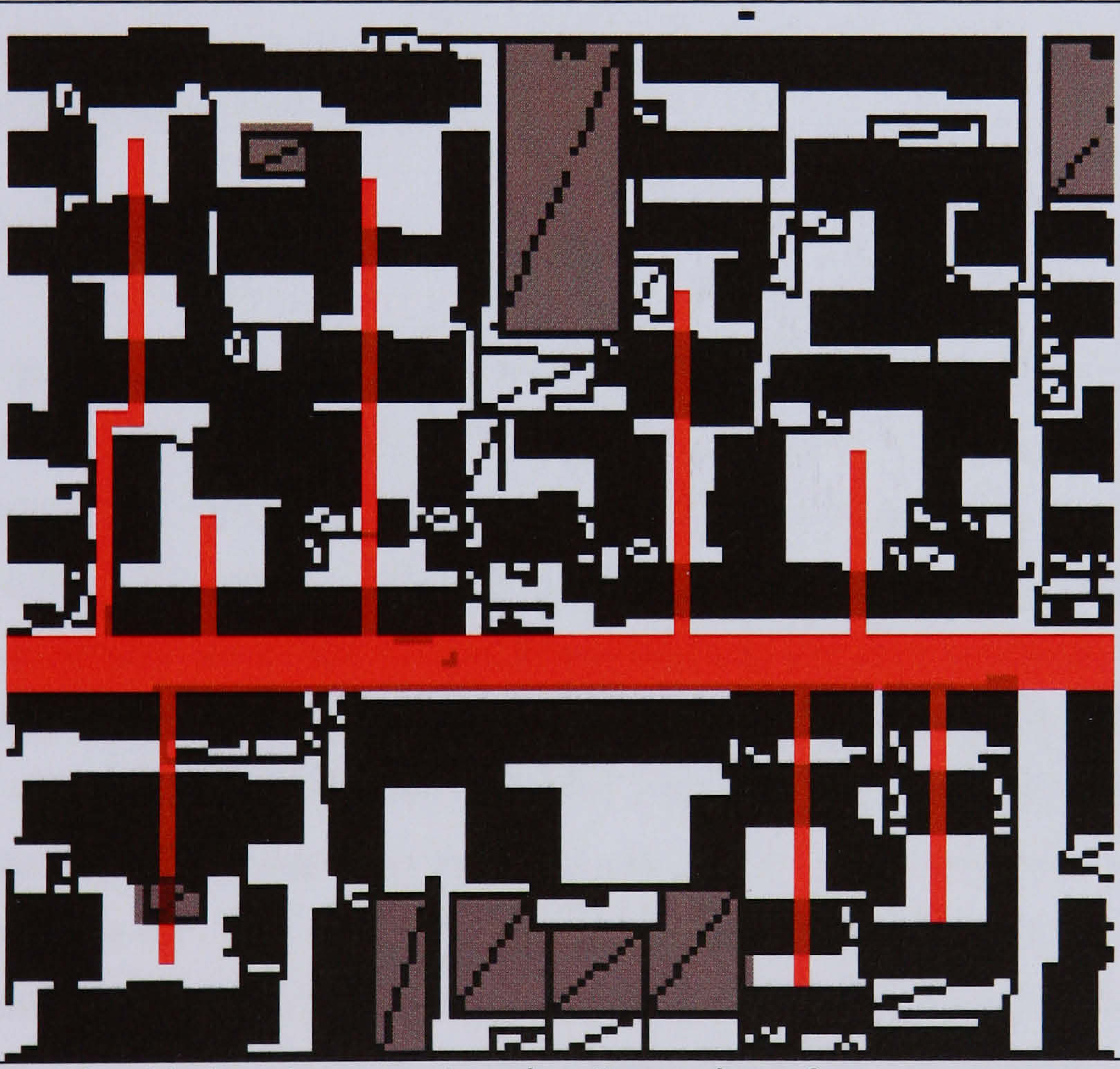


Fig.6.3 Series of voids in urban courtyard patterns: lane 8
Note: Red: urban links; Black: historical buildings, white: urban inner pocket (void); grey: new buildings.

The figure ground drawing also indicates the urban patterns of the courtyard building groups that are located among the lanes, sub-lanes and the edge-defining buildings. The urban patterns of these building groups are organized into a series of linked urban voids (yards and courtyards), and there is clearly a transition point between the external urban voids and the internal voids, whether for the large scale or small scale courtyard buildings group. This transition point is marked by different types of entrance gates. The inner urban voids have left great potential for nature to penetrate into the buildings, and also provided a place for family leisure uses and so on. The series urban pocket (courtyard and yard) buildings urban patterns also indicate the flexible character of this urban pattern (Fig.6.3), and provide great potential for the buildings group to be subdivided and amalgamated. The inner urban void can also provide the potential for future construction and buildings transformation (Chapter 9, transformation studies). From the figure ground map, the smaller urban voids (yards) of the courtyard buildings have normally been closely located behind the main lanes, and the relatively larger urban voids (courtyards) were situated in the middle of the buildings groups. This layout has helped to create a spatial hierarchy for courtyard living following the physical living environment that the buildings, the courtyards and yards created (for details see Chapter 7: social culture values studies), and the different openness of the courtyard and yard to sky can also help the courtyard buildings group create an inner microclimate system (for details see Chapter 8: response to the environment).

6.1.3 Summary

In general, four types of urban solids (the monumental buildings, the large courtyard buildings (e.g. *Fuwangfu* mansion), the ordinary courtyard buildings and the edge-defining commercial buildings) and five types of urban voids (the hierarchal urban grid, inner urban void which was created by *Dongsi* archways, the concession front space of the temple, inner block yard and courtyard, and the entrance foyer) have been identified from this part of the figure ground studies. The urban void is the medium of the urban experiences, providing sequences of the buildings, space for social cultural activities, economic activities and so on. These relatively stable urban voids also allowed the accumulation and construction of the urban and neighbourhood identity. Together, these five types of urban voids and four types of urban solids have composed the basic urban fabric of the neighbourhood that included the hierarchal urban grid and the series of urban pockets of courtyard urban patterns. The significant difference between this traditional Chinese urban space and the modern urban space is that the traditional urban voids were basically enclosed and controlled by the urban solids. There were basically no freestanding urban solids or completely open space in a traditional Chinese urban neighbourhood. Furthermore, the inner urban courtyard and yard left great potential for the residents to include natural elements and allow for future transformational work.

6.2 Urban morphology studies

The above figure ground studies mainly focused on a two dimensional plan analysis. Three dimensional urban structure studies include the plot pattern, the building types, the street pattern, and also.the spatial hierarchal studies will step further to provide a much better understanding of the streets, plots, buildings, uses and spatial quality of the neighbourhood.

6.2.1 Plot pattern

All the allotments of ground upon which the habitations throughout the city were constructed are square, and exactly on a line with each other; each allotment being sufficiently spacious for handsome buildings, with corresponding courts and gardens (Polo, 1928:173).

From the planning strategies, a basic standard plot size of 8 *mu* (5333 square meters) plot size was generally applied in the construction of the courtyard buildings, which also means 'a typical plot measures 73 by 60 meters or 62 by 63 meters' (Wu, 1999: 77). Furthermore, 'the basic form of *siheyuan* is replicated at grander scales in temple and palace complexes' (Knapp, 2000:176), therefore, the plot layout of 8 *mu* could be enlarged where there were predominant scale buildings such as government offices, mansions and temples. For the plot that could not be used by one owner alone, the regulations allowed use of the residential plot by ordinary residents. These planning policies/strategies were recorded in *Yuanshi-shizubenji* (Yuan history-the record of the first emperor), in which up to the second month of the twenty-second year (of first emperor's reign), the affluent and the high-ranked residents were called first, and if the household was not able to make full use of the allotment, the extra space had to be given to commoners who could then build their own houses (Song, 1369). This plot pattern arrangement also allowed the inclusion of large scale courtyard buildings into the neighbourhood, such as *Fuwang fu* mansion and the Taoist temple. 'Peking temples were built on the same basic plan as homes, official *yamen* (government buildings), merchant guild-lodges, and even the Forbidden City itself. To understand how one temple was organized was to understand the others' (Naquin, 2000:34). The shops had the most flexible building plots, which basically followed the needs of the shop owners and the availability of the plots located at the edge area of the neighbourhood.

PAGE NUMBERING AS ORIGINAL

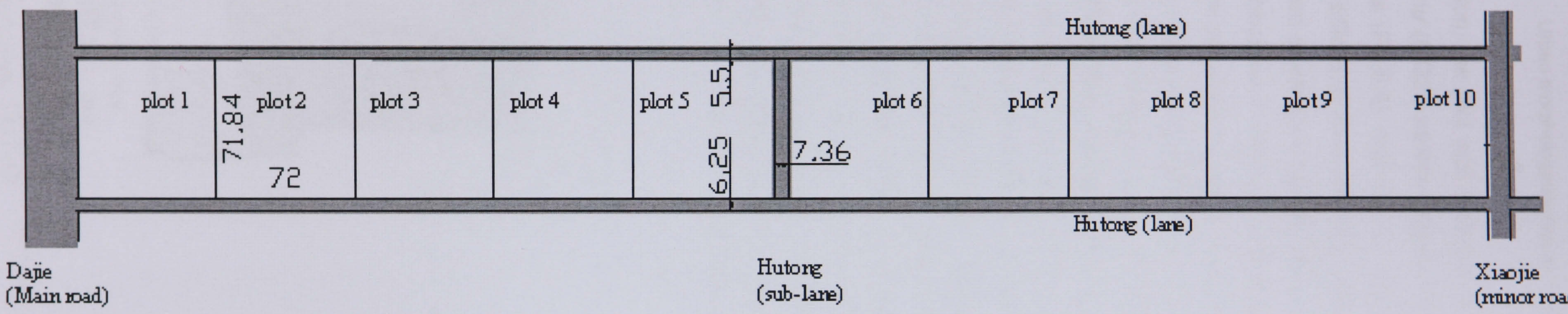


Fig. 6.4 The ideal plot pattern: drawn based on the existing urban structure between lane3 and lane 4

Scale 1:3000

From the investigation, the plot size between two lanes of *Dongsi* 3rd lane and 4th lane is exactly 80 *mu* (53333 square meters) which in theory can accommodate at least ten households (Fig.6.4), and has 1.9 dwellings per hectare of urban density. However, it is very difficult to know the real urban density of the past, even though there are 95 courtyard dwellings from the current survey (IPPR international design, 2003), and the neighbourhood has 18 dwellings per hectare urban density between 3rd and 4th lanes. The population density shown in Gamble's survey in 1917-18 was 386-559 people per hectare (Fig.6.6). The current urban density is 368 people per hectare according to IPPR Design's survey in 2003, so surprisingly the urban density actually did not fundamentally change during 1910's and the current survey, which indicates the large courtyard buildings (all the family members lived in the same buildings group) could also accommodate a similar population density as the current smaller households do. A similar population density, but with denser dwellings also indicates that the plot size has not been static but has been bought and sold. Large plots were subdivided, or smaller plots were amalgamated, when the family size grew. They bought nearby smaller size plots and then built a link with the existing plot. Meanwhile, when there were fewer family members, it was also easy to subdivide the large size of the courtyard buildings into a smaller size plot. Therefore this 8 *mu* (5333 square meters) plot size was used flexibly, according to the residents' social and economic status.

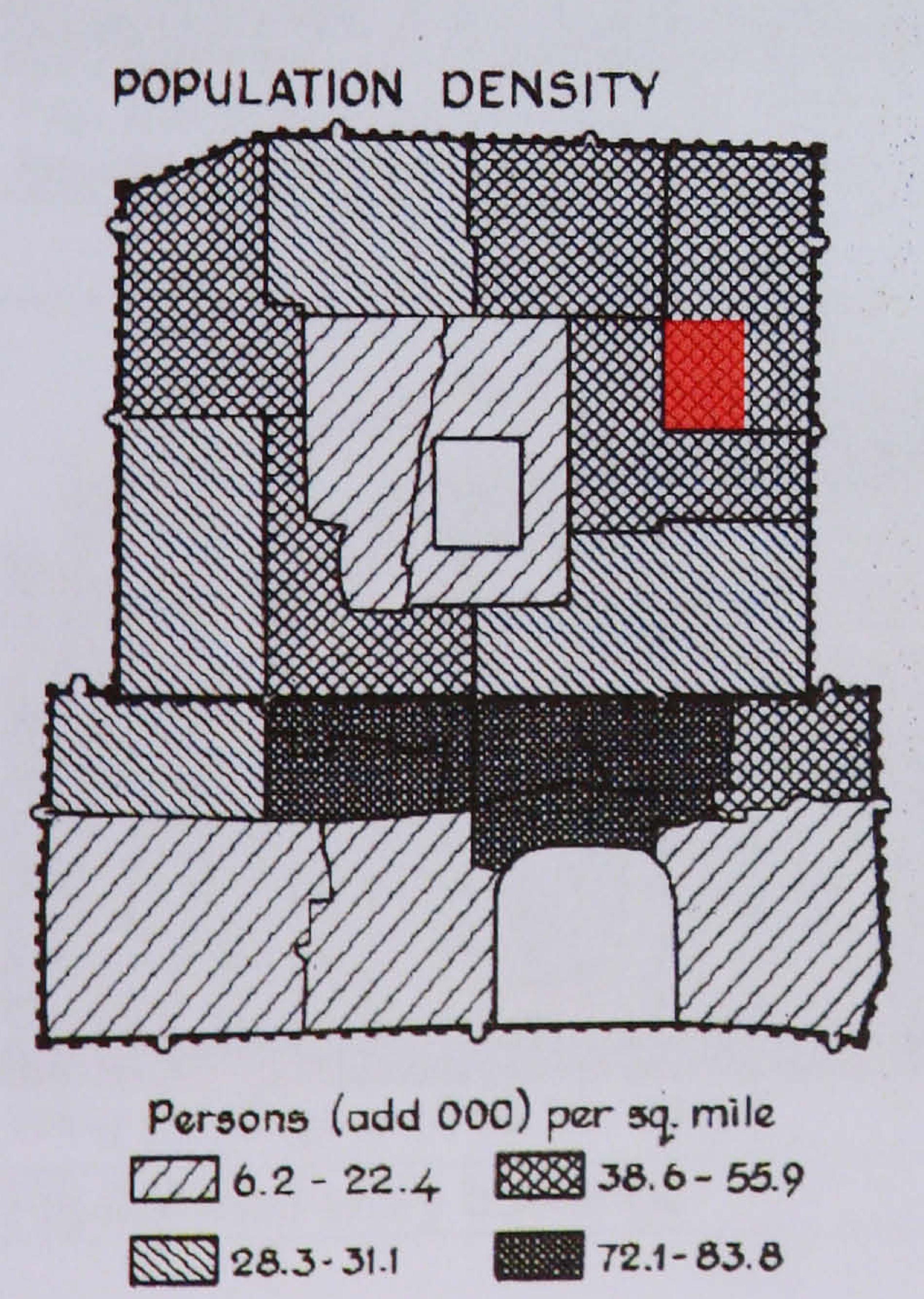


Fig.6.5 Population densities, 1917-18
Source: Gamble, S. D., 1921:412-413. Note: red represents the site

Generally, the rectangular plot patterns make the different types of rectangular courtyard buildings (residential, religious, leisure and so on) fit easily into the hierarchical urban grid patterns, and the edge-defining plot also meets the demands of the commercial uses. The flexible use of standard 8 *mu* (5333 square meters) rectangular plot size arrangement makes it possible for any future transformation, for potential amalgamated or subdivided work. The flexibility achieved by using the 8 *mu* plot size strategy also allowed the coexistence of the large and small scale plot for the rich and poor, which also helps to reduce social segregation.

6.2.2 Courtyard buildings pattern

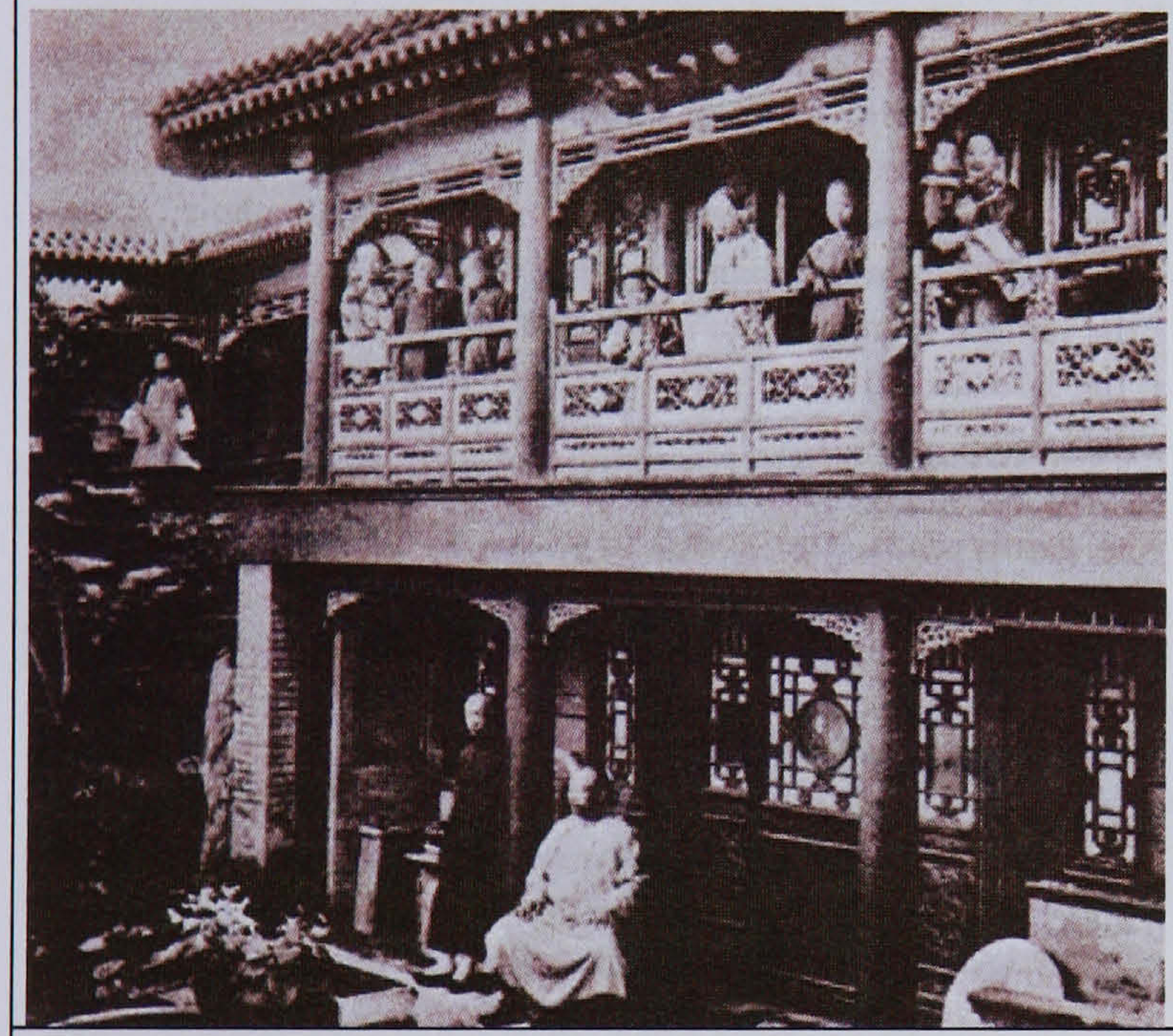


Fig. 6.6 A Beijing household, Beijing official (1872) seated in his garden courtyard
Source: Fairbank & Reischauer, 1989:315.

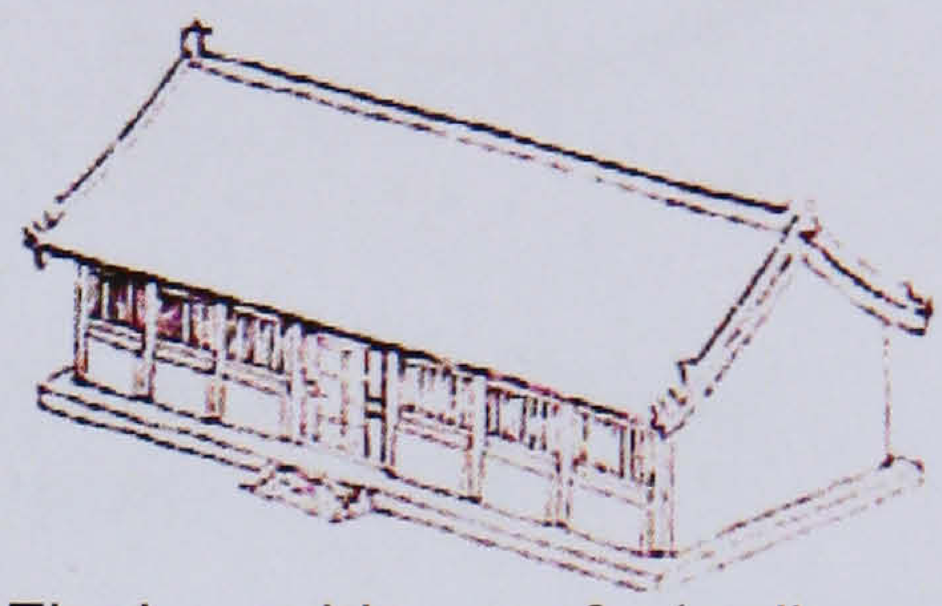
Wing buildings, no51& 53, lane 6

Wing buildings, Fuwangfu mansion

Fig.6.7 Two-story buildings

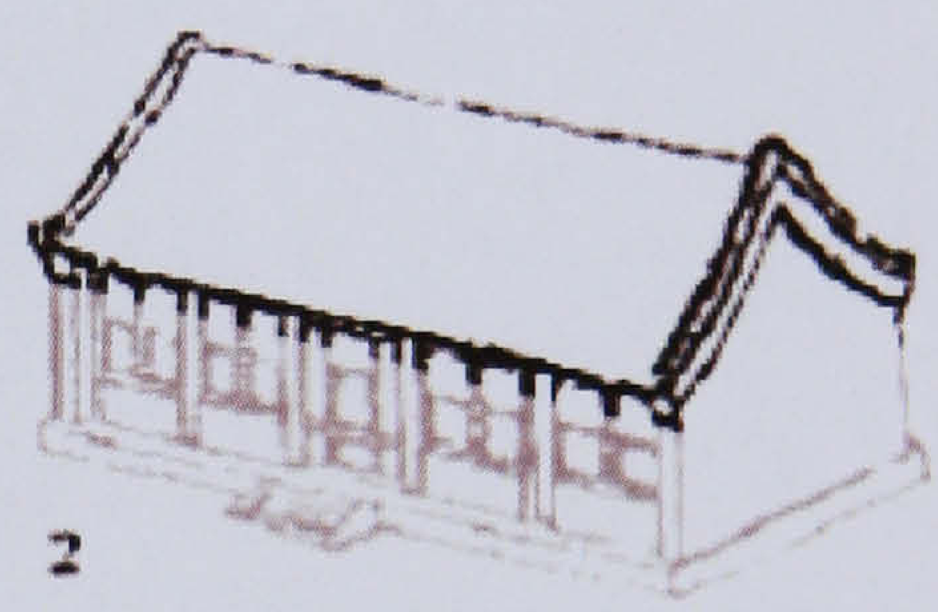
From the investigation, we can see that the height of the buildings inside the *Dongsi* neighbourhood is mainly one story, except for the edge-defining shops of the neighbourhood and the very few courtyard dwellings such as number 51 & 53 of lane 6 and *Fuwangfu* mansion (Fig 6.6& 6.7). However, the building height is not the determining parameter in the building standards. The five conventional roof types and the number of the buildings' bay principles that were introduced in Chapter 4 are very useful in helping to identify the dwelling's standard.

A: No 71, lane 8



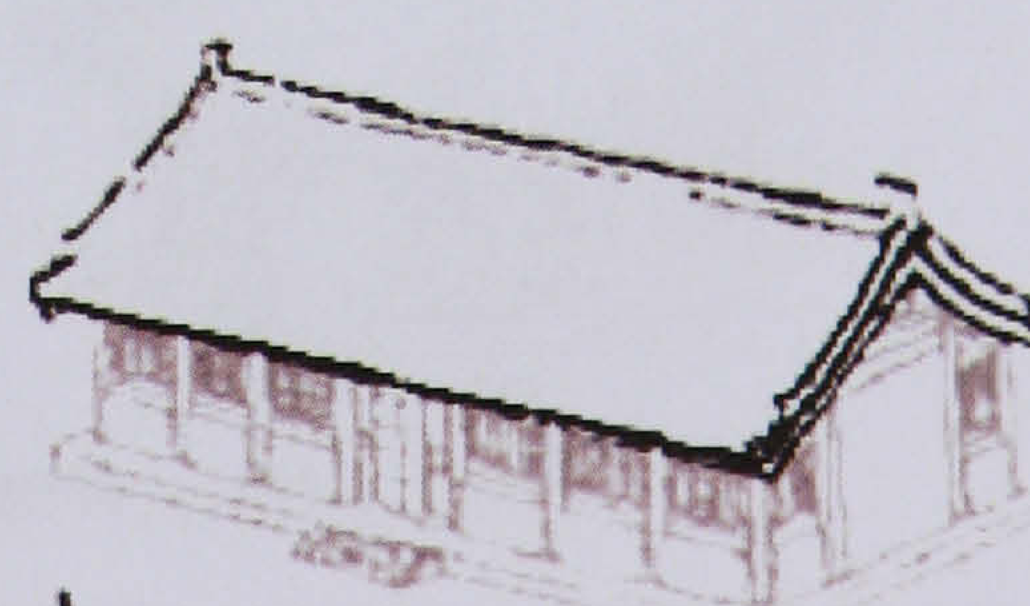
Flush gable roof (ordinary type)

B: No 2, lane 4



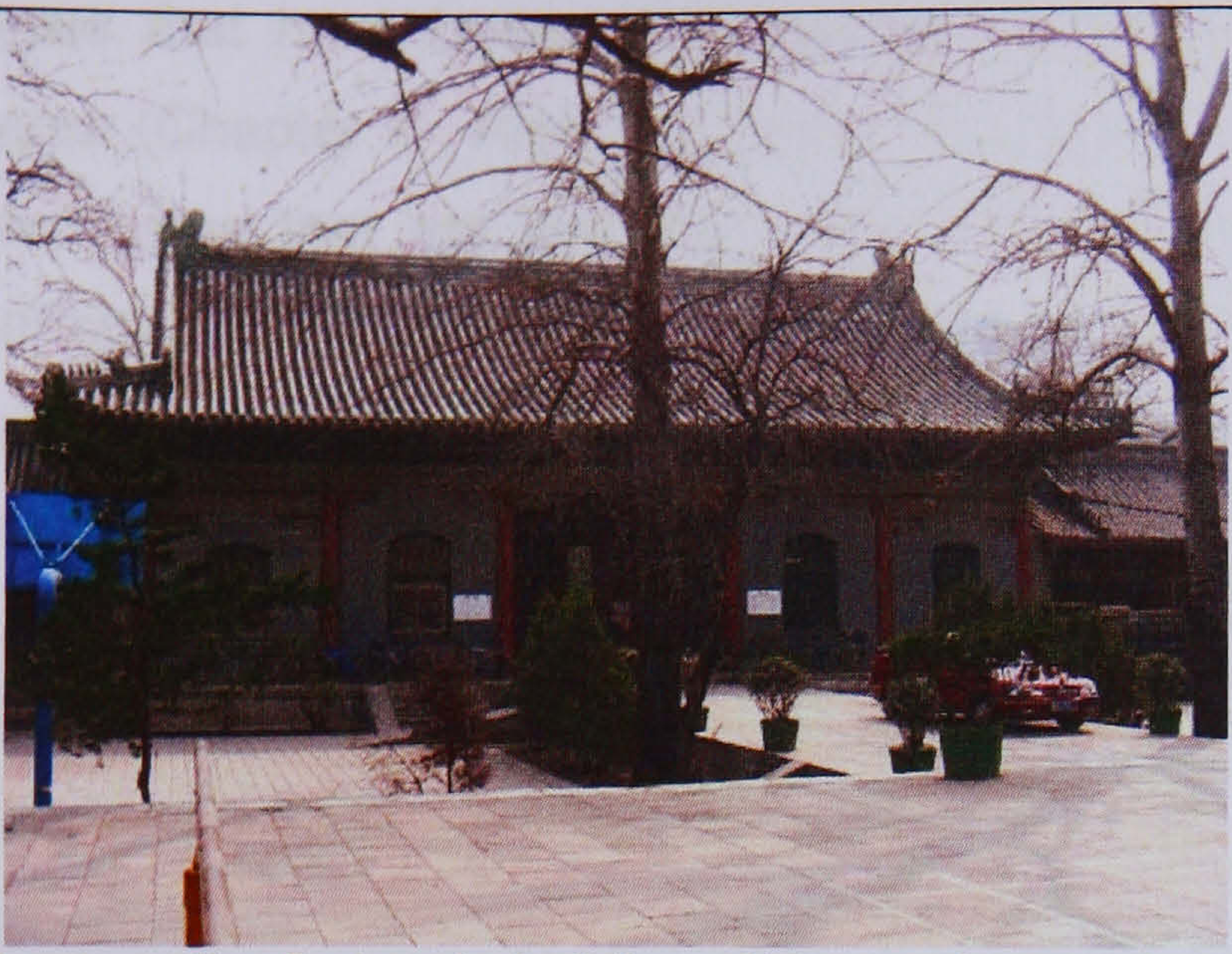
Flush gable roof (rolling type)
No 2, lane 4
Source: Liang, 2001

Fig.6.8 Flush gable roof

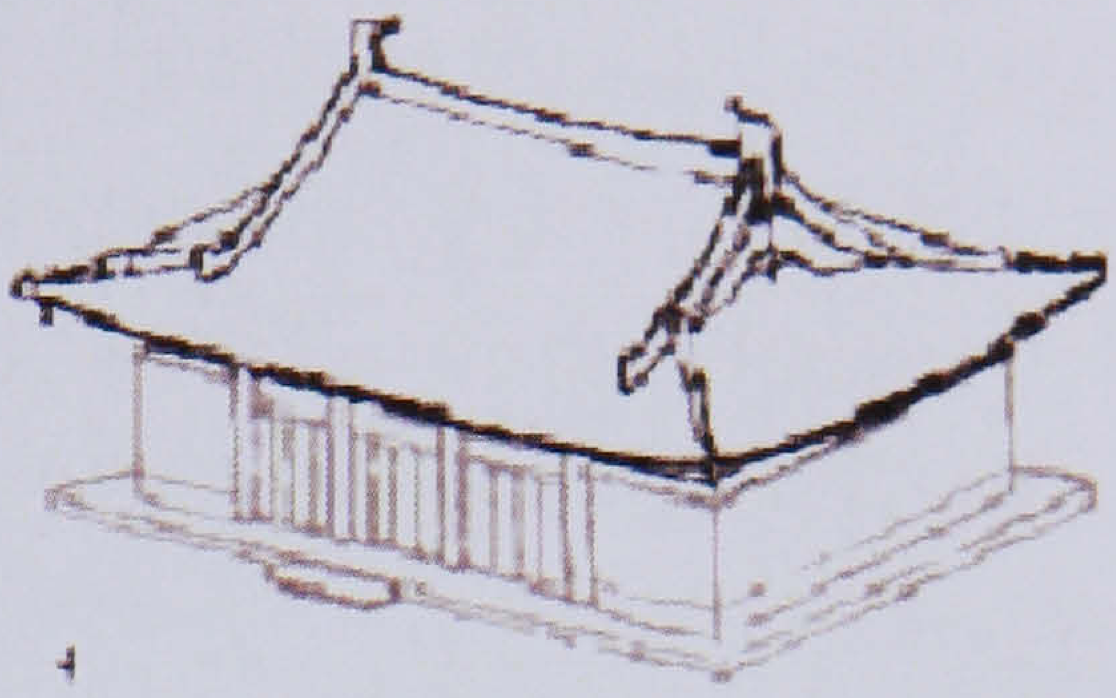


Overhanging gable roof
Source: Liang, 2001

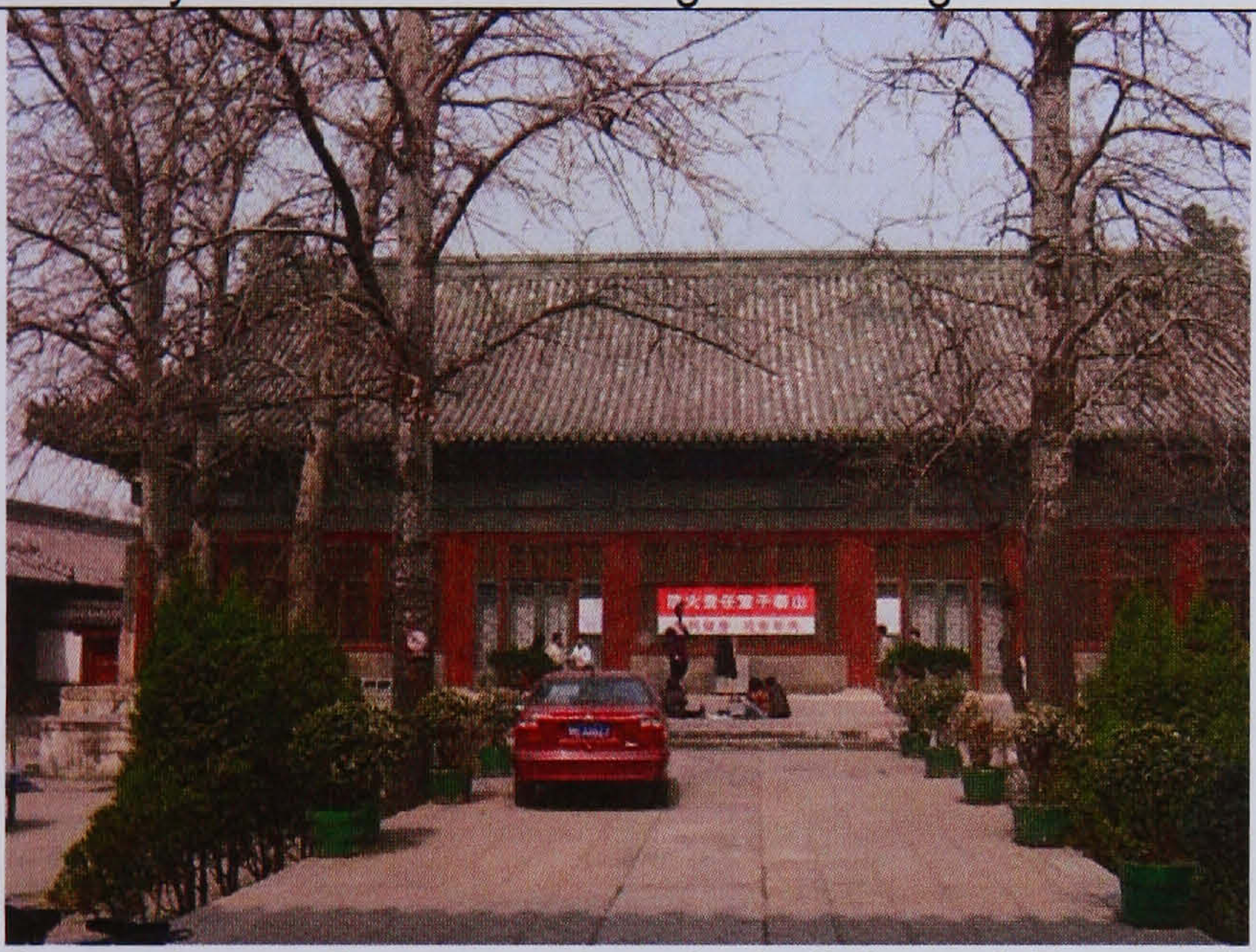
Fig.6.9 The overhang gable roof (rolling type) from the service courtyard buildings of *Fuwangfu* mansion



Five bay: the first main building of Fuwangfu mansion

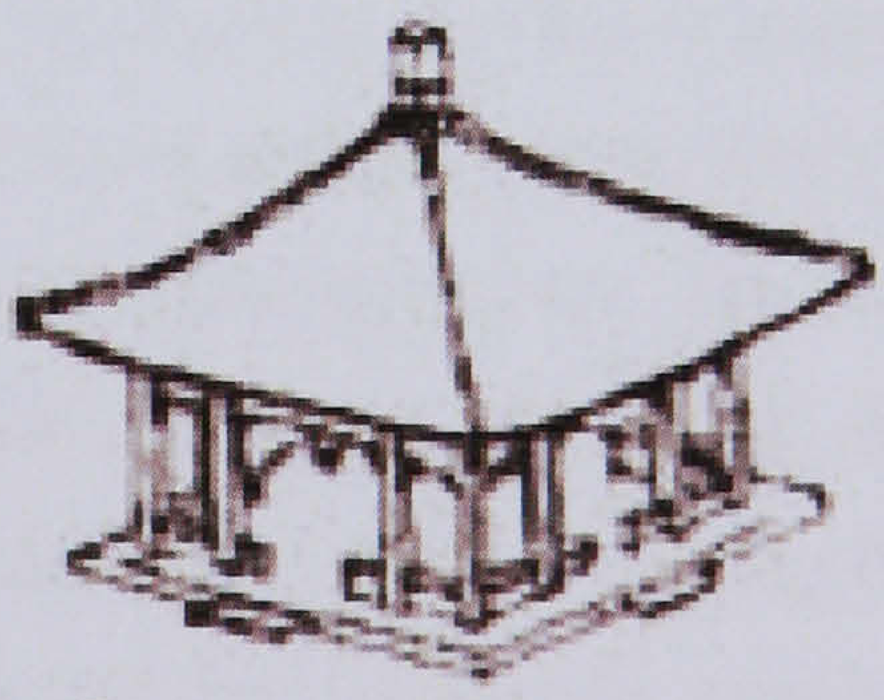


The gable and hip roof
source: Liang, 2001



Seven bay : the second main building of Fuwangfu mansion

Fig 6.10 The gable and hip roof type of *Fuwangfu* mansion



source: Liang, 2001

Fig.6.11 The pyramid roof type, lane 10

From the field investigation, the majority of roof types inside the neighbourhood are the flush gable roof, which can be further classified into ordinary flush gable roof and rolling flush gable roof (Fig.6.8). The rolling flush gable roof type was only used from the *Ming* Dynasty (1368-1644) which is much later than the other five major roof types that have been conventionally classified as traditional Chinese formal roof types (Chapter 4). Also, the rolling roof types do not belong to the conventional five roof types that are covered in the *Qing* Dynasty's Building Regulations Manual, although it has been broadly used for the transformed flush gable and overhang gable roof types. The roof types of *fuwangfu* mansion buildings group are unique in scale, colour and type, which include the overhanging gable roof, flush gable roof and hip-and-gable roof types (Figs.6.8, 6.9, 6.10). However, the full hip roof (Chapter 4), which represents the highest social status, was not used in the *Dongsi* neighbourhood. The Building Regulations of the *Qing* authorities stated that the hip roof and gable-and-hip roof types could only be used by the royal family and religious buildings; ordinary residents were prohibited from using these two roof types.

The overhang gable roof was found from the west axis of the *Fuwangfu* Mansion buildings group (Fig.6.9). There is also a pyramid roof as a pavilion garden building inside the survey area, which is located on the west side of the 10th lane (Fig.6.11). The traditional pyramid roof type in this neighbourhood can only be used by garden buildings. In general, the four of five conventional roof types which were defined in Chapter 4 have been found in the survey area. The informal rolling roof type which transformed from the flush and overhanging gable roof types also were found inside the neighbourhood. Building roofs can help to classify the vast buildings of the neighbourhood into two basic classes according to roof types; the royal family hip-and-gable roof, and the ordinary flush gable and overhang gable roof with their rolling varieties for the ordinary residents.

The number of bays is another important parameter of the standard of the traditional buildings. From the survey, we can see that the bays of the buildings varied from the one bay wing buildings of No. 125 of lane 8, two bay wing buildings of No. 39, to the majority three bay buildings (Fig.6.12 top), five bay main buildings of the first main building of *fuwangfu* mansion (Fig.6.11 middle), and also the seven bay (Fig.6.12 bottom) wing building and the second main buildings of the *fuwangfu* mansion. However, the number of the bays and the height of the buildings do not directly indicate the social status of the buildings in the same way that the roof types. 'The facades were never meant to be seen as symbols of prestige or wealth, and were, as a consequence, built in a standard fashion with the level of decoration suitable to the rank of the occupants' (Chan, 1991:26). From the field study, we can see that the relatively small scale buildings such as the main buildings of No. 129 of lane 8, and

No. 3 of lane 4 courtyard complex can also have the five bay main building just like *fuwangfu* mansion. The wing building of No 51-53 is also two stories, just like the *fuwangfu* mansion wing and back buildings. Therefore, the roof types played a dominant role in indicating the social status of the buildings. Meanwhile, the height and the number of bays can also help to indicate but not determine the social and economic status of the owners.

3 Bay, front building, No 39, lane 8,

3 Bay, main building, No 51& 53, lane 8

Five bay, Main building, *Fuwangfu* Mansion

Seven bay, Wing building, *Fuwangfu* mansion

Fig.6.12 The scale of the buildings (bay)

In summary, four of five conventional roof types were found from the investigation of the evidence in the neighbourhood, and these roof types have basically been employed on different types of courtyard buildings in the neighbourhood, according to the social and economic status. The width of the building can vary from one bay building, to two, three, five and seven bay buildings as seen from the investigation. The discovery of a two bay building in the neighbourhood (which is different from the conventional odd number system of bays) suggests that the builder may have applied the buildings regulations flexibly on site according to the plot size and also the economic situation. All building patterns existed at the same time and area which created a good sense of richness and diversity of the neighbourhood; however, this character is still systematically controlled and provided a strong political, social cultural and economic identity to each courtyard buildings group.

6.2.3 Use pattern

As the theoretical studies in Chapter 4 have indicated, compared to other key urban elements, land uses are relatively temporary, new/changing uses often lead to redevelopment, create new buildings, cause plot amalgamations and subdivisions, transform the street patterns and so on. The original uses of *Dongsi* from 1st through 10th lanes can be basically identified as a residential living quarter with commercial and leisure buildings surrounding the neighbourhood (from IPPR's field study in 2003), and also included the religious building *Daciyanfugong* Taoist temple and so on (Chapter 5). Furthermore, the dwellings included the imperial *Fuwangfu* mansion, those of the nobles and wealthy owners such as *Congli* dwelling (No 63-65, lane 6), *Shaqianli* dwelling (No 51, lane 6), and also included many single ordinary courtyard dwellings. The traditional commercial buildings on the edge of the neighbourhood, the famous Chinese traditional herb medicine building *Tongren Tang*, and different types of restaurants, teahouses, theatres, baths, pawnshops, book shops, and so on all have been merged into the neighbourhood (Fu, etc. 2004). From the survey materials, we observe that *Fuwang fu* mansion and *Daciyan fuwang,* with the highest social status, are located behind the main road *Chaoyangmen Nei Dajie*, and most of the shops were also located along the *Chaoyangmen nei dajie* and *Dongsi Beijie* (main road). Traditionally, different shops and leisure buildings were also located along lane 10 and *Chaoyangmen Nei Xiaojie* (minor road).

Fig.6.13 Beijing street scene with shops.
Source: From a scroll celebrating the K'ang xi Emperor's birthday (1713), Fairbank & Reischauer, 1989:229

From this part of the study, the mixed uses in the neighbourhood basically included three types of uses: residential, commercial/leisure and religious. The mixed use living quarters created a very convenient place for the local residents to use. Yang also suggested that it was possible 'to work and live in one neighbourhood with minimum contact with other parts of the town' (1963:16). Meanwhile, all the uses, except the retail/commercial use, employed the courtyard buildings type, and the uses of the courtyard buildings were easily transformed between residential use, leisure use, religious use and so on, which indicates that the courtyard buildings have good adaptability. The studies also suggest that all the dominant buildings such as the Taoist temple, *Fuwangfu* mansion, and the retail/commercial buildings were located alongside the main road of *Chaoyangmen nei Dajie* (main road) and *Dongsi Beijie* (main road) (Fig.6.13). The residential uses were mainly located among the lanes and sub lanes inside the neighbourhood, which created a relatively quiet but convenient urban living environment.

6.2.4 **Street pattern**

The two dimensional figure ground studies have suggested a hierarchical urban grid urban pattern of the neighbourhood, and the main road *Chaoyangmen nei Dajie* which was indicated by the *Chaoyangmen* city gate and *Dongsi Beijie* which was indicated by *Congwenmen* city gate followed the orthogonal arrangement of the main road in the capital, with width 24 Bu, (1Bu=1.55meter) and named *Dajie* (main road) in Chinese. *Chaoyangmen Nei Xiaojie* (Minor streets, 12 *Bu*) was about half as wide as *Dajie* (main road) and *hutong* (lane) only a quarter as wide (6 *Bu*). Beijing's street system during the *Ming* (1368-1644) and *Qing* dynasties (1644-1911) inherited the traditions of the Yuan dynasty (1279-1368), which divided the city into many blocks with main streets that ran from north to south, parallel to the central axis. The planning of such residential blocks was in accordance with the design of *Siheyuan* house itself. A basic courtyard house normally has a quadrangular shape and works well with the hierarchal urban grid system which the main road, minor and also *hutong* created.

6.2.4.1 *Dajie* (Main road) and *Xiaojie* (Minor road) from 1st through 10th lanes, *Dongsi* neighbourhood

'The whole plan of the city was regularly laid out by line, and the streets in general are consequently so straight, that when a person ascends the wall over one of the gates, and looks right forward, he can see the gate opposite to him on the other side of the city. In the public street there are, on each side, booths and shops of every

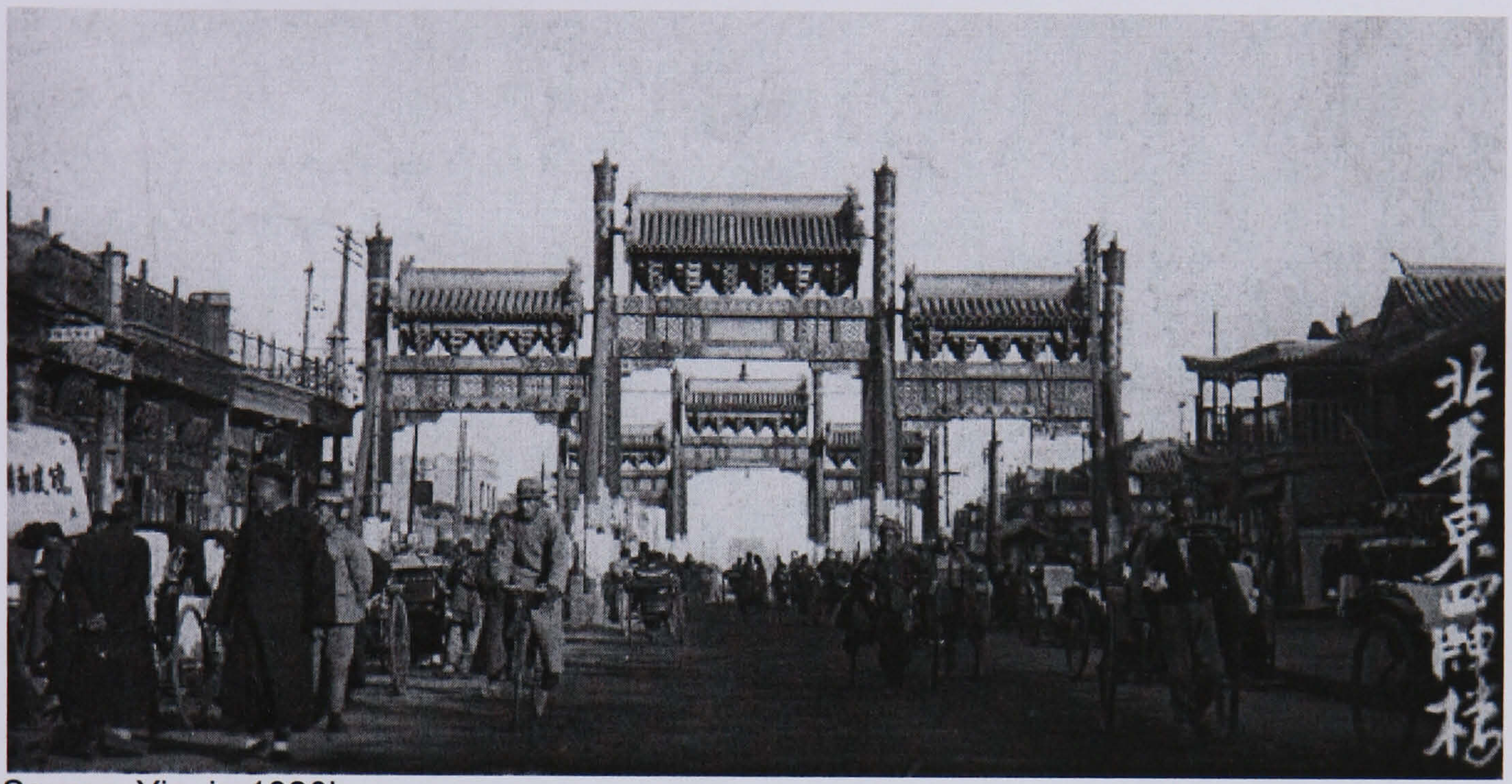
description' (Polo, 1928:173).

Fig. 6.14 Commercial street scene of Qianmen, Xu, 1776
Source: Fu,etc.2002:264

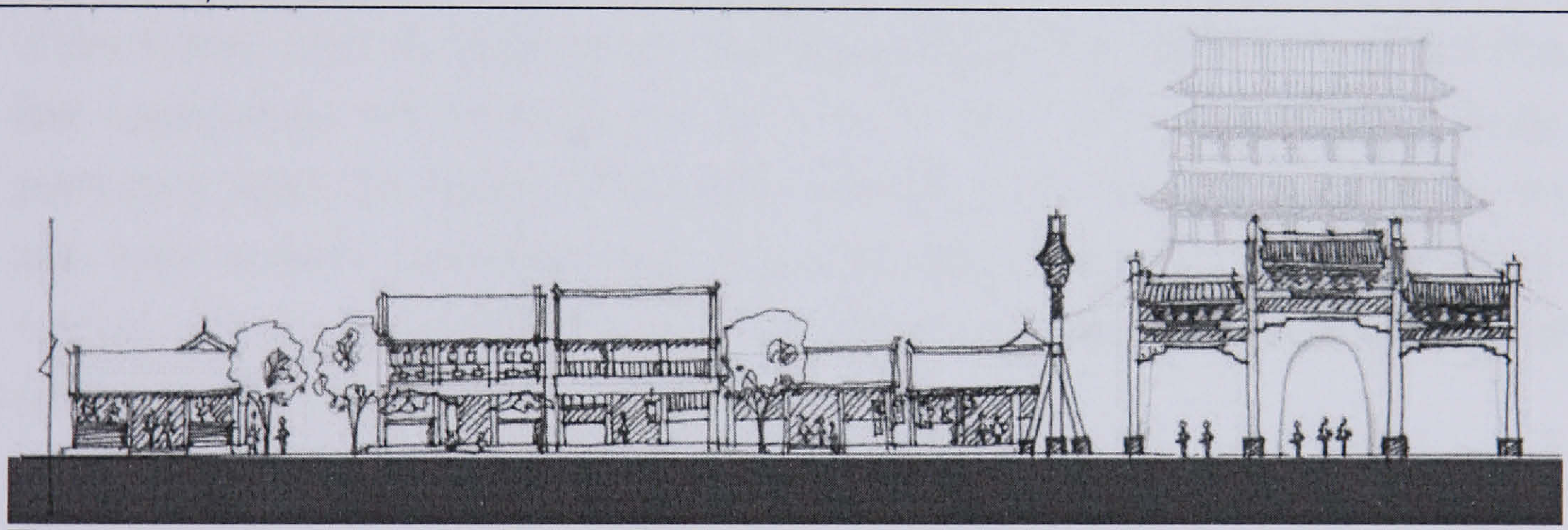
Chaoyangmennei Dajie road on the south side and *DongsiBeijie* road on the west side of the neighbourhood are the main roads. The east side of *Chaoyangmennei Dajie* was marked by *Chaoyangmen* city gate and south side of Dongsi Beijie was also marked by *Congwen* Men (city gate). *Chaoyangmen Nei Xiaojie* was a minor road with 12 Bu (18.6m) in width (and current is 12 meters), and the main lanes (*hutong*) are 6.5 meters in width which was also less than the official figure of 6 *bu* (9.3 meters) (Fig.6.15).

Chaoyangmennei Dajie road was also famous for its prosperous commercial activities. *Chaoyangmen* was the nearest city gate to approach the famous *Jingtang* canal (from Beijing to Hangzhou which was constructed mainly to ship the goods from the south of China). This made the road the most convenient place for merchants to visit the capital and also to conduct business inside the city. The *Dongsi*

Beijie, *Dongsi* archways marked the south part of the road, and then one could see the *Longfusi jie* temple street east archways, and also many shops (Figs.6.14 & 6.15). One of the most famous and oldest Chinese medicine shops *Tongrentang* was in the neighbourhood for many hundreds of years.



Source: Yin, in 1920's



The main road section of the *Dongsi Beijie*

Fig. 6.15 Dongsi archways and the Dongsi Beijie (main road before 1900's)

- The main road length inside the neighbourhood (Figs.6.14 & 6.15):

From the survey, we can see that the length of *Chaoyangmen nei Dajie* inside the neighbourhood is around 700 meters in length. The length of *Dongsi Beijie* (from *Chaoyangmen Nei Dajie* to lane 10) is 945 meters, all within walking distance. It is very easy for the residents to access the main commercial street, the local shopping street and also the leisure facilities.

- The street proportion of the main road

The ratio of the street width to the height of the enclosing buildings is critical for good street design, and also to encourage social behaviour and activities on the street. It is very difficult to give a precise height of the buildings along the main road because of the heavy transformation, but from the historical images, the edge commercial buildings were mostly two storeys (around 10 meters) in height (Fig.6.15), and the width of the main road was 37.2 meters in theory, and therefore the road proportion is 3.72. Bentley suggested that the width to height ratio of the street enclosure of more than 3: 1 seems 'weakly enclosed' (Bentley et al, 1985). The width of minor road was 18.6 meters, and the road proportion is 1.86. This 1.86 to 3.72 street proportion indicated a weak street enclosure but the archways and the city gates have helped to enclose and control the void space that the main road created (Fig.6.15: bottom).

6.2.4.2 *Hutong* (Lanes and sub lanes)

Previous studies have identified the *Hutong* as one of the main social foci of traditional Beijing. The *Hutong* was not just the basic urban pedestrian roads to the neighbourhood but also more importantly it represents a lifestyle with rich social and cultural activities. If the previous studies mainly focused on the social culture contexts of the *Hutong*, then the physical environment of *Hutong* that held the social activities and communities will be the main concern for this part of the physical study, particularly when 'the narrow lanes called *hutong* are still mostly undisturbed by the new living quarters that have risen elsewhere about the city' (Cameron & Brake, 1965:5), and this will help to explore the design implications of a good quality of street with a strong historical background.

Street length: The average length of the main lanes (*hutong*) is basically similar to the main road which is around 700 meters. Lanes one and two are shorter than the average length because both of them have been blocked by mansion buildings. Lane 5 in the middle of the neighbourhood is the longest *hutong* which is around 760 meters in length because it is not straight. From the street map, we can see that there is at least one sub lane (*hutong*) which links two main lanes together, and there are more vertical links between the main lanes in the middle of the neighbourhood. This also helps to give a good quality of permeability and walkability to the neighbourhood. It also helps the residents to access different facilities and shops inside the neighbourhood easily, and this arrangement also means anyone from the neighbourhood can easily access *Dongsi Beijie* and *Chaoyangmen nei Dajie*. For the lane itself, the diversity of the courtyard entrance gates, the decorations, and the social activities greatly enrich the experiences of walking. Furthermore, the distance between lane 1 and lane 2, lane 2 and lane 3, lane 3 and lane 4, lane 7 and lane 8, lane 8 and lane 9 are around 70 meters, and this result also matches Wu's studies on the traditional neighbourhood; 'the typical distance between *hutong* is 70 to 80 meters…a typical plot measures 73 by 60 meters or 62 by 63 meters' (1999:77). The distance between lane 4 and lane 5, lane 5 and 6, lane 6 and 7 are around 140 meters which allows the plot of larger scale courtyard dwellings to fit easily into the neighbourhood.

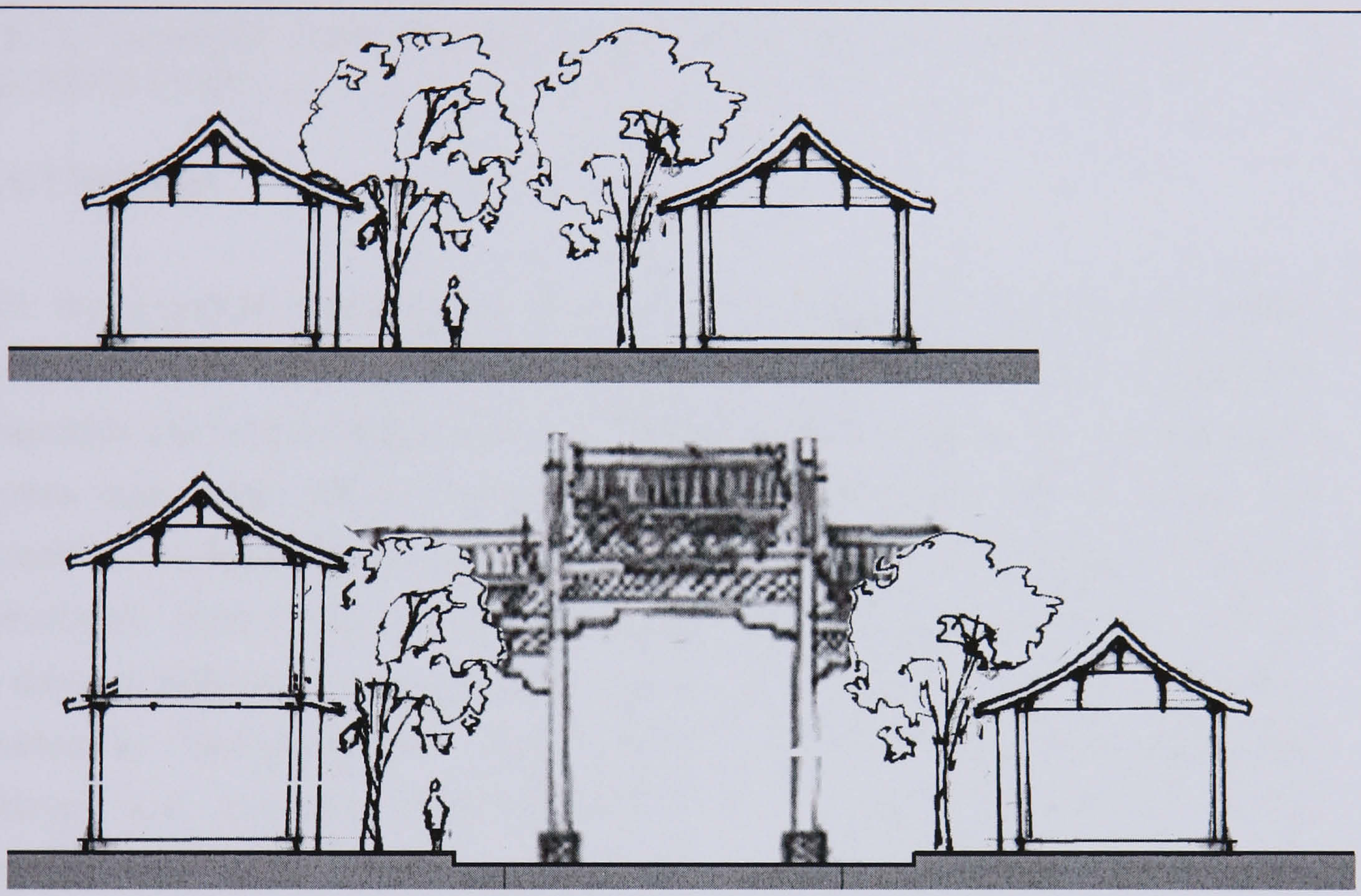


Fig.6.16 The *hutong* and minor road street proportion
Note: top: *hutong*; bottom: minor road

Street proportion of the *hutong*: From the investigation, we can see that the front buildings of *hutong* are normally 5 meters in height and the entrance gate is a little bit higher- around 5.5 meters. The width of the lanes is around 6.5 meters, and the sub-lanes are around 4 meters. From these data, the enclosure of the lanes (*hutong*) can be calculated as follows: (1) the width of lanes to height of the building is approximately 1.3 to the main lanes (Fig.6.16: top), and (2) the width of sub-lanes to the height of the buildings is around 0.8. The enclosure of *hutong* was shaped by the front buildings and the entrance gates, and the trees along the street also helped to improve the enclosure of the lanes (Fig. 6.16 & Fig.6.17).

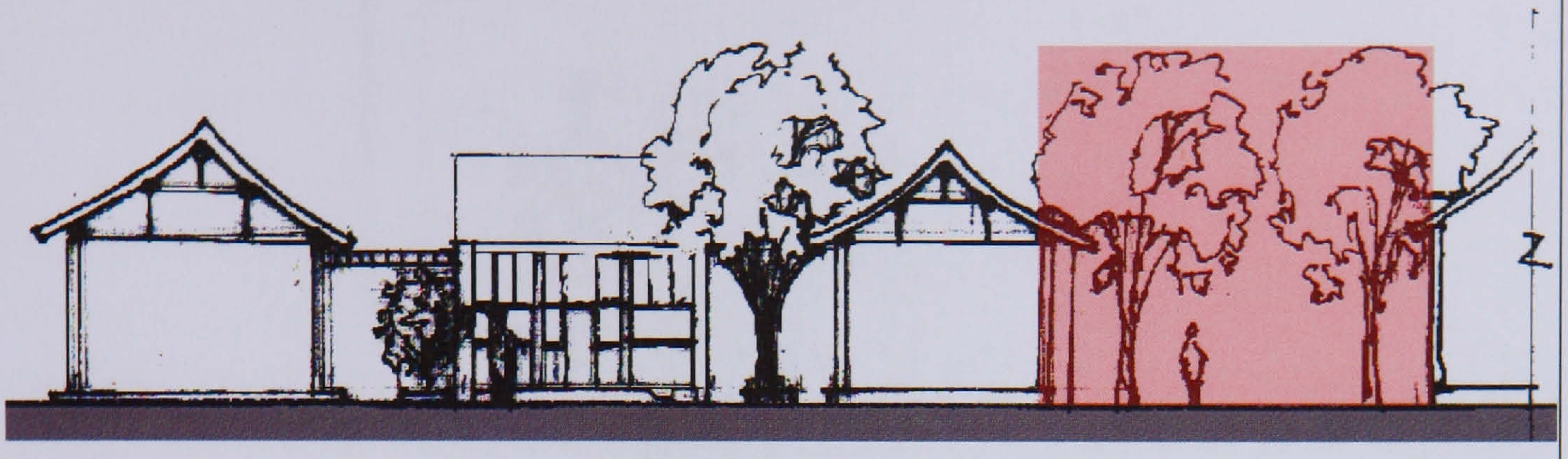


Fig.6.17 The section drawings across No 39 courtyard dwellings of lane 8
Grey: hutong (lanes)

6.2.4.3 Summary

From the physical characteristic studies of the hierarchal streets, the design implications of the street system could be drawn as follows. There is a conventional hierarchical planning strategy for the transport system of traditional Beijing which includes main roads (24 Bu), minor road (12Bu) and *Hutong* (6Bu or less). This hierarchical transport system fostered a pedestrian-friendly, traffic-calmed residential environment. Most of the important religious buildings, imperial buildings, and also the commercial/leisure buildings were located along the main road which together provided an identifiable and legible main road. Meanwhile, commercial/retail buildings and landmark buildings helped to provide urban edges to the neighbourhood.

The 70 meters and 140 meters distance between two major *hutong* (lanes) matched the plot and the courtyard planning strategies. The west-east oriented main *Hutong* and the south oriented courtyard buildings also work well to exploit a good quality of sunlight penetration into the courtyard buildings for much of the year. More sub lanes (*hutong*) links have been created in the middle of the neighbourhood than the edge area, which helped to create a good quality of legibility of the neighbourhood. The 3.72 street proportion of the main road indicated that there is a weak road enclosure, but the archways (and also the city entrance gate) have created the necessary spatial control over the main road. The 1.3 to 0.8 street proportion of the *hutong* indicated a good enclosure which allowed the holding of social activities and street communities. This street proportion of *hutong (*less 1.5) is also recommended for pedestrian areas by Bentley etc. (1995) in their 'Responsive Environment' studies.

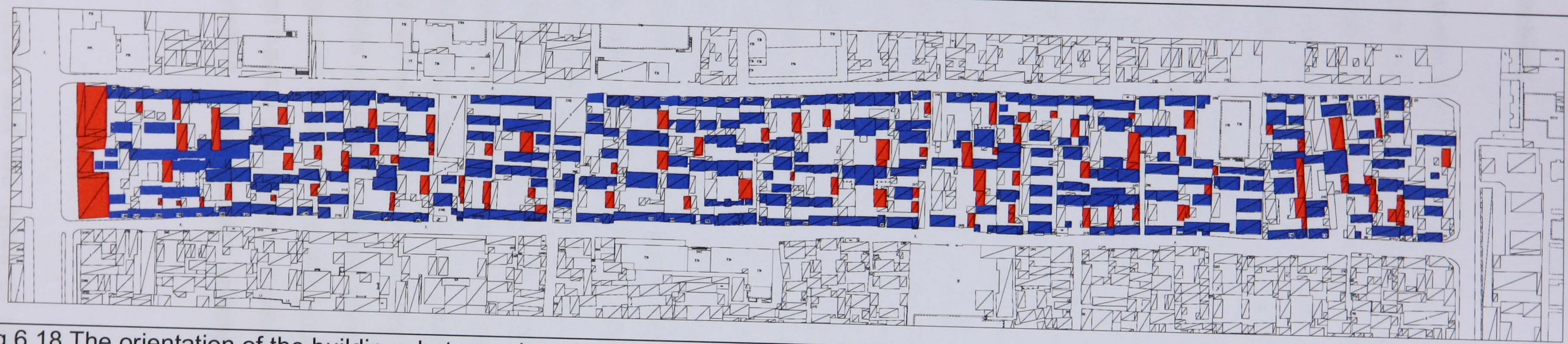


Fig.6.18 The orientation of the buildings between lane 8 and 9
Blues is south to north direction, red is west direction and the left is east direction
scale: 1:3000

0 m 100m 200m 300m

6.2.5 Spatial hierarchical

As discussed, the spatial transition started from the city entrance gate, which gave a strong sense of urban boundary to Beijing as a city. Passing through the *Chaoyang Men* city entrance gate, *Dongsi* archways were the next important spatial transition point to the neighbourhood which gave identity to the neighbourhood, both social culturally and physically. For the enclosed public space of *Daciyan fugong* Taoist temple, the front courtyard was used for the daily worship, temple fairs, social gatherings, commercial gatherings, social relief (see Chapter 5) and so on. In the neighbourhood, lane one to lane ten have been identified as the main *hutong* in the field, the transition between the traffic road and the *hutong* was achieved by the edge-defining commercial buildings. Meanwhile various types of entrance gates were used to provide a semi-public transition place before entering into private courtyard dwellings. The entrance gates were also the most important spatial transition point from the public *hutong* to the private dwellings, which give a strong boundary to the residents. Spatial orientation is another important parameter of the spatial quality of the courtyard dwellings. The majority of courtyard buildings (whatever the uses) are oriented to south according to the survey, and the west and east oriented wing buildings have been used to enclose the courtyard (Fig.6.19). Most of the courtyard dwellings are directly linked to the west-east oriented *hutong*, and some of them are linked with the north-south oriented sub lanes (*hutong)*. From the survey drawing, we see that the space on both sides of the main *hutong* have all been occupied by the south-north oriented buildings, and the eastern and western orientated buildings are all located between these buildings (Fig.6.18). The south-north orientated buildings also have different opportunities to access the natural light and ventilation according to the location. The buildings next to the main lanes should have more chance to access the good quality of natural light and ventilation but with less privacy (therefore, most of the front buildings inside the neighbourhood have a closed front elevation). The courtyard buildings next to the front buildings all have good quality natural light and ventilation and also have a good sense of privacy (Fig.6.18). Generally, the four types of spatial transition have greatly enriched the spatial quality of the neighbourhood.

6.3 Conclusion

Four types of urban solids and five types of urban voids together created a hierarchical urban grid and the series of courtyard pockets of urban patterns of 1st to

10th lanes of *Dongsi* neighbourhood. The hierarchical urban grid is indicative of good quality permeability and legibility of the urban space. The hierarchical urban voids have been enclosed and controlled by different types of urban solids, and the studies also suggest that there are no completely open urban public spaces or freestanding buildings inside this urban neighbourhood. The series of pocket courtyard urban patterns also help to achieve a great potential to approach the natural environment and also for the transformation of future buildings. Furthermore, the urban morphology studies which include the plot pattern, the buildings pattern, street pattern and the spatial hierarchy studies have helped to analyze the urban physical form and also the urban shape of the neighbourhood. The 8 *mu* (5333 sqm) standard plot size and the flexible use of this plot size have created a mixed community both for the rich and poor. This strategy also allowed different scale courtyard buildings to fit in the hierarchical urban grid system. Meanwhile, four roof types with two rolling varieties, one or two stories in height, a system of mostly odd number of bays (including some two bay buildings) are the three external parameters for the buildings types. The studies have suggested buildings in the neighbourhood are composed using these three parameters. Furthermore, the roof types are the determining parameter of the social status of the residents.

The hierarchical transportation system, with the front yard of the temple, has traditionally acted as the most important urban public place for social gatherings, social relief (offering help to the poor), commercial gatherings, and exhibitions and so on. All the important landmark buildings and the commercial buildings have been located alongside the main road, and this main road has also been linked with the central north-south axis of the city. This layout can help residents access the main road of the city easily. The walkable street length and the 1.3 to 0.8 street proportion of *hutong* have achieved a good quality of enclosure to hold the social activities, which helps to create a lively street life for the residents. Finally, there were four types of spatial transition worth mentioning again, which include the *Dongsi* archways, the front enclosed public courtyard of the religious building, the entrance to *hutong* and the entrance gate to courtyard buildings. These four spatial transformation points helped to achieve a fluent and continuous transition from the main public road, to the important public gathering space, and then the *hutong* and finally to the private courtyard buildings. This part of the study also indicates that the spatial hierarchy can be achieved not only by the physical buildings and buildings elements, but also by the uses. In general, the hierarchical urban grid of the neighbourhood can help to create a place with good quality permeability, identity, diversity, legibility, and also helped to achieve a place with a strong sense of control, identity, orientation, mixed community, diversity of the buildings, lively and walkable streets and a smooth and continuous spatial transition.

'Set in the midst of the universe, man needs a place of peace, seclusion, as part of the greater, hostile, amorphous world outside, a space which, all the same, receives its share of day and night, sun and moon, heat and cold and rain. This space, which is subservient to the passage of the days and years and to the rules that order existence, is the 'courtyard' (Blaster 1985:7).

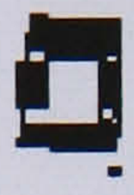
Chapter 7: Courtyard dwellings: the social culture values studies

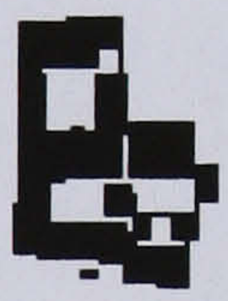
As studied in Chapters 5 and 6, the urban patterns of the 1st through 10th lanes of *Dongsi* neighbourhood were first established by the *Yuan* authority (1276-1368) which was guided by traditional Chinese *Fengshui* theory and the Ideal *Wangcheng* (imperial city) theory. *Fengshui* theory is applied to achieve good fortune, healthiness and happiness through the most privileged site location of the main buildings. Meanwhile, the Confucian Ideal *Wangcheng* (imperial city) theory has strongly shaped the city layout in many ways, including the strict location of the city gate, wall, street and palace, and also the emergence of the central axis and so on. Residential constructions were then permitted according to building standards, which became more strict and formal after *Qing* authority regulations instigated in 1734. The place and urban morphological studies of the *Dongsi* neighbourhood were discussed in the previous chapter. Following this discussion, several typological qualities will be examined in this chapter which include: how to classify the courtyard buildings; how plan and colour contexts reveal social and cultural values; and how secondary buildings illustrate design values and so on. This does not imply, however, that these typological studies should be considered in isolation, but rather that all the information is needed to understand the complexities involved.

The specific building groups chosen attempt to represent all courtyard types of the neighbourhood, while the choice of *Dongsi* neighbourhood itself, according to the criteria set out in Chapter 3, serves to represent the traditional courtyard urbanism in the larger context of Beijing. The chosen case studies in the *Dongsi* neighbourhood broadly represent varying qualities of courtyard buildings including plot sizes, courtyard numbers, grouping shape and scale, material, form, and colour. The field work completed at lanes one through ten of *Dongsi* neighbourhood included the survey, measuring, and photographing of thirty-five different courtyard building groupings, and included the detailed physical measurements of 12 courtyard building groups which together represent the typological diversity of the neighbourhood. A total of thirty yards, courtyard building groups within 12 courtyard dwellings were completely surveyed, whereas, due to its scale, *Fuwangfu* mansion was only partly documented. However, the study of these buildings is complicated by their diversity and the complexities of the existing situations, often transformed beyond recognition.

From the investigation of the courtyard building groups 1st through 10th lanes of *Dongsi* neighbourhood, the number of inner voids (include the types of courtyard, yard and inner garden) of a courtyard buildings group can vary from one basic example to over seven (in the case of *Fuwang Fu* mansion), as can their arrangement, scale, surroundings, colour, and materials. However, these rich differences can cause confusion. In order to communicate the collected data, the information has to be classified and identified for the common characteristics that enable architectural phenomena to be considered in specific classes or sub-classes. Therefore, the area's contexts will initially be outlined to help clarify the role of the courtyard building as a whole, and to assist in identifying key elements for further unit classifications. Table 7.1 shows those common elements of the building groups that are most helpful in outlining their general characteristics, including plan, entrance gate location, the orientation of the main buildings, courtyard and yard number, three building parameters of the main buildings and so on. These elements will give a brief picture of the courtyard buildings groups of the neighbourhood.

<table>
<tr><th>NO</th><th>Site</th><th>Entrance location</th><th>Main building orientation</th><th>Inner void</th><th>Roof types, building height and width (bays)</th></tr>
<tr><td>1</td><td>No68 / lane8</td><td>Northwest</td><td>North south elongated</td><td>One courtyard</td><td rowspan="2">Flush gable roof, one storey and three bays</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>3</td><td>No125 /lane8</td><td>Southeast</td><td>South north elongated</td><td>One courtyard</td><td rowspan="2">Flush gable roof, one storey and three bays</td></tr>
<tr><td colspan="5"></td></tr>
</table>

NO	Site	Entrance location	Main building orientation	Inner void	Roof types, building height and width (bays)
5	No9/1ST lane link lane8 and lane 7	East	South north elongated	One courtyard	**Flush gable roof (ordinary type)**
					
7	No39 /lane8	Southeast	South north elongated	One courtyard	Flush gable roof, one storey and three bays
					
9	No28/ maze area	West	Has an angle with south north elongated	One courtyard	Flush gable roof, one storey and three bays
					
2	No129/ lane 8	Southeast	South north elongated	Two courtyard and one yard	Flush gable roof, one storey and three bays
					
6	No71 / lane8 Yeshengtao House	Southeast	South north elongated	One courtyard and two yards	Flush gable roof, one storey and three bays
					

<table>
<tr><th>NO</th><th>Site</th><th>Entrance location</th><th>Main building orientation</th><th>Inner void</th><th>Roof types, building height and width (bays)</th></tr>
<tr><td>11</td><td>No21 /lane2</td><td>Southeast</td><td>South north elongated</td><td>Two courtyards and one yard</td><td rowspan="2">Rolling flush gable roof, one storey and three bays</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>10</td><td>No3 /lane4</td><td>Southeast</td><td>South north elongated</td><td>Two courtyards and one yard</td><td rowspan="2">Rolling flush gable roof, one storey and five, three bays</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>4</td><td>No111 /lane8 zhuqixian House</td><td>Southwest</td><td>South north elongated</td><td>Three courtyards and one yard</td><td rowspan="2">Flush gable roof, one storey and five, three, and three bays</td></tr>
<tr><td colspan="5">
Note: The building group has its own sub-lane which links with the main lane of 8</td></tr>
<tr><td>8</td><td>No51&53 /lane6</td><td>Southeast</td><td>South north elongated</td><td>Three courtyards and two yards</td><td rowspan="2">Flush gable roof, Partly two storey and all three bays</td></tr>
<tr><td colspan="5">
Note: The building groups have two storey buildings located at the back right of the building group and also have a unique back window which looks out to the garden.</td></tr>
</table>

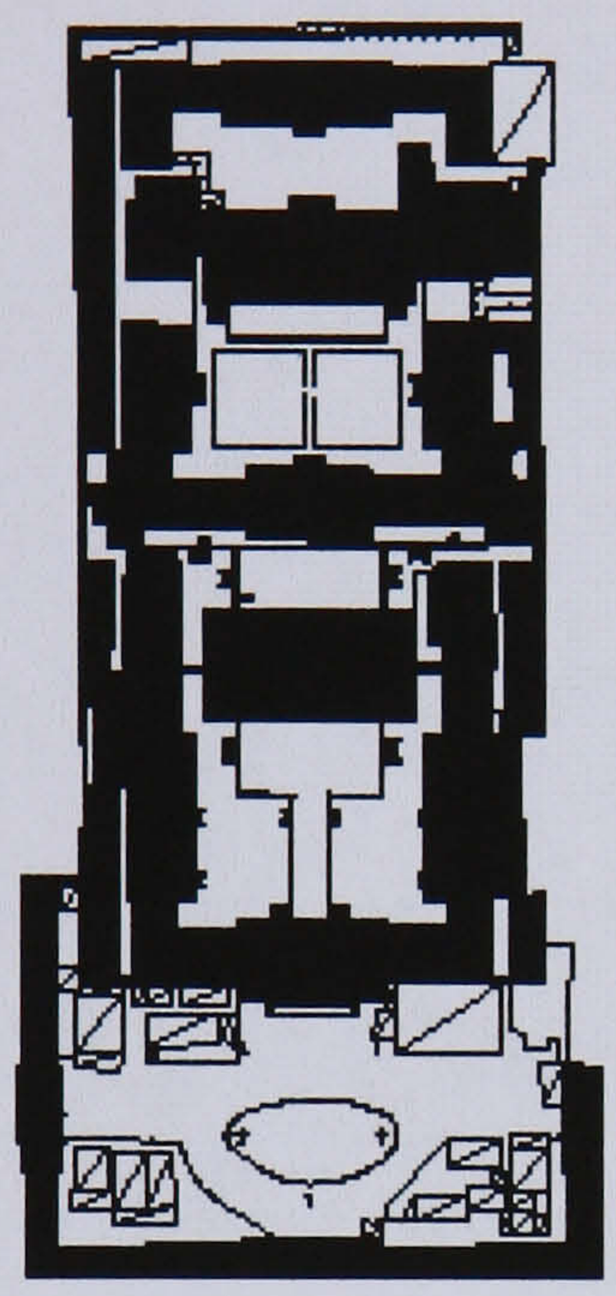
<table>
<tr><th>NO</th><th>Site</th><th>Entrance location</th><th>Main building orientation</th><th>Inner void</th><th>Roof types, building height and width (bays)</th></tr>
<tr><td>12</td><td>Fuwang Fu (mansion)</td><td>Middle part</td><td>South north elongated</td><td>Four courtyard and one yard</td><td rowspan="2">The gable and hip roof, the flush gable roof, mainly are one storey, partly two storeys, with the five bays, seven bays, five bays, seven bays and seven bays in width</td></tr>
<tr><td colspan="5">
Note: the highest standard building groups are located at 1st to 10th lanes which was built for the son of the Emperor in 17th century.</td></tr>
</table>

Table 7.1 The survey of the 12 represented courtyard buildings groups

Note: 1:The orientation of the courtyard buildings means the orientation of the main buildings
2: The roof types based on Ch6 building types
Scale: 1:2500

0 m 100m 200m 300m

N

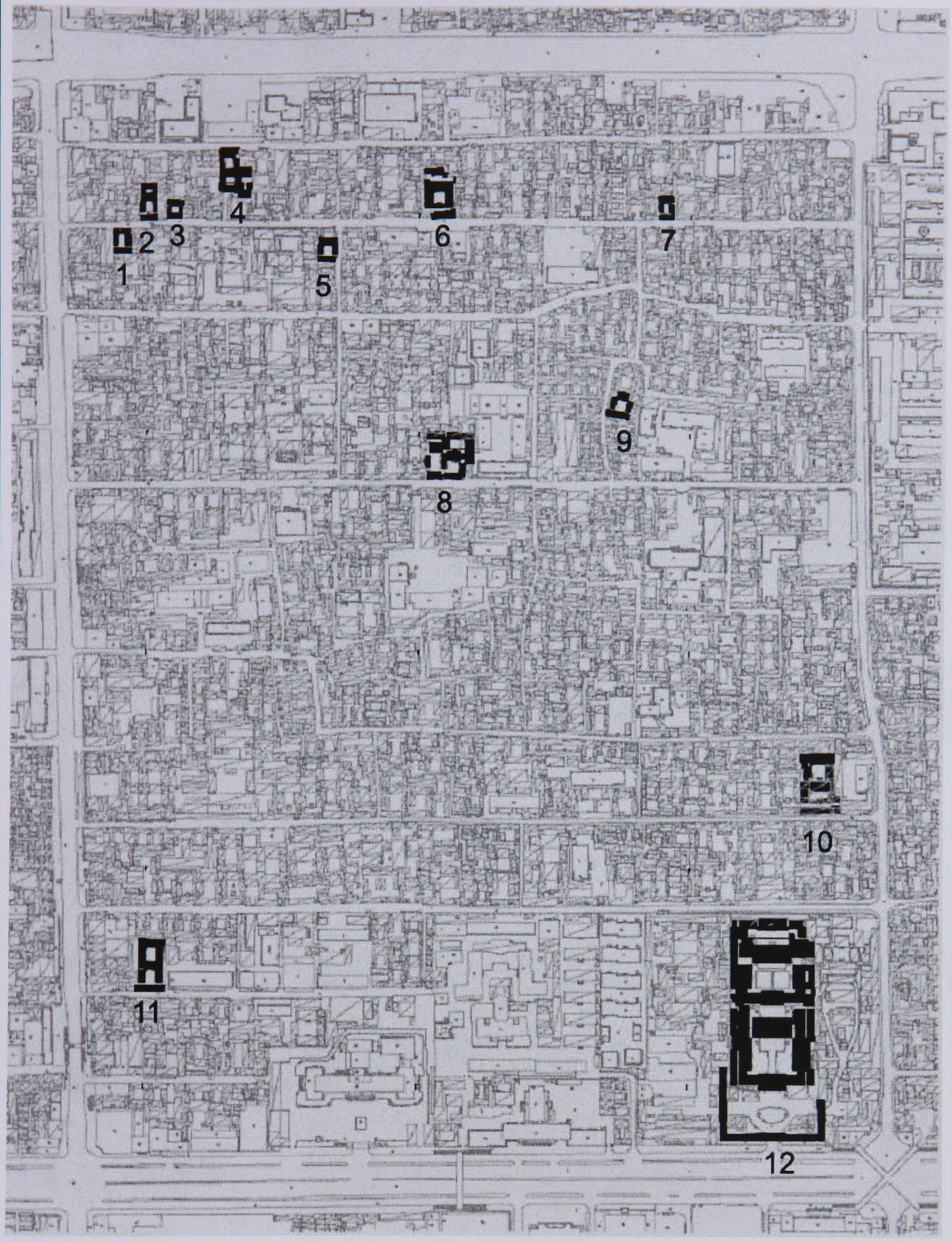
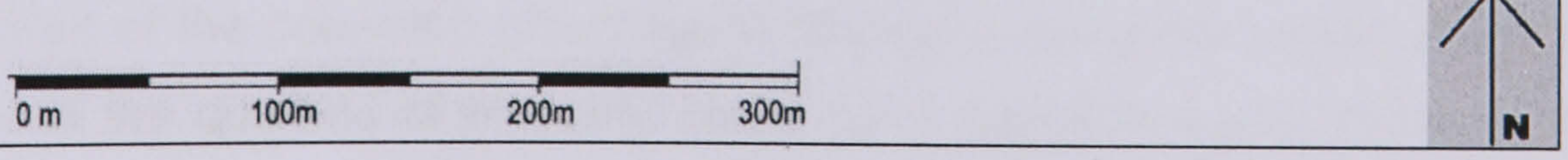


Fig. 7.1 The case studied courtyard of 1st to 10th lane of *Dongsi* neighbourhood

Scale: 1:5000

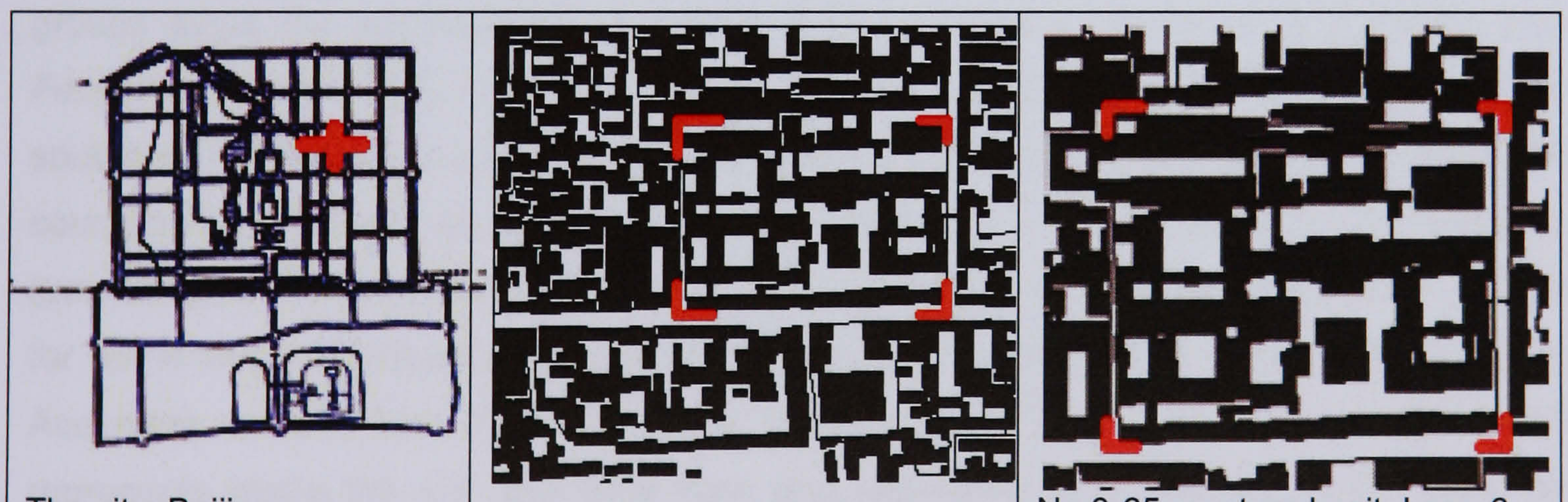


7.1 The influences of primary shaping forces (Daoism, *Fengshui,* Confucianism) upon the *Dongsi* neighbourhood courtyard buildings

To study the urban courtyard dwellings in *Dongsi* neighbourhood in Beijing, the general physical effects of the urban courtyard dwellings resulting from primary shaping forces which include Daoism, Confucianism, and *Fengshui* theory (first explained in Chapter 2, section 2.3) must be understood in more detail before classification and typological study of the groupings can begin. However, the buildings type studies in Chapter 6 have suggested there are two classes of buildings inside the neighbourhood, which include the imperial buildings with the gable and hip roof type and the ordinary buildings with the flush gable roof and overhanging gable roof types (including their rolling types). However, this is only a very general buildings classification, and can not completely solve the complication of the courtyard buildings. Therefore, this part of the study will focus on the general elements shared under each fundamental influence except the building regulation shaping force, and will help with further classification.

7.1.1 The courtyard layout and the practice of *Daoism*

From the investigation of the representative examples, it is shown that all the courtyard groupings have rectangular plans (Table 7.1) and are well integrated into the hierarchical urban grid system. Fundamentally (Fig.7.1), at the city scale, the rectangular courtyard groupings, grid lanes, and walls contributed to create the enclosed grid-based city of Beijing (Chapter 4.1.2.4).



The city: Beijing | 6th lane, Dongsi neighbourhood: | No 3-65 courtyard unit, Lane 6

Fig.7.2 The shape of the city, neighbourhood and the courtyard unit plan

Moreover, the layout of the courtyard groupings is similar to the urban layout of Beijing, not only because of the qualities of enclosed rectangular space, but also because of a series of entrance gates and a layout of enclosed spaces (Fig.7.2). This neighbourhood and courtyard buildings pattern reveals that 'a house may be viewed as a town in miniature; the town as a house on a vast scale' (Bouvier, 1971:11). From the investigation (see Chapter 6), the urban courtyard buildings work as the basic unit of the old city of Beijing (*Liang,* 1999; Boyd, 1954), however, they can vary in courtyard number, from only one small courtyard to large multiple courtyards such as those at *Fuwangfu* mansion. Other variable factors include yard, scale, location and orientation of the entrance gate/building, colour, and decoration details. Despite these variations, the groupings share similar principles of a flexible rectangular plan layout, commonly including main, wing, front buildings and entrance gates. All of these elements contribute to creating an enclosed place that embodies many aspects of Chinese *Daoist* thought: these include the ideas of earth as a life-giver, a place for daily and seasonal changes, fragments of nature, concentrations of light, sound, and water, and a refuge of safety and privacy. In general, here, the courtyard is the place where people and nature work in harmony; this principle is also a core principle of the *Daoist* decree to 'work in harmony with nature' (Clarke, 2000; *Zhao*, 2001; Antoniou, 2001). Furthermore, these common buildings have been used inside the neighbourhood to create variations of enclosed courtyard buildings groups, and this repetition of the courtyard buildings followed the principles of Daoism's concept of '*Dao'* which 'gave birth to the one, the one gave birth to two things, three things, up to ten thousand' (*LaoTzu*, 1963). These principles of the courtyard buildings groups shown in the case study examples validate the classification of these into groups, since similar buildings types/details are often repeated inside the neighbourhood.

7.1.2 The courtyard layout and the practice of *Fengshui* theories

From the survey, it can be concluded that all the entrance gates of the courtyard building groups avoid the evil trajectory of southwest to northeast, mentioned in Chapter 4 in *Fengshui* studies (Fig 7.3). The majority of the entrance gates are located at the southeast corner of the groupings, considered the best place in the manmade rectangle courtyard environment, as it leads to the gate of heaven, happiness, wealth, and longevity (see Chapter 4.2.1.3). The majority of the main buildings are oriented to the south except for some single courtyard buildings groups such as No 68 of lane 8 which faces north. According to the Five Elements (see Chapter 4.2.1.1) and orientation, the south represents where the sun originates from, and represents good fortune. Furthermore, all the wing buildings face each other and are located at the front side of the main buildings. From the previous *Fengshui* studies in Chapter 4, it is shown that the left wing building has the position of 'Green Dragon,' while the right wing building is considered that of the 'White Tiger.' Green Dragon is related to the orientation bringing vital energy and is associated with the heavenly forces that represent the direction of east and male, while 'White Tiger' brings negative energy, which represents the direction of west and female.

Both of the wing buildings provide protection to the main buildings, and the enclosure is completed by the courtyard wall.

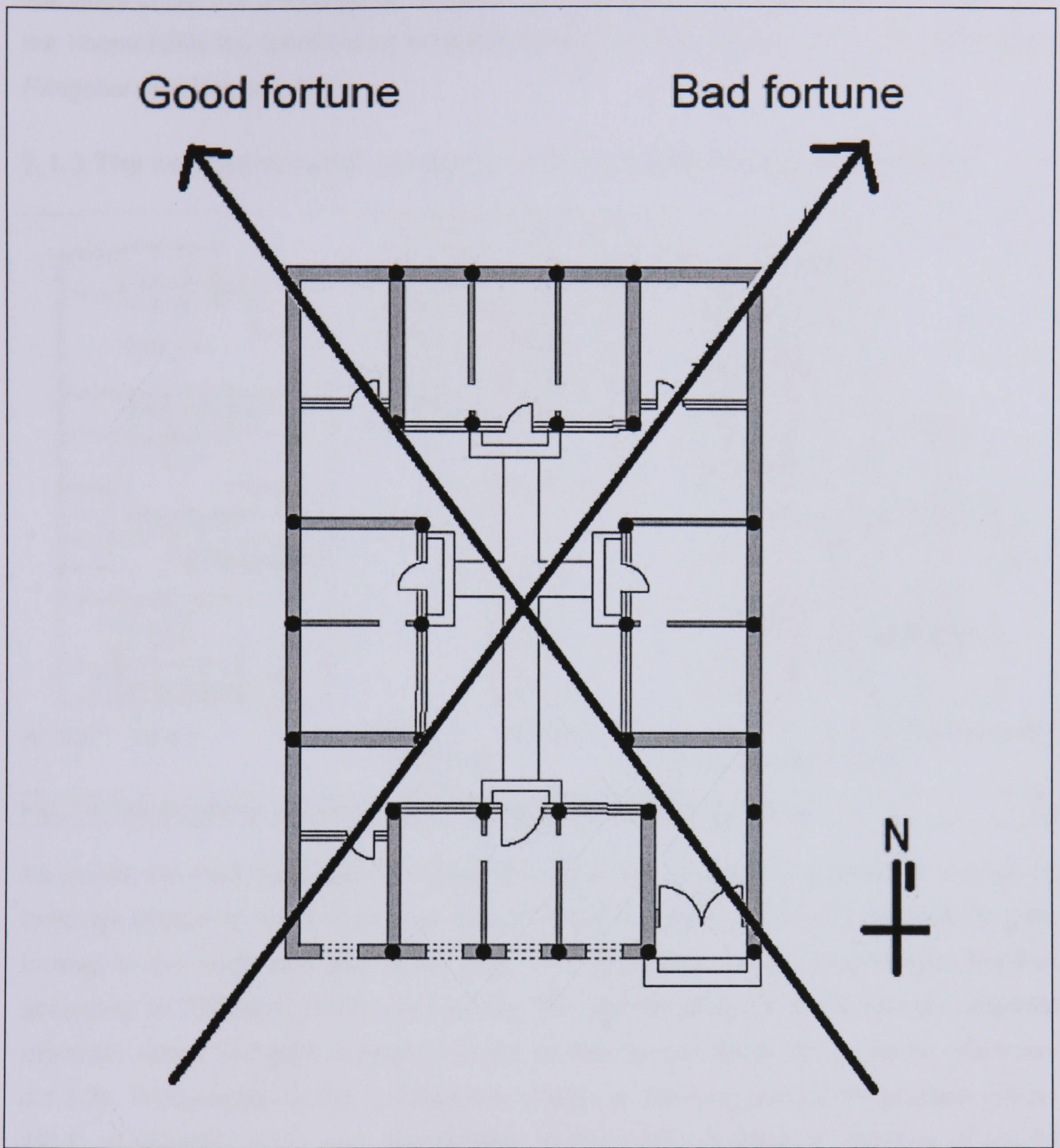
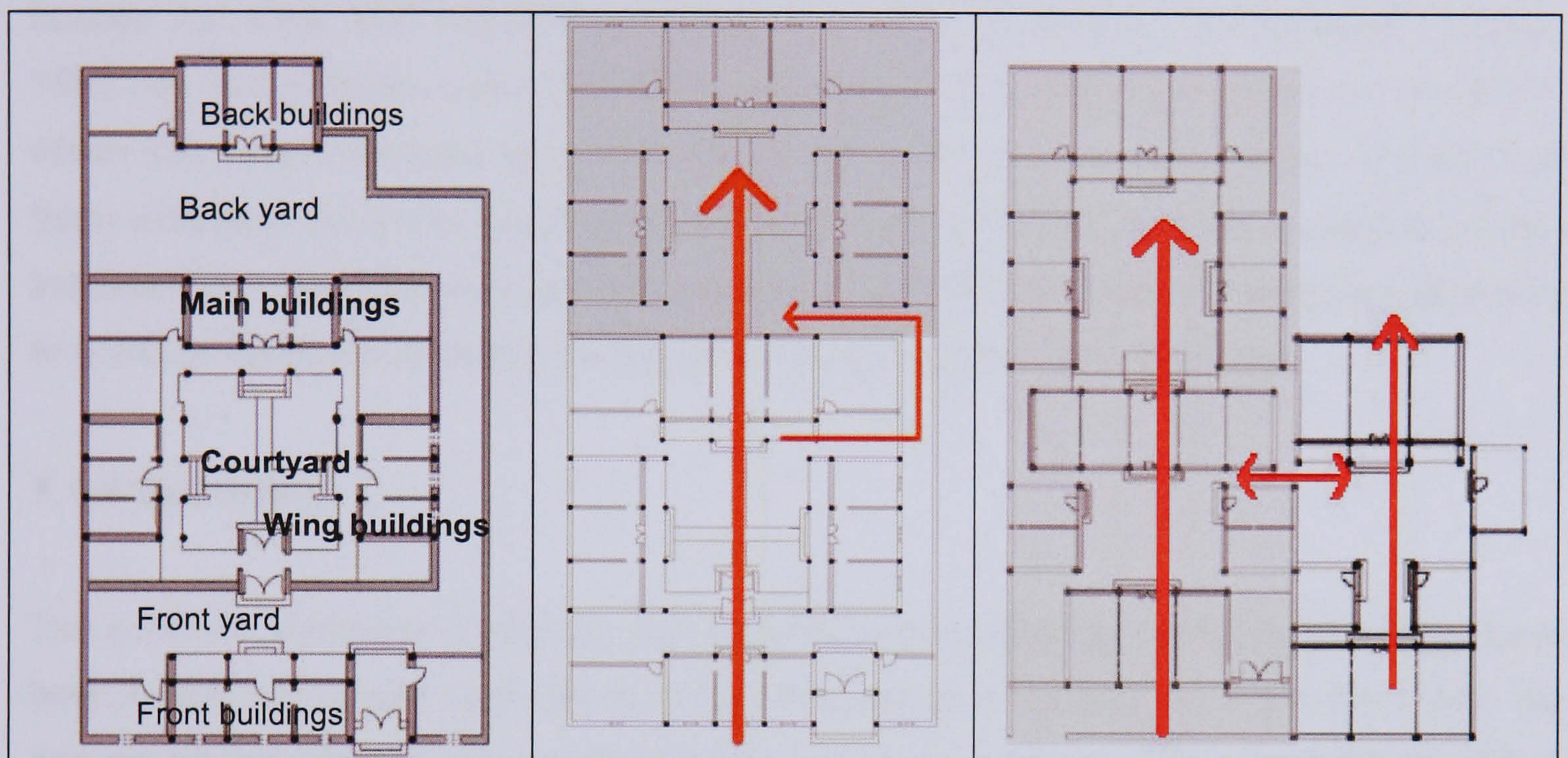


Fig. 7.3 The location of the entrance gate of one courtyard unit

Here 'the main consideration in the design of housing was to maximize the flow of positive *Qi* and to eliminate any arrangements of space that might give rise to, or enhance, the presence of harmful *Qi*. The consideration of *Qi* in Chinese traditional dwellings was based on a simple principle: it was through it that the dwellings themselves were able to breath through openings, such as doors and windows' (Mitchell & Wu, 1998:56). This traditional manifestation should be considered in the application of the case study to current sustainable design because in many ways *fengshui* was an advantage to the

Chinese people to respond to the local environment in very early times. In general, the location of the front gate, the wing buildings, the main buildings and the wall are vital elements under the principles of *Fengshui*. In this layout of the courtyard building groups, the house fulfils the functions of containing lively *Qi* in the same way as the ideal site of *Fengshui* (see Chapter 4).

7.1.3 The courtyard buildings layout and the practice of Confucianism



A: No71, lane 8

B: No 21, lane 2 (north-south axis)

C: No 111, lane 8 (north-south and west-east axis)

Fig.7.4 The extension of the courtyard buildings groups (not to scale)

As stated, the main buildings that have the front or back service yard of all the courtyards buildings groups in the survey area are oriented to south, and have the entrance gate located in the southeast part of the plot, are considered to have a privileged location according to *Fengshui* theory, except for the highest class of the *Fuwangfu* imperial mansion, where the gate is located at the central part of the building groups (also see 4.1.2.3). This general layout corresponds closely to the *Qing* authority's practice (1644-1911) of allowing noble and rich families to have the privilege of choosing 8 *mu* (1 mu=667sqm) (*Liang*, 1999). This site choice strategy fairly reflects the social role/status of the residents from the Confucian social role for every one principle (see Chapter 4). Following these Confucian principles, a typical layout of internal yards, courtyards, and building arrangements (such as that of No. 71 of lane 8) can be revealed simply as including: the front yard and the front buildings, the main courtyard and the wing buildings and main buildings, the back yard and the buildings, and the front yard and the buildings normally used as the guest area by the house owners. The wing buildings and the main building normally represent a family with the house owners and their next generation, and the back yard and related buildings mainly provide the service to the main courtyard and the buildings (Fig.7.4 left). This layout of a typical courtyard building group also represents a typical family unit in the urban area of ancient China. This is similar to group 39 of lane 8 and other one-courtyard types: they possess only front buildings for guests, wing buildings for first generation family, and main buildings for the owner. Furthermore, this layout can be easily extended for a larger family, 'to meet the exigencies of Chinese family life, this arrangement can be extended to the rear by new courtyards with their houses for sons and relations, resulting in a kind of 'cellular' development' (Blaser, 1985:14). For a larger and richer family, extension is possible, as in No. 21 of lane 2, which has been extended along the south-north axis, and No. 111 of lane 8 which has been extended along the south-north and east-west axes (Fig. 7.4) As the above studies indicated, the gate, the front buildings, the wing buildings and main buildings are essential to a unit of courtyard buildings for the practice of the Confucian principles.

7.1.4 Summary

The common elements of the four primary influences upon the courtyard groupings have been briefly introduced (with the Buildings Regulation in Chapter 6). From the study, the primary shaping forces are only applied to a group of buildings rather than the individual building. The front buildings, entrance gate, courtyard, the wall, the wing and main buildings form a basic unit for the working of *Fengshui* theories, the Confucian principles, and also the duplication and principle of working with nature from *Daoism,* and further make it possible to classify the groups according to the number of the courtyard unit to make this study easier and clearer. Furthermore, the building standards help to classify the vast buildings of the neighbourhood into two major classes: the imperial family buildings (gable-and-hip roof) and the ordinary buildings (flush gable and overhang gable roof with the further rolling roof types). These two preliminary important conclusions from the social culture and also the building standard studies of all the courtyard buildings groups inside the neighbourhood will provide the fundamental criteria for the future classification of the courtyard buildings groups for the typology studies.

7.2 The classification of the represented courtyard buildings of the first through 10th lanes of *Dongsi* neighbourhood

After defining the overall nature of the courtyard groups related to primary shaping forces studies, the classification of various courtyard buildings units can be carried out. From the previous studies, two conclusions have been made: firstly the socio-cultural and also physical location of each building grouping reveal practices of Daoism, *Fengshui* theories and Confucianism, and secondly, two types of dwelling are revealed; 'ordinary' and 'imperial' (as in the *Fuwangfu* Mansion). Furthermore, for the courtyard buildings inside the neighbourhood, each courtyard unit after the classification should respond to the primary shaping forces which were studied in the previous Chapter 4.These include the principle of the 'Dao', which can be recreated by all courtyard units inside the neighbourhood, *Fengshui* theories, whose manmade environments ensure a good position and prosperity, and the Confucian notion that one family can be located in a specific place in a proper manner.

According to the above requirements, it is easy to identify that a courtyard unit of 1st to 10th lanes must include the front buildings and entrance gate, the west and east wing buildings, the main buildings, the courtyard and finally this 'seclusion is ensured by the bordering walls and single gate' (Knapp, 2000:34). More essentially, the classification based on the five common buildings and structural elements will make it much easier to classify the collected materials into the specific categories and sub-categories. These five common buildings/building elements which form the basic architecture layout of the courtyard buildings groups are referred to as one *Yuanluo* (courtyard buildings) unit. From this classification, the number of courtyard units can be easily identified as being one to four to more than four units, and from the building standard roof principles, these 12 types can be grouped as imperial or ordinary. To the common buildings/buildings of a basic unit of the *Yuanluo* (courtyards building) (Fig.7.5), the direct translation into English can be concluded as follows:

1. *DaoZuo* and *DaMen:* **Front buildings and entrance gate**
2. YuanLuo: **Courtyard**
3. *XiangFang*: **Wing buildings**
4. *ZhengFang*: **Main buildings**
5. *WeiQiang*: **Enclosure walls**

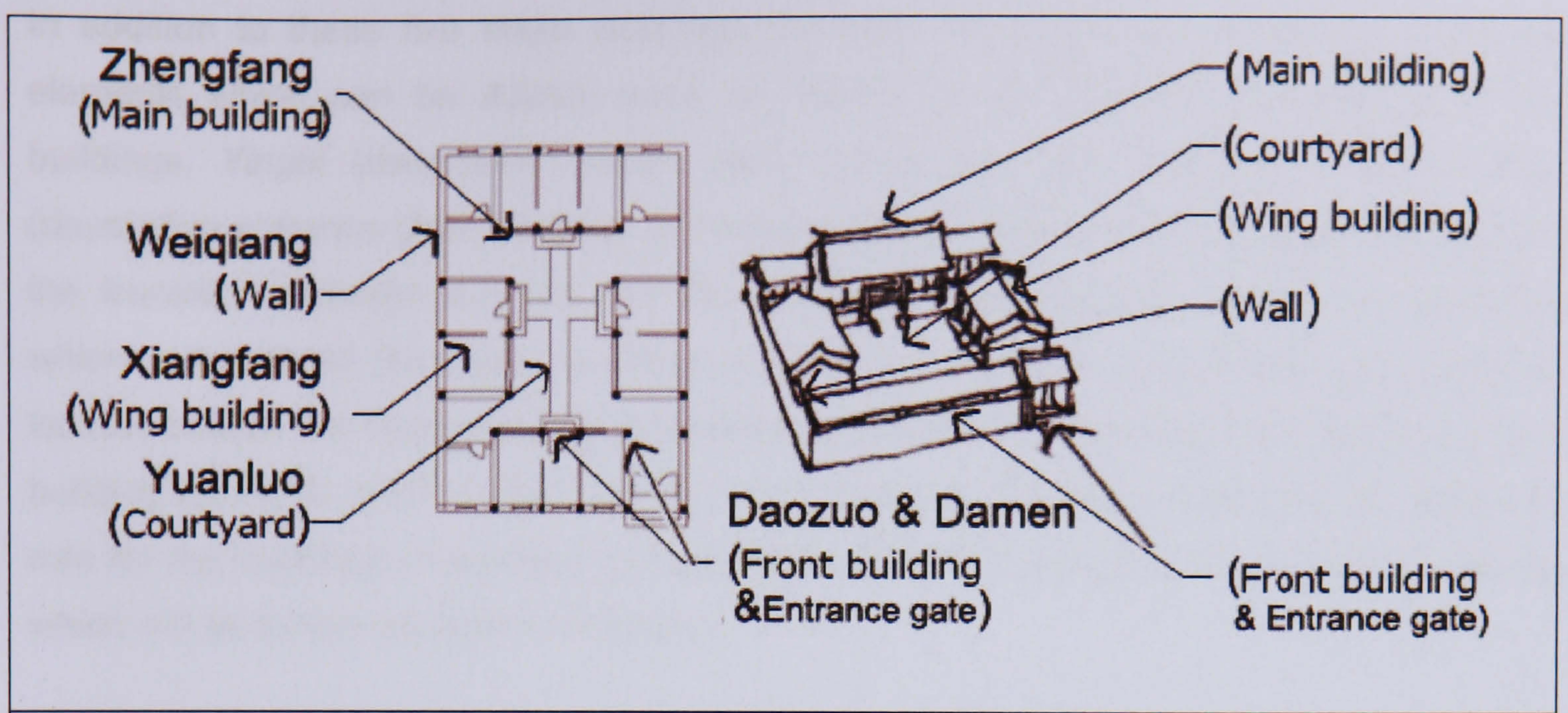
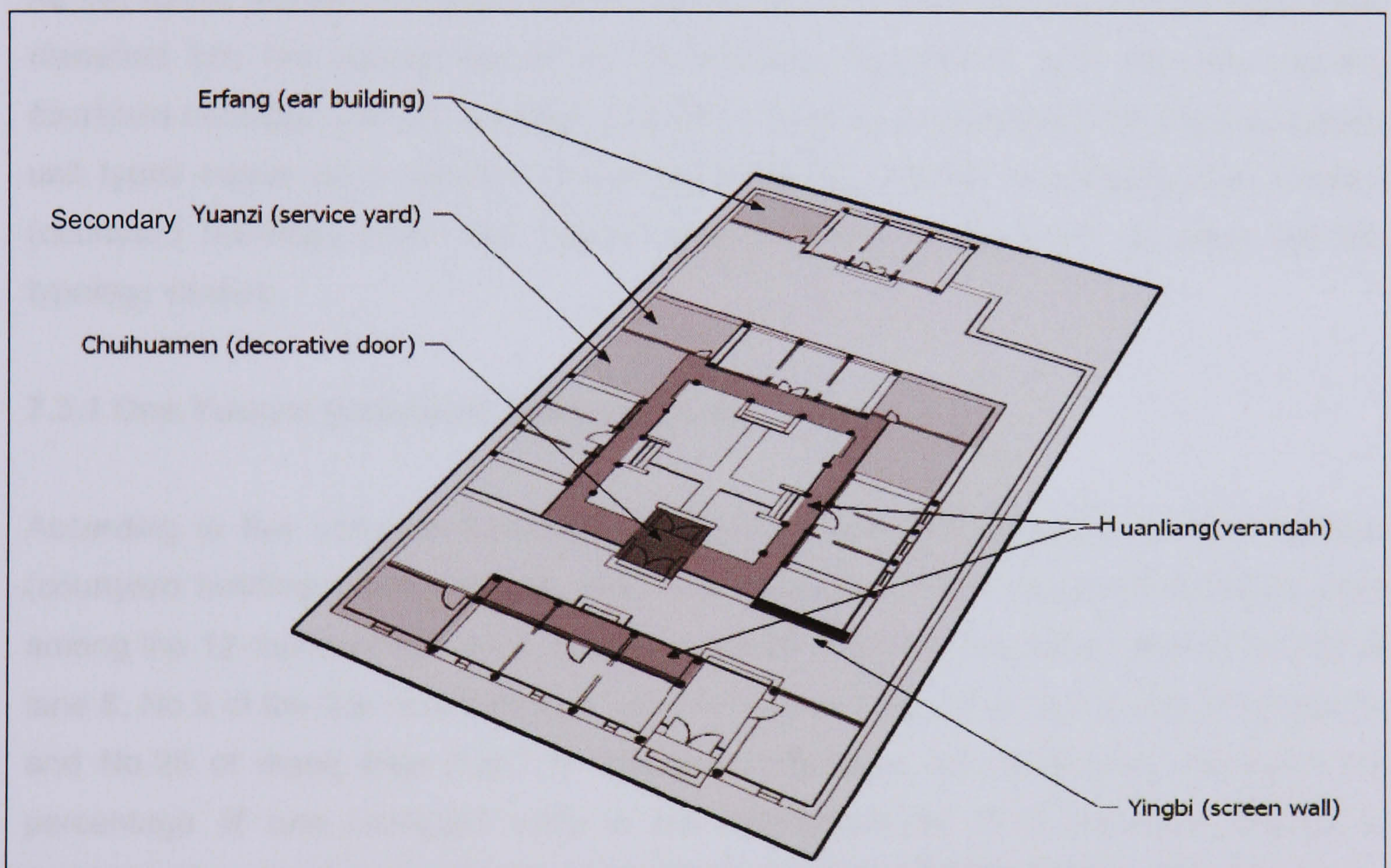
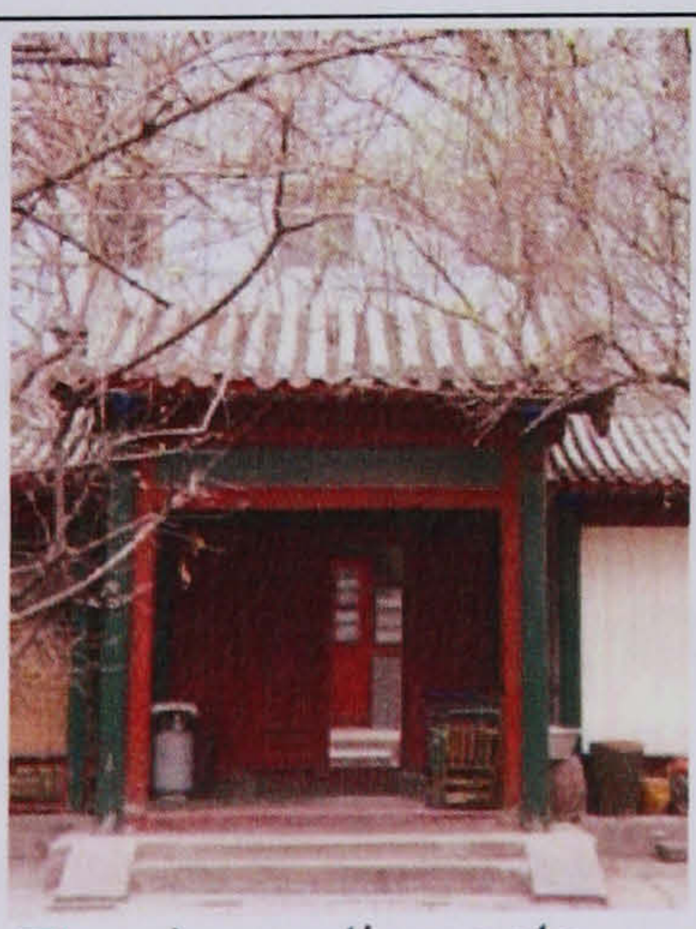
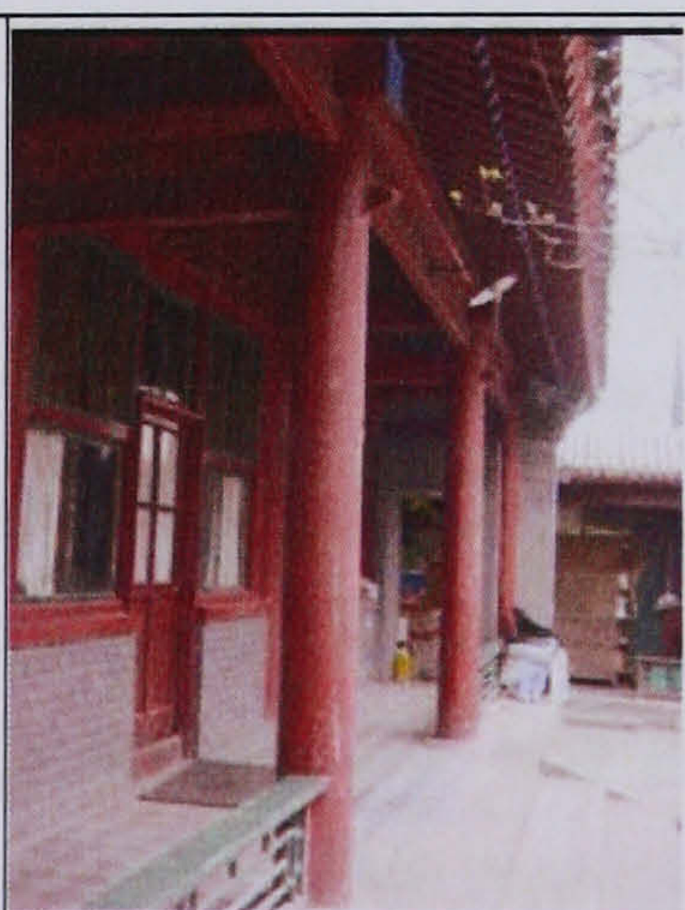


Fig. 7.5 The primary buildings of a *Yuanluo* (courtyard buildings) unit
Note: the drawing is based on No 39 of lane 8




The screen wall


The decoration gate


The verandah


The 'er' (ear) building

Fig.7.6 The secondary building and buildings elements,
Note:the drawing is based on the *Ye shengtao* house (No 71 of lane 8)

In addition to these five major buildings/elements, there are also secondary buildings elements which can be added, such as *Yuanzi* (yard), providing the service to the buildings, *Yingbi* (decorative screen wall), facing the main entrance, *Chuihua Men* (decorative entrance gate), located at the central axis of the main building which provides the transition between the first and the second yard, *Huanlang* (encircled verandah), which connects all the major buildings around the courtyard, and *Erfang* (ear building) located beside the main buildings to provide a service space for the main buildings. The building elements such as the building wall, windows, and doors also play an important role for the buildings to achieve a comfortable living environment and the design values which will be further studied in Chapter 8.

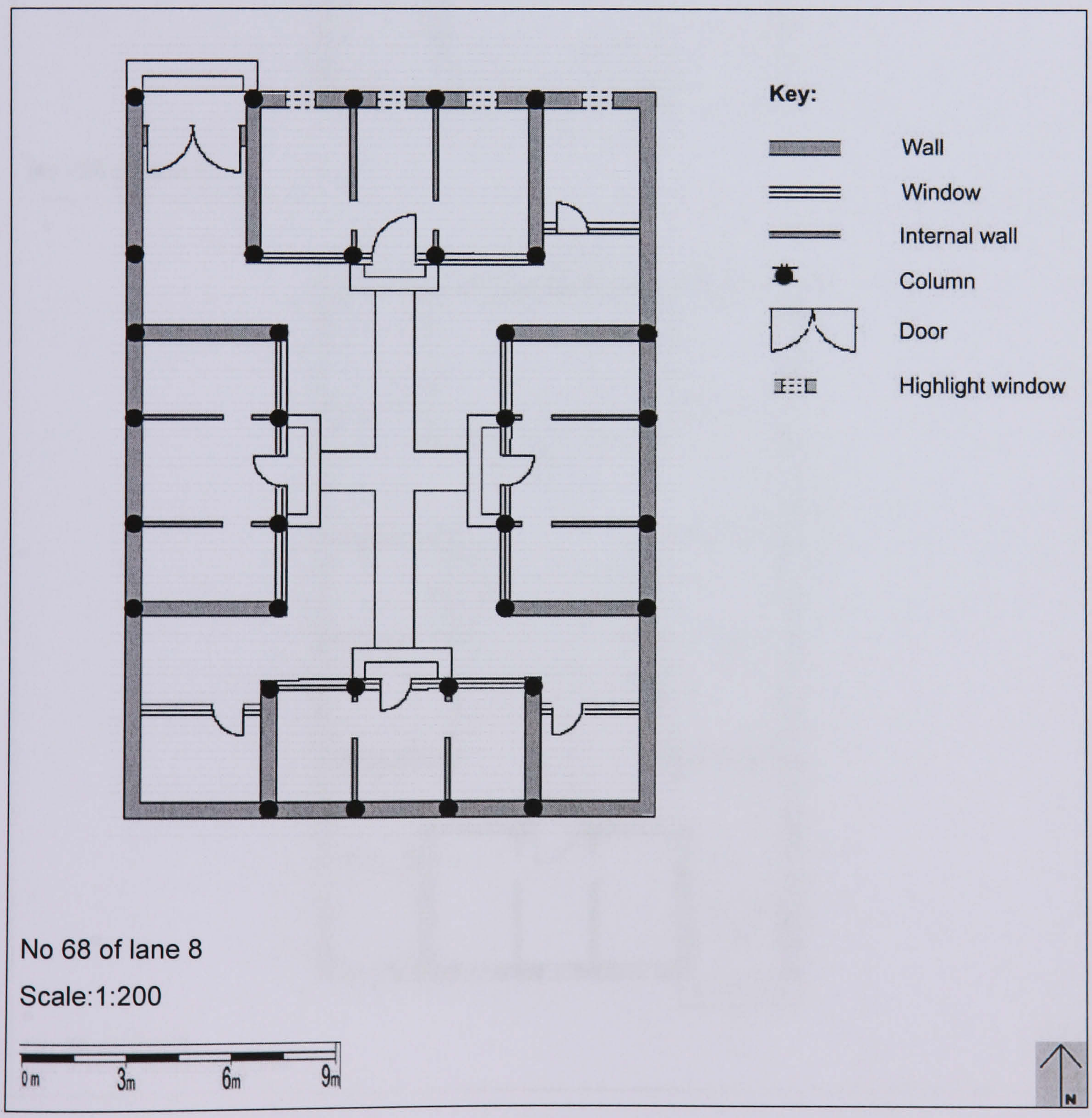
7.3 Courtyard buildings unit plan typology studies

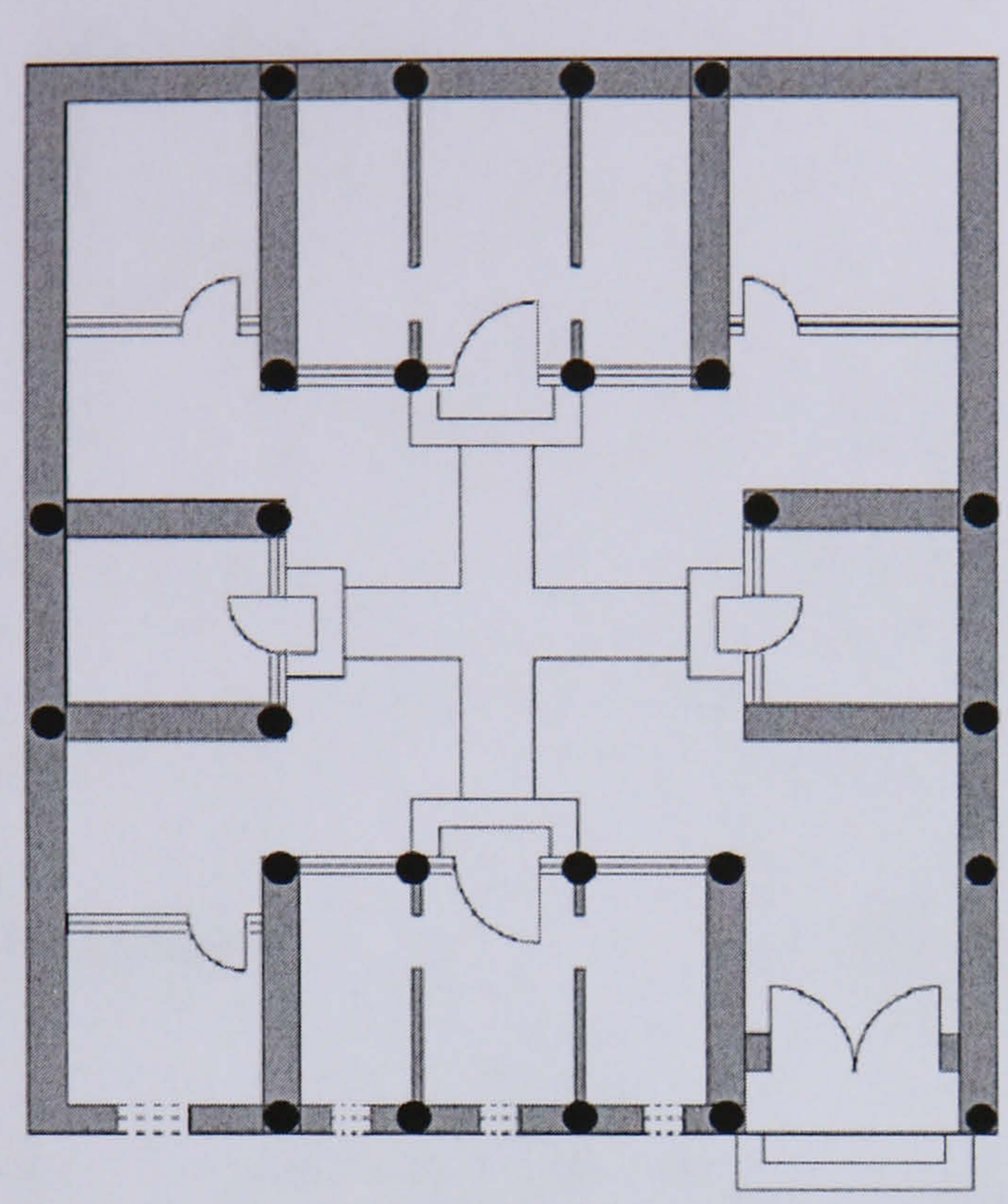
As the above studies indicated, the 12 case study courtyard building groups have been classified into two classes based on the Building Regulations, and then the ordinary courtyard buildings (except *fuwangfu* mansion) have been classified into three courtyard unit types based on 5 common buildings/ buildings element composing one *Yuanluo* (courtyard buildings unit). This classification makes it much easier to carry out the typology studies.

7.3.1 One *Yuanuo* (courtyard buildings) unit

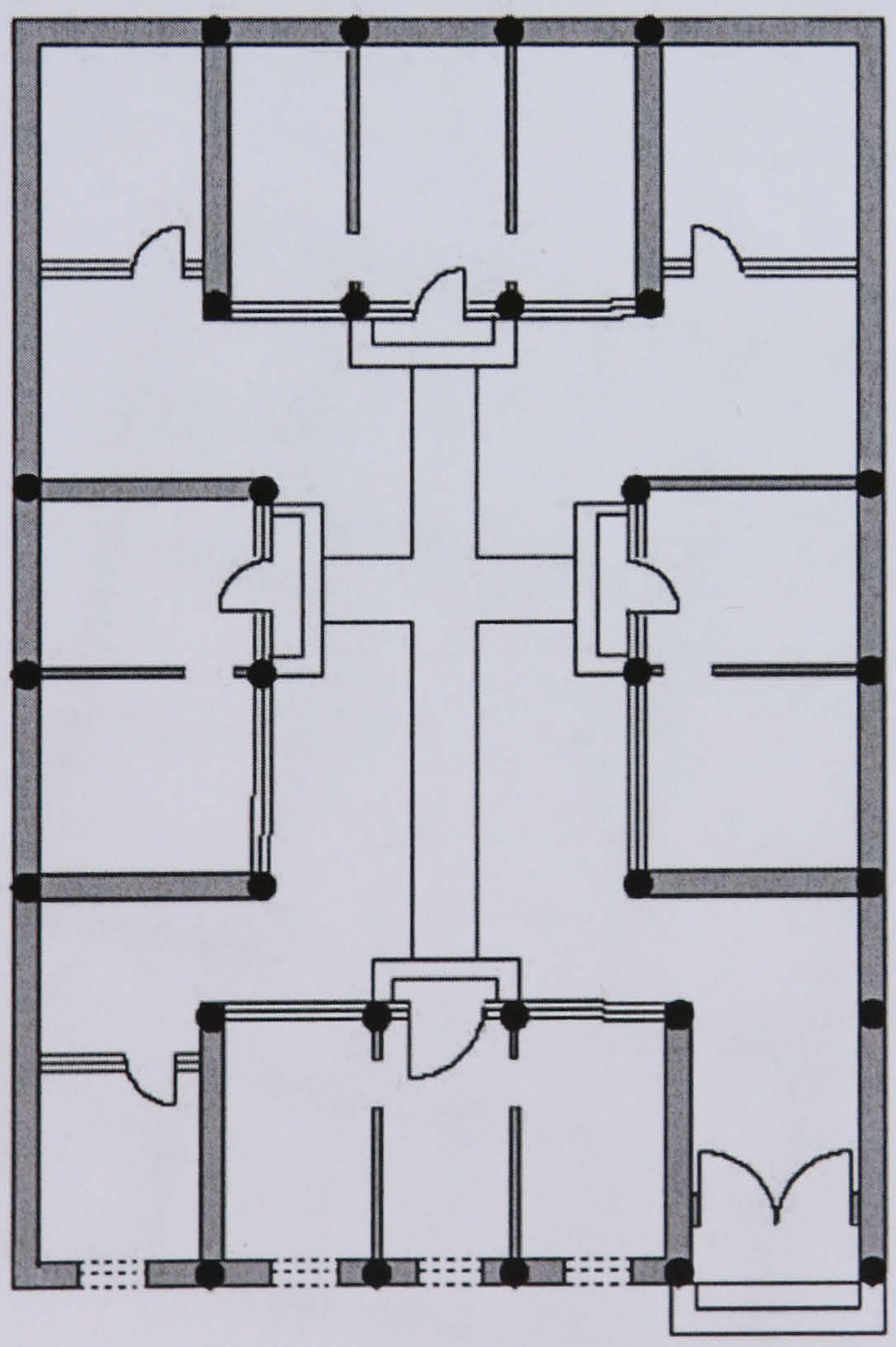
According to five common buildings and building elements classified as one *Yuanluo* (courtyard buildings) unit principle, there are altogether 7 one courtyard buildings units among the 12 represented cases, which are No.68 of lane 8, No.129 of lane 8, No.125 of lane 8, No.9 of the first lane between lane 8 and lane 7, No.71 of lane 8, No.39 of lane 8, and No.28 of maze area (Fig.7.7). However, this does not necessarily represent the percentage of one courtyard units in the neighbourhood. It is extremely difficult to calculate the percentage of the one *Yuanluo* (courtyard buildings) units inside the neighbourhood because of the transformation of the courtyard buildings groups and also the lack of a precise survey drawing of the neighbourhood before 1950's. Nevertheless, the rough percentage of one *Yuanluo* (courtyard buildings) units may be calculated from the current situation which is 45 of the 56 identifiable courtyard buildings between lanes 8 and 9. There are also 6 two courtyard units, 4 three courtyard units and 1 four courtyard units; the remaining 63 courtyard unit buildings are not identifiable because of transformation. This result indicates that the number of courtyard buildings from the small scale buildings groups to the large scale courtyard buildings groups is a pyramid shape, which also shows the mixed community of the neighbourhood- the rich and the relatively poor community have lived together. This indicates the mixed nature of the community which, just as the interviewee of No 111 of lane 8 stated:

Zhu (6): some of the smaller and poor quality courtyard units normally provide (in the past) services to the larger and richer courtyard buildings nearby.

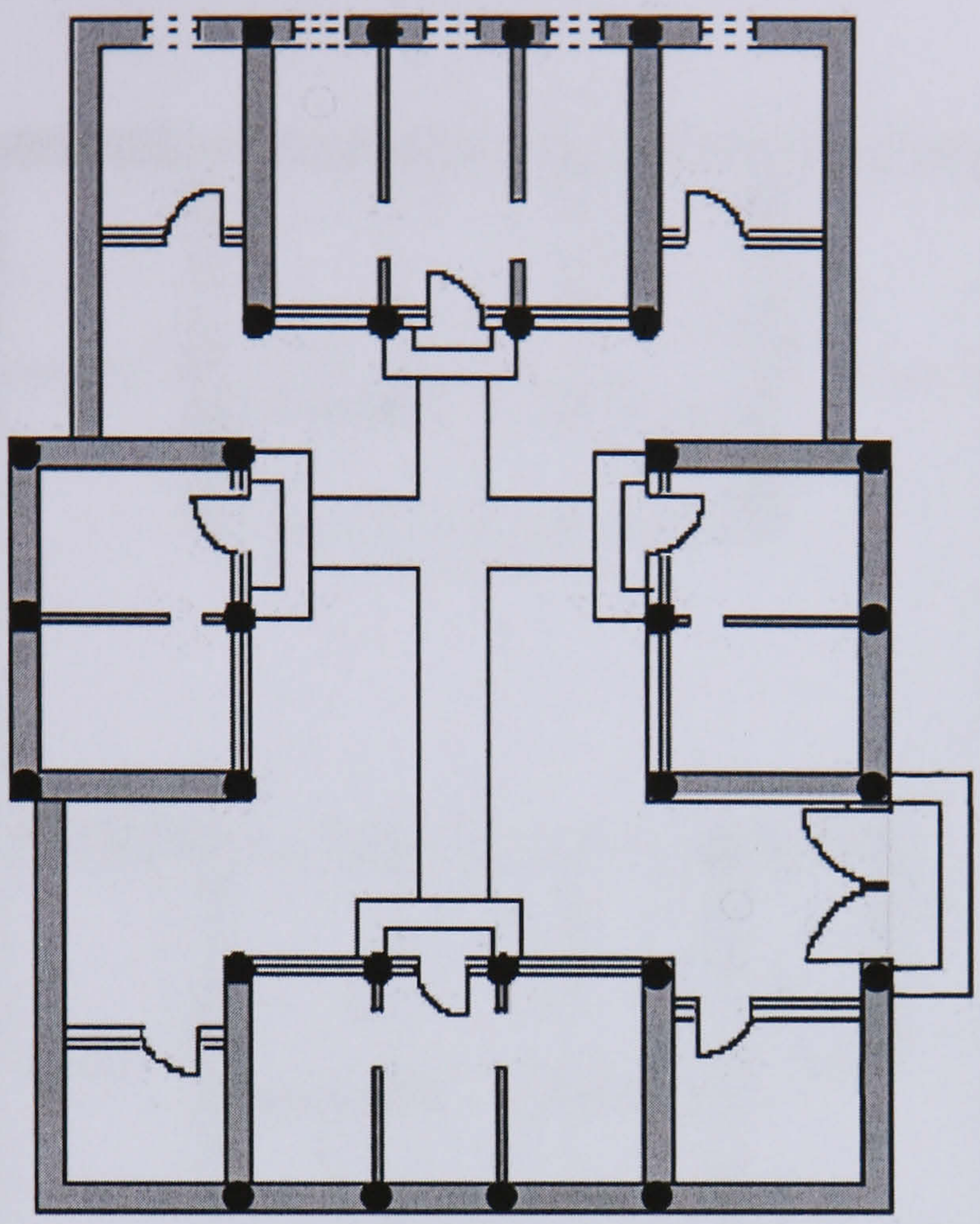




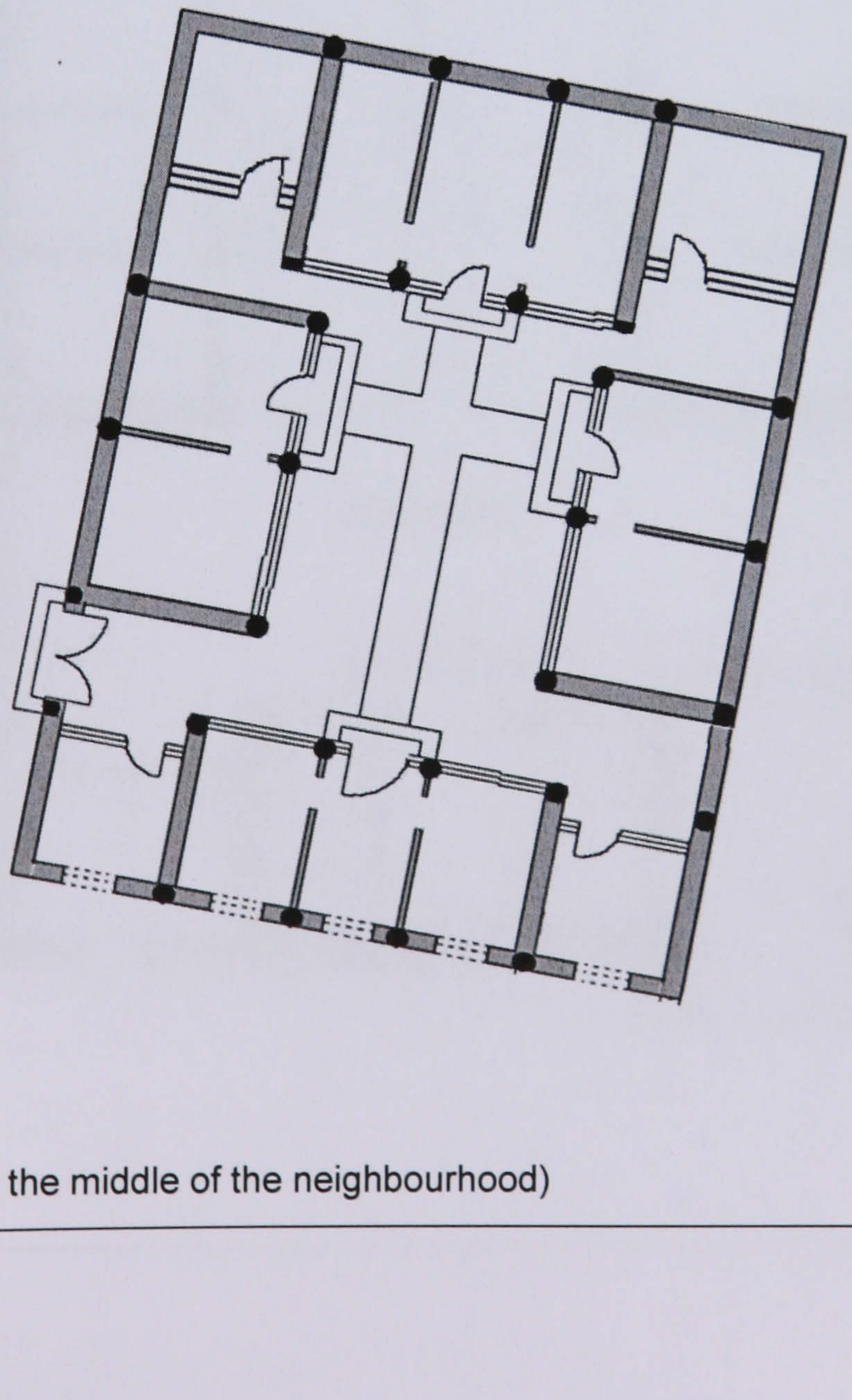
No 125 of lane 8



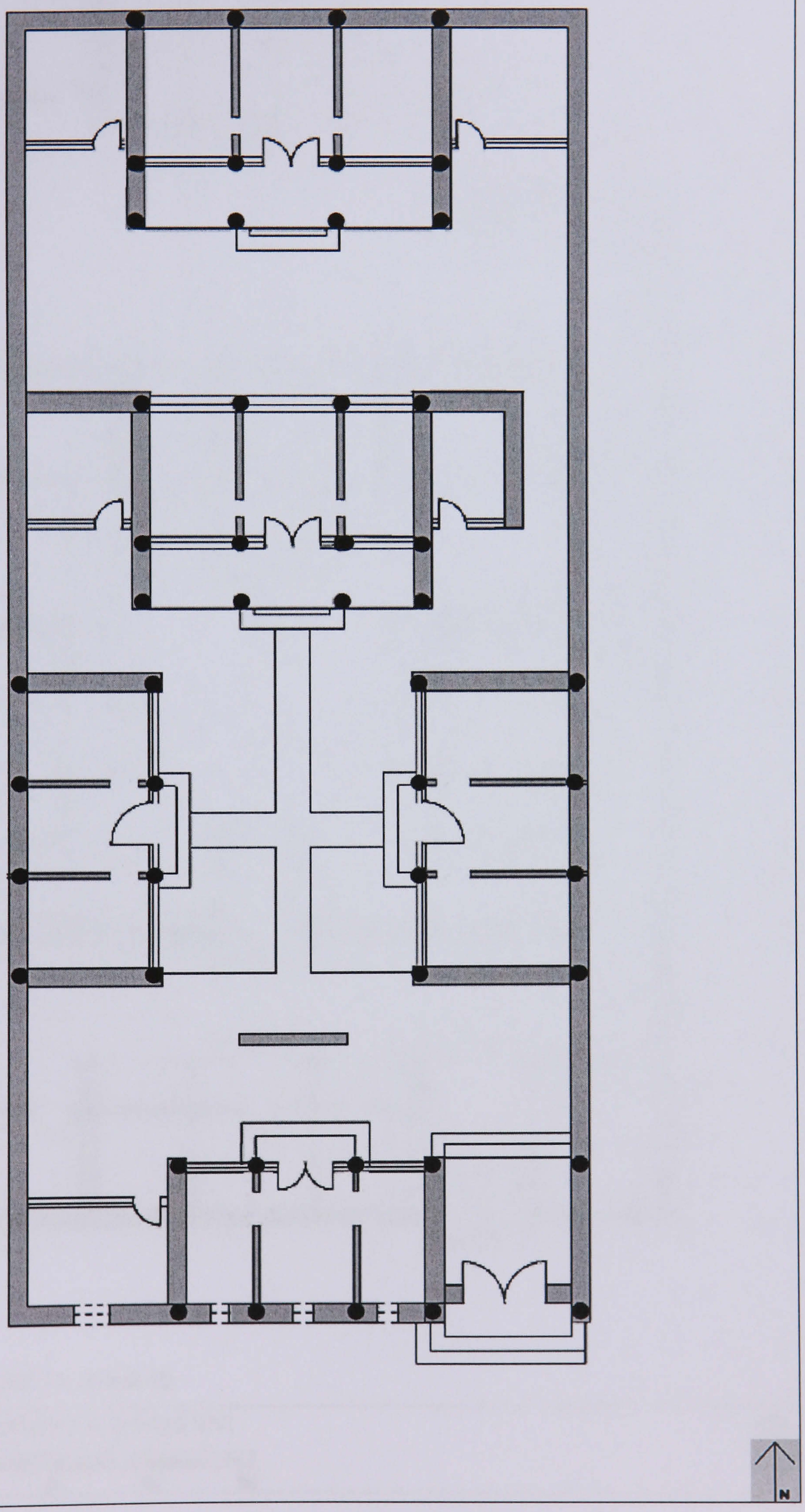
No 39 of lane 8



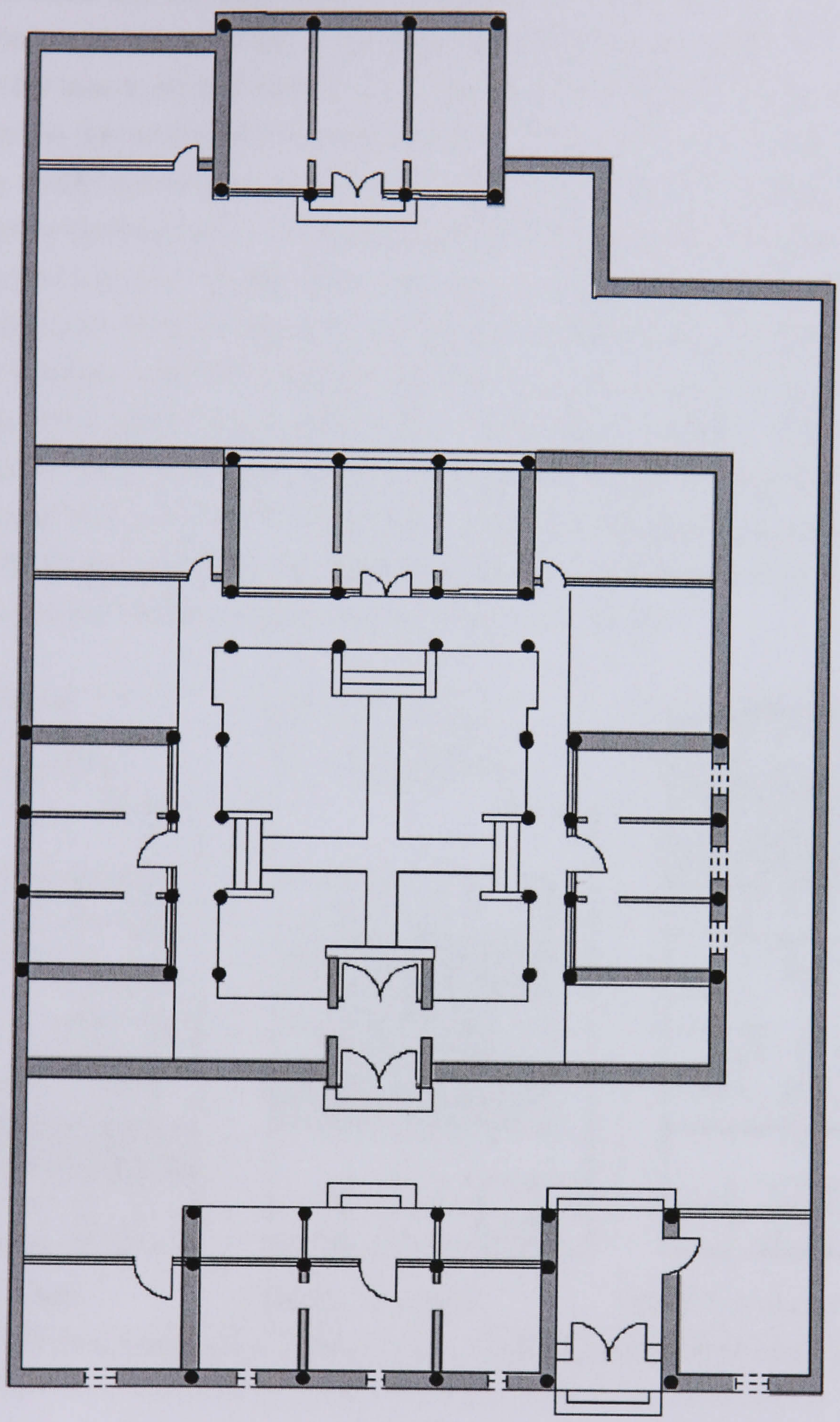
No 9 of lane 7 & 8



No 28 of maze area (in the middle of the neighbourhood)



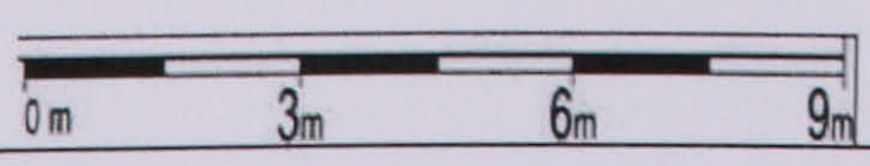
No 129 of lane 8



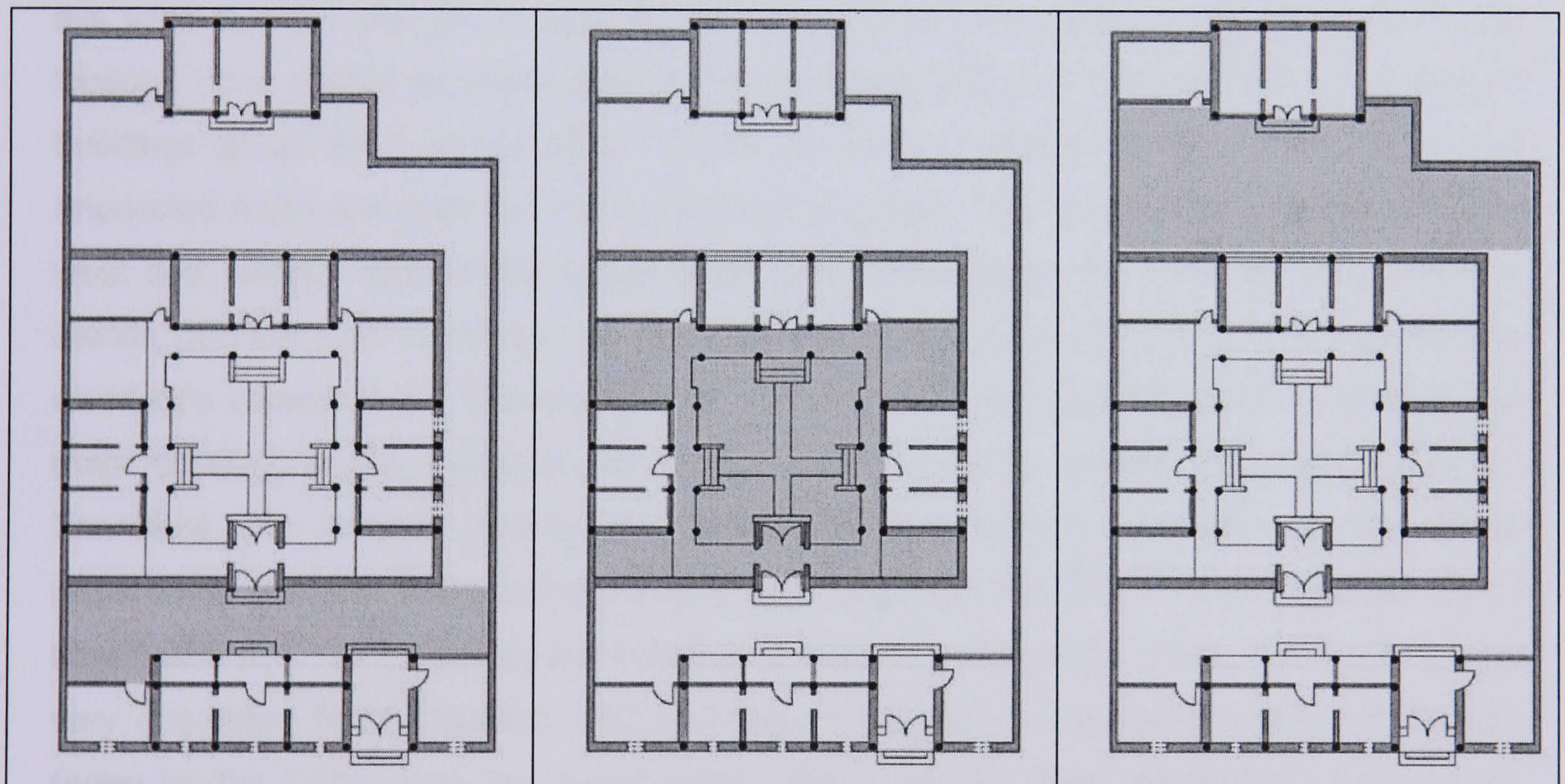
Ye Shengtao House (No 71 of lane 8)

Fig.7.7 The one courtyard buildings unit

Scale: 1:200



The location of the entrance gate of the *Yuanluo* is the most important link point between the internal world and the external world. Identifying its location on the plan will help to disclose the social culture values of the gate. From the survey of these 7 one courtyard units, No.129/ lane 8, No.125 /lane 8, No.71/lane 8 and No.39 /lane 8 have the entrance gate located in the southeast privileged direction which represents the gate of heaven, happiness, wealth and longevity in *Fengshui* principles, but the gate location of No.68 of lane 8 is in the northwest part of the buildings group because of the limitations of the plot. No 9 of the first sub-lane between lane 8 and lane 7 is in the east part of the building and No. 28 in the maze area is in the west part of the buildings. These entrance locations do not have a privileged orientation because they have to use plot space left by the residents with higher social status and a better economic situation. However all the courtyard buildings of the survey area have avoided the worst direction by *fengshui* principle, which is the direction from northeast to southwest. These entrance gates also perform as the service point for the water, goods supply and also the waste collection by a system of carts, often run by a private enterprise based on door to door work.



Front Yuanzi (yard) | Yuanluo (courtyard) | Back Yuanzi (yard)

Fig. 7.8 The different types of the Yuanzi (yard), Yuanluo (courtyard) of one courtyard unit No 71, lane 8

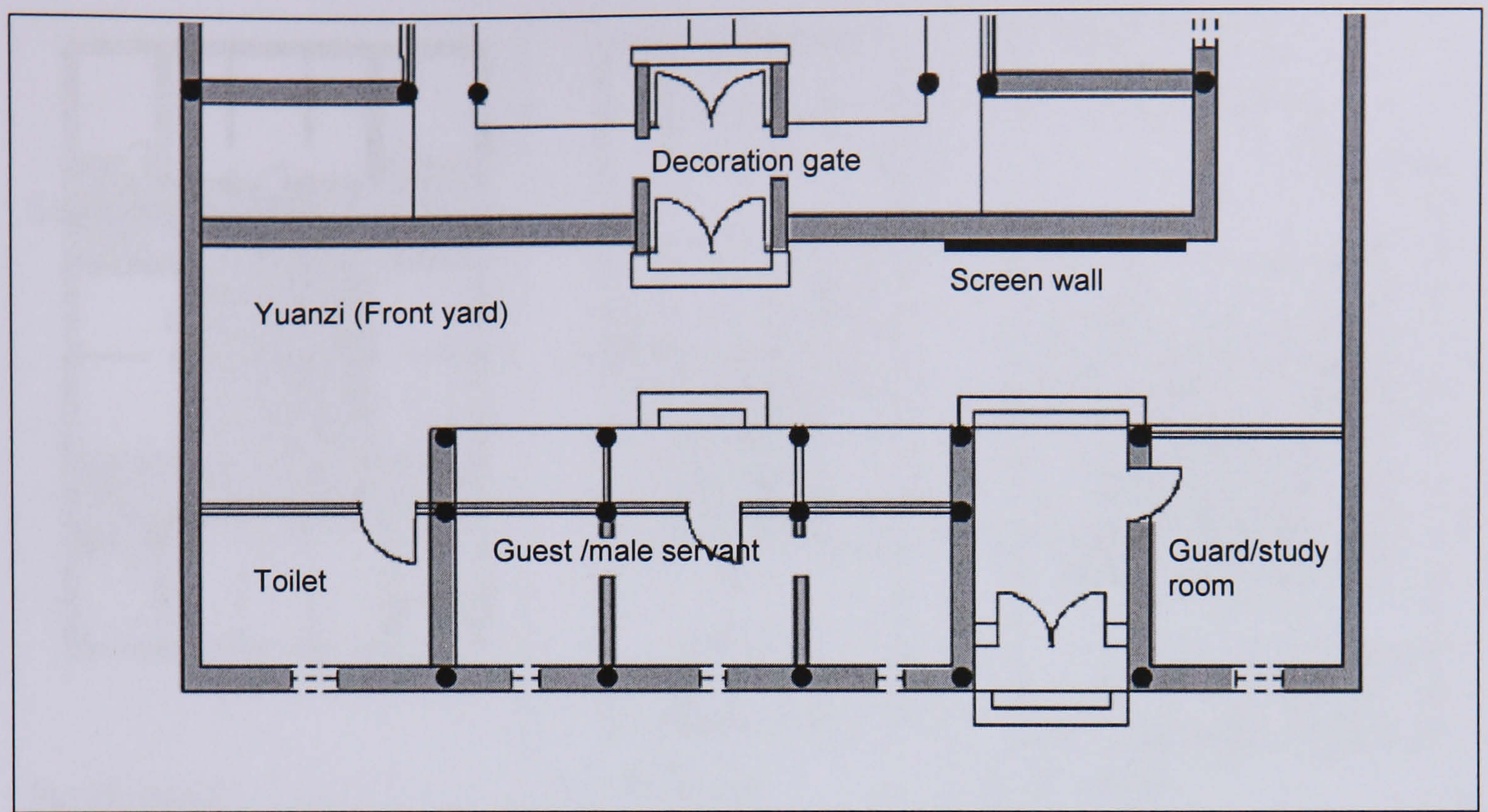
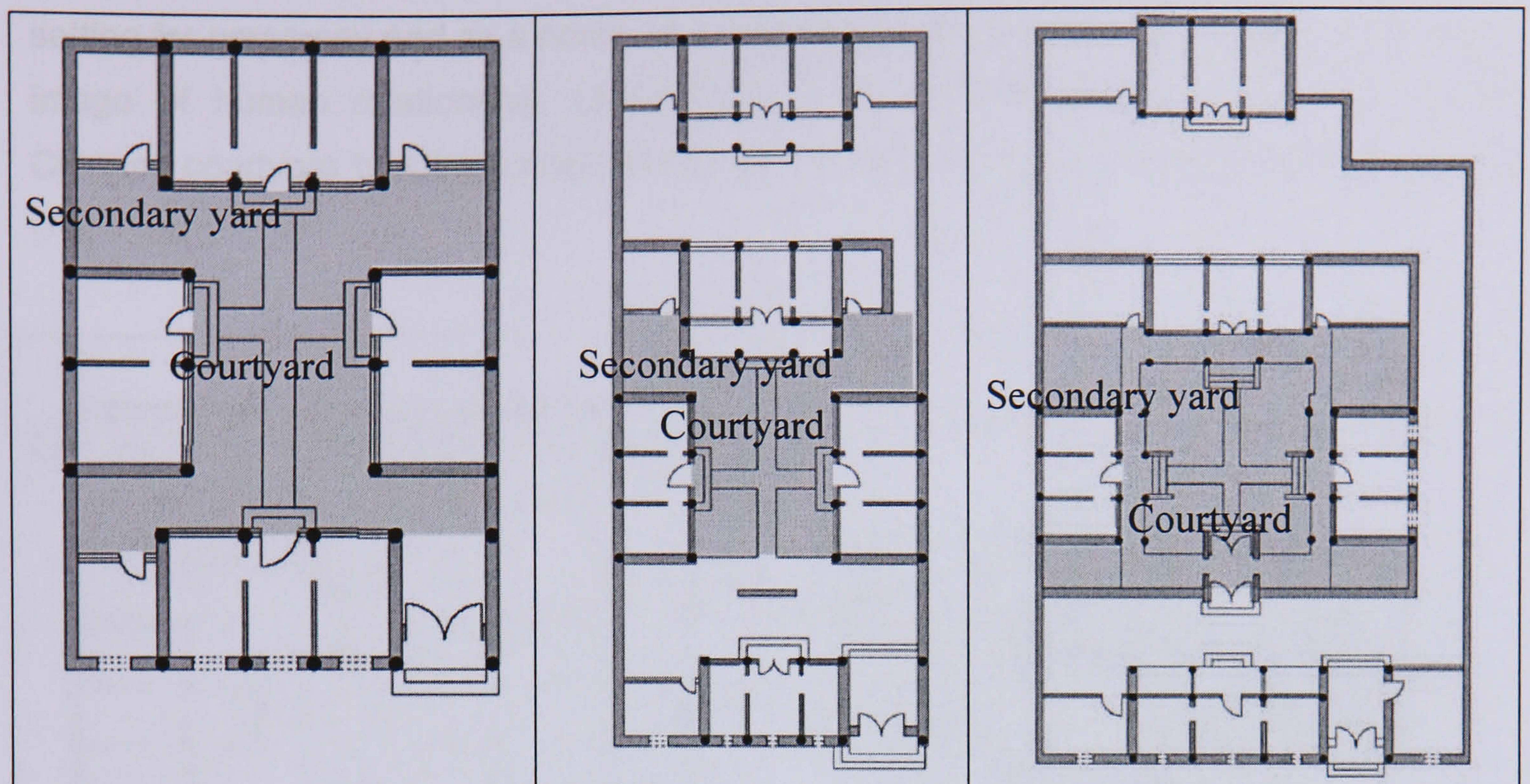


Fig. 7.9 The uses of the front Yuanzi (yard), no 71, lane 8

Meanwhile, the number of the *Yuanzi* (yard) of the one *Yuanluo* (courtyard buildings) unit are various from one (front yard) to two yards (front and back yards). Orientation and location have played an important role in regulating uses; for a south oriented courtyard buildings group such as No.39 of lane 8, the front buildings located in the south and orientated north are used by the visitors and servants. The wing buildings located in the west and eastern part of the building groups were used by the next generation of the owner, and the main building located in the north and oriented to the south is used by the dwelling's owner. If the building groups oriented to north such as No.68 of lane 8, the main building would locate at south part of the building groups and oriented north. Therefore, the deepest location is normally more important and used by the oldest generation, but in a two yards one courtyard buildings unit (Fig.7.8) such as No. 71 of lane 8 and No. 129 of lane 8, the activities of different courtyards, yards and the buildings vary according to the location and orientation. The front buildings located in the south (open to the north) hold the guest room, the youngest male generation of the family member may occupy the middle of the front buildings, and the male servant room can also be located inside this building. The study room (in ancient China, the education of the rich family was normally carried by a private tutor at home) and the guardroom were normally located in the east part of the front buildings, and the toilet was located in the west part of this front building where the gate of sickness is; this arrangement uses the human waste to suppress the bad fortune by *Fengshui* means (Fig. 7.9). Guests and some of the servants could only access the front yard, however, the closest family friends could go further to the courtyard buildings with permission (Knapp, 2000).



No 39, lane 8 | No 129, lane 8 | No 71, lane 8

Fig. 7.10 The courtyard of the one courtyard unit buildings (not to scale)

The *Yuanluo* (courtyard) where the wing buildings and the main buildings are located was a private place for the residents, particularly in a multi-courtyard buildings group, and the visitors and servants could not enter into the place without permission (Fig.7.10). Here the main building was normally oriented to the south and the wing buildings face each other (the main building of No 68 faces north). From the survey, we see that the *Yuanluo* (courtyard) can assume a variety of forms, which can be a simple single courtyard (like most of the one courtyard buildings, e.g. No. 129 of lane 8) or a courtyard surrounded by a circulated colonnade like No. 71 of lane 8, and most courtyards have two secondary yards to provide the service to the 'ear room' (Fig.7. 10). The *Yuanluo* (courtyard) was the most important and private area in a courtyard unit and is surrounded by the main building, wing buildings and other secondary buildings.

In the one courtyard unit, the *Zheng Fang* (main buildings) were normally divided into three bays and contain the most important rooms. The *Zhengfang* (main building) was not only a place for the owners' living room and bedrooms but also an important place for the family's ancestral worship and sacrificial ceremonies. The ancestral hall together with the living room was located at the centre of the main buildings. Traditionally, in the early morning the younger generation would go to the ancestral hall area to pay their respects to the older generation and to listen to their advice and admonitions. During festivities or memorial ceremonies, the most important rituals would take place in this area: family members would worship their ancestors one by one in the ancestral hall (Fig.7.11). The uses of the ancestor hall is just as Nelson Wu states: 'The dual quality of the house, as a setting for ceremony and as a home, is a most important characteristic of the house as an image of human relationship' (1963:32-34). The multi-function ancestral hall in the Chinese courtyard buildings which similar to a living room which can be used as follows (Fig.7.11):

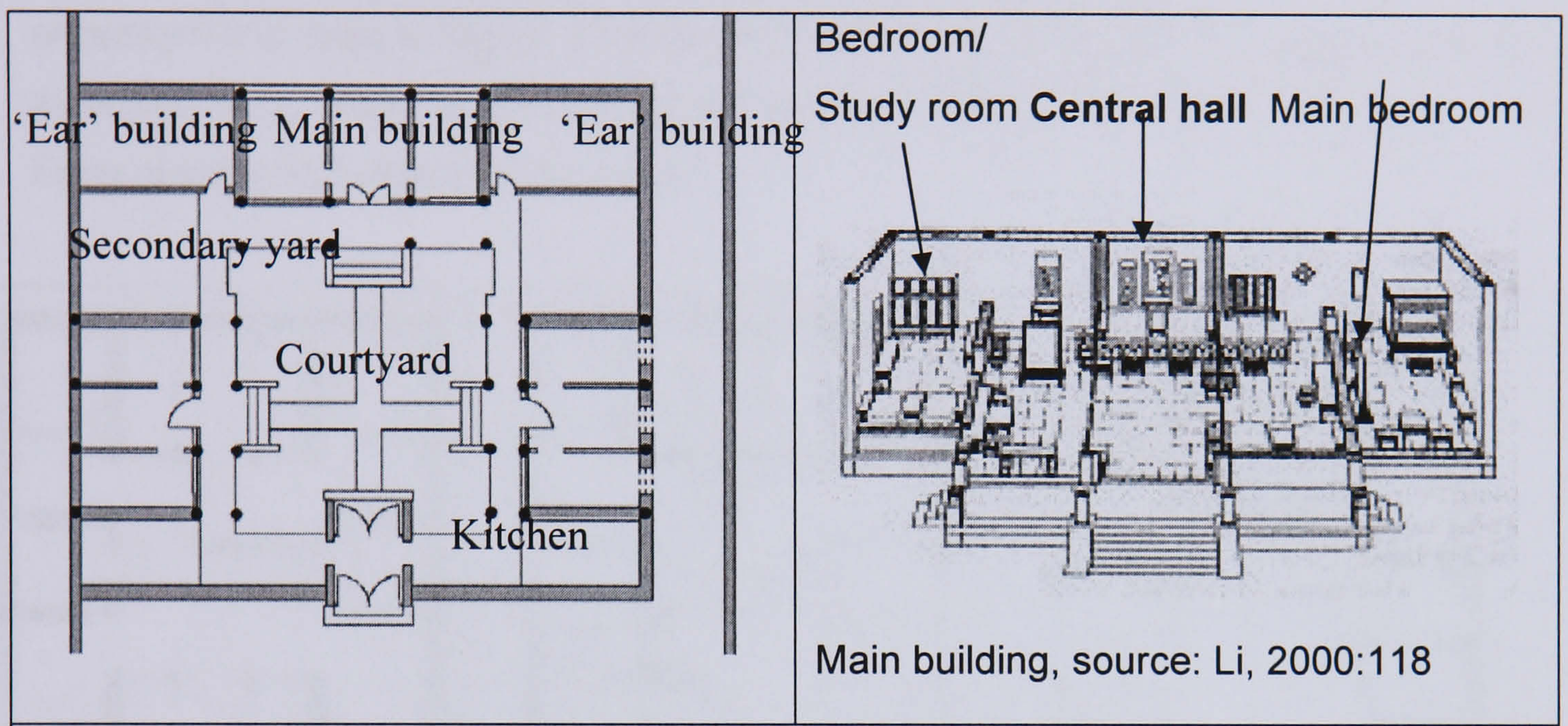
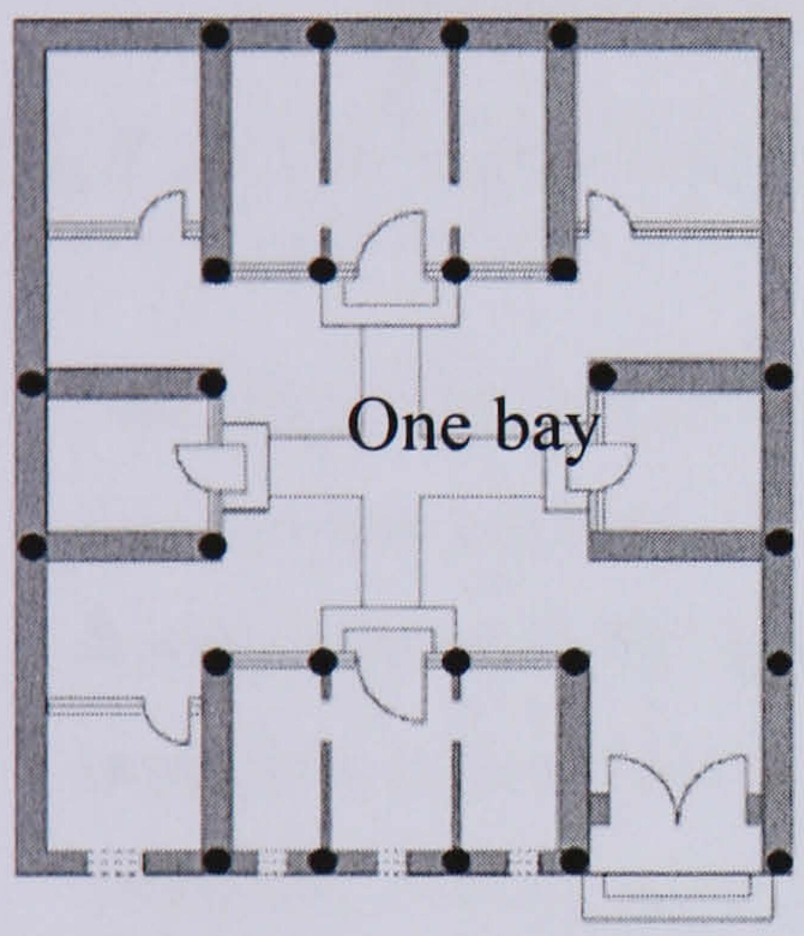


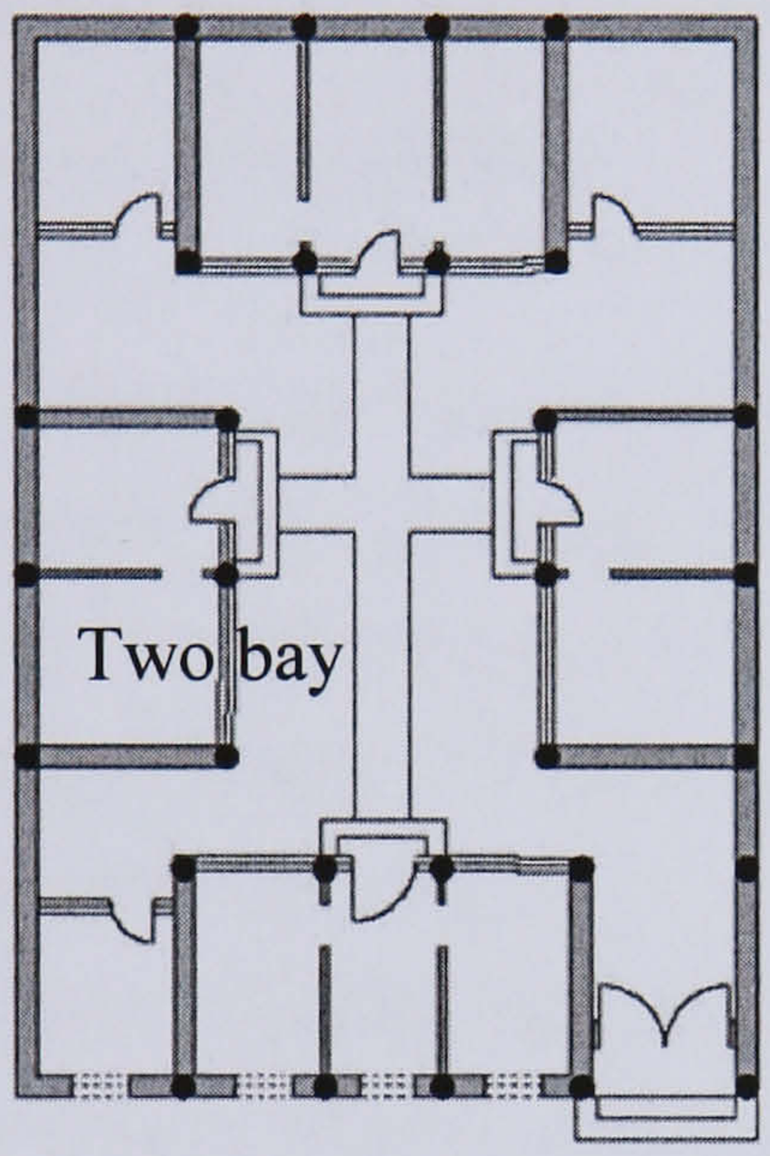
Fig. 7.11 The uses of the main buildings
Based on number 71 of lane 8 courtyard building

- Daily worship and showing of respect to the oldest generation of the family and the ancestors.
- Living room for the oldest generation.
- Ancestral worship and sacrificial ceremonies during annual festival days.
- Ceremonies such as weddings, funerals, the naming of a new-born baby and so on.
- Family formal gatherings and sometimes receiving relatives and guests.
- Dining after the previously mentioned large ceremonies.
- Displaying objects from the family art collection.

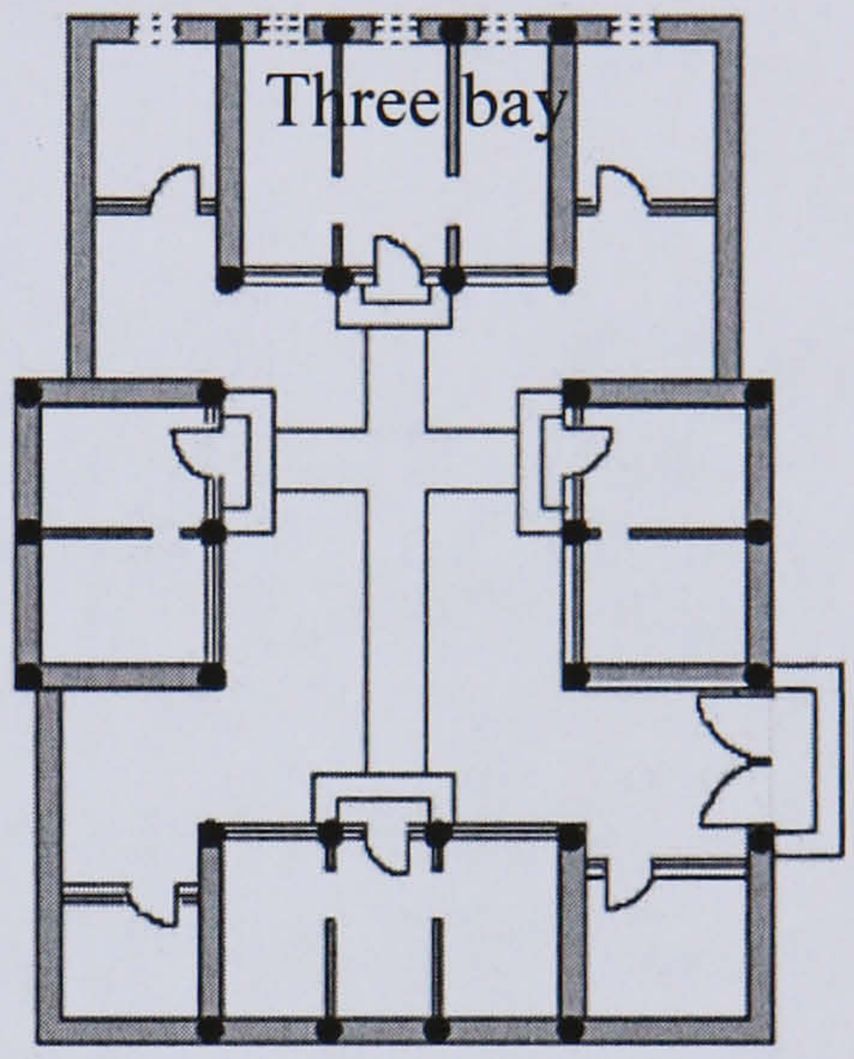
The master bedroom for the householder occupies the left or right hand side of *Zheng Fang* (main building), the eastern rooms of the main rooms (including 'ear' buildings) were the bedroom of the wife while the western one (include the 'ear' building) was given to the concubine. This is because the east was taken as the upper direction in *fengshui* and Confucian ideology (Li & Wang, 1999). Only the ancestral hall in principal rooms had a door leading to the outside, and the bedroom and the living room were normally connected by a decorated doorframe, and the view was always blocked by curtains. In the internal layout of the bedroom, 'Beds are usually placed so that the sleeper's head will be to the east and his or her feet will be to the west. The human body is thought to be a microcosm of the universe as a whole' (Mitchell & Wu, 1998:63). In general, this allocation of rooms to different members of a family was subject to the Confucian regulations that the elders are much more respected than the youngsters, therefore seniors have a higher social status than the younger family members (Keswick, 1978). This principle is just like Gillingham explained, 'a hierarchy of human relationships that is man to elders, man to ancestors and man to family' (Gillingham, 1971:107), while rooms for sons are placed in *zuoxiang Fang (*east wing building) facing west, and daughters are located in *youxiang Fang* (west wing building) facing east.



A: No 125, lane 8



B: No 39, lane 8



C: No 9, first lane between lane7 & 8

Fig.7.12 The different bays (wing buildings) of the one courtyard buildings unit

The wing buildings are normally conventional three bay buildings such as No. 71 and No. 129 of lane 8 and so on (Chapter 4). However, from the survey, we see that two bay wing buildings of No. 39 of lane 8, No. 9 of the first lane between lane7 and 8 and even a one bay building (No.125 of lane 8, No. 9 of first lane of lane7 & 8) have also been found for a smaller scale one courtyard unit (Fig.7.12). In theory there should be only three bay buildings, but in practice various patterns of the wing buildings have been found inside the neighbourhood. The interior arrangement of a three bay wing building was similar to that in the main building which, with the living room in the middle and bedrooms (or maybe study room) on both sides the buildings, the one bay would be a simple bedroom and the two bay will be a living room and bedroom (Fig.7.12: a, c). The kitchen of number 71 of lane 8 was located at the south end of the east wing building because, 'to the Chinese, cooking is so important an activity that a special altar is set up in the kitchen for the "God of the Stove",'(Mitchell & Wu, 1998:63). Furthermore, 'bathrooms were rare. Baths were taken in tubs and emptied after use on shrubs in the courtyard' (Antoniou, 2001:73).

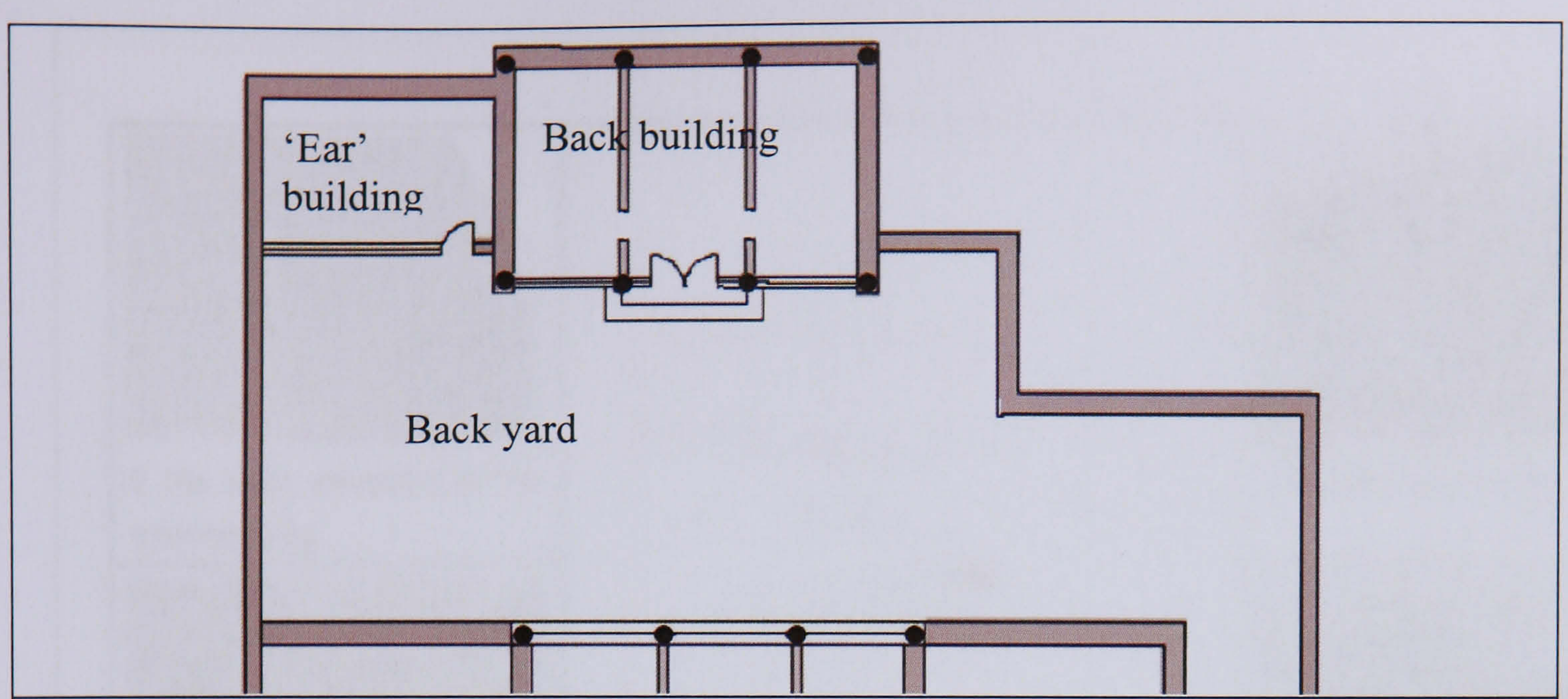


Fig.7.13 The uses of the back yard and buildings

The back *Yuanzi* (yard) with the south oriented buildings (Fig.7.13) was normally used by the female servant and possibly the youngest female generation of the family, which mainly provided the service to the house owners located at the courtyard. Generally, 'the hierarchy of the family is also mirrored in the arrangement of the rooms' (Mitchell & Wu, 1998:63). However, all these different uses of the courtyard, yards and buildings were not fixed, particularly for secondary buildings such as the 'ear' building which were used by the closest servant inside the courtyard, and the youngest generation of the family members might also be located at the front and back buildings if there was not enough living space inside the buildings of the courtyard unit. The details of this part of the studies will be shown in the following section on the secondary buildings.

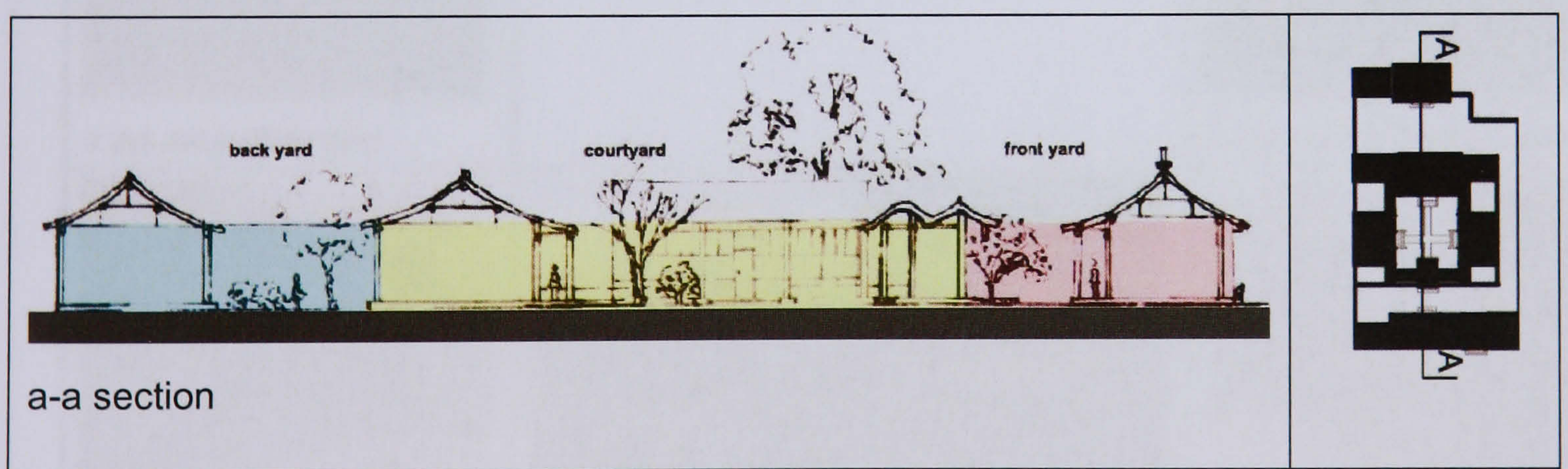


Fig. 7. 14 The north-south section of No 71 of lane 8

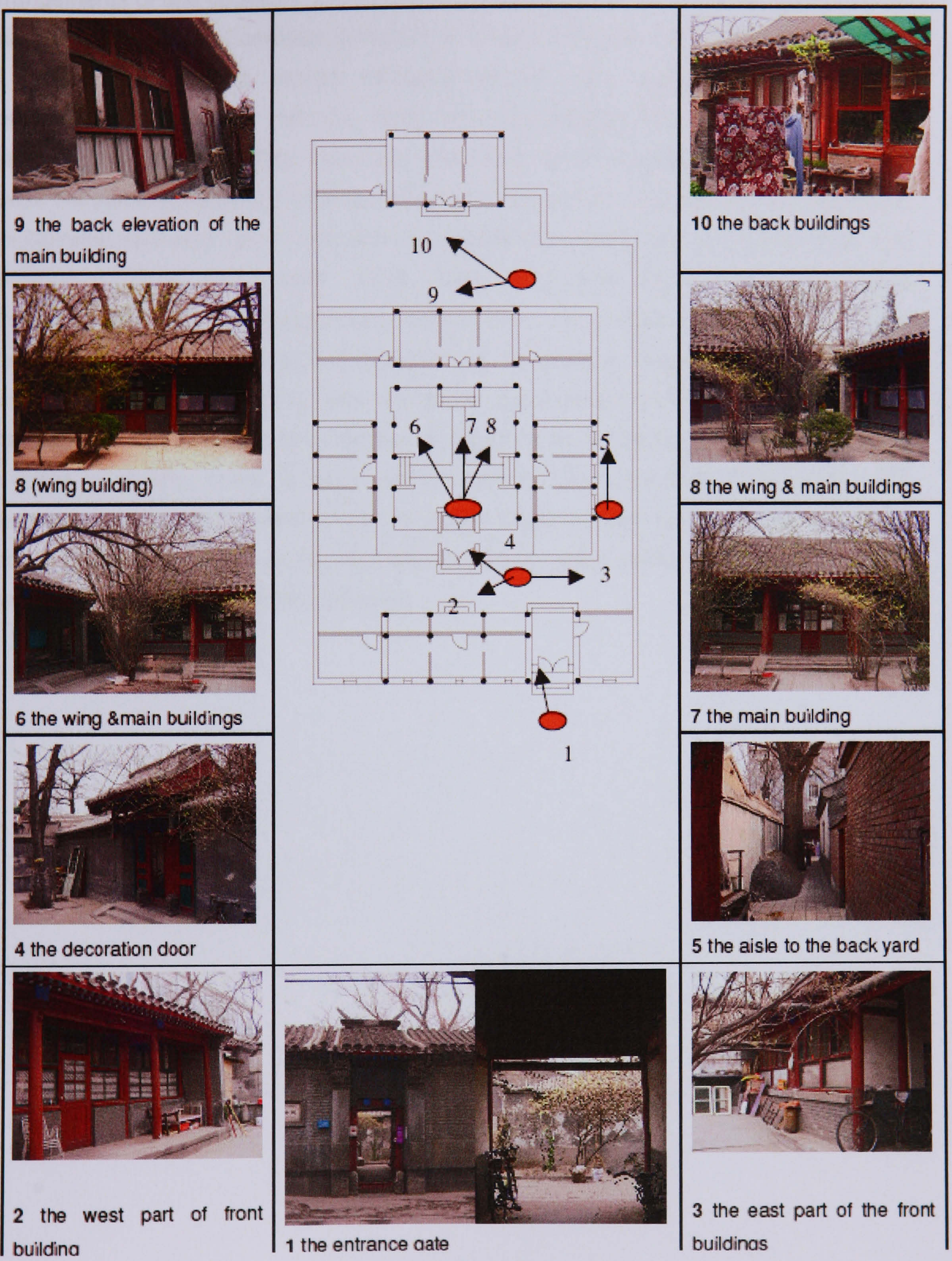
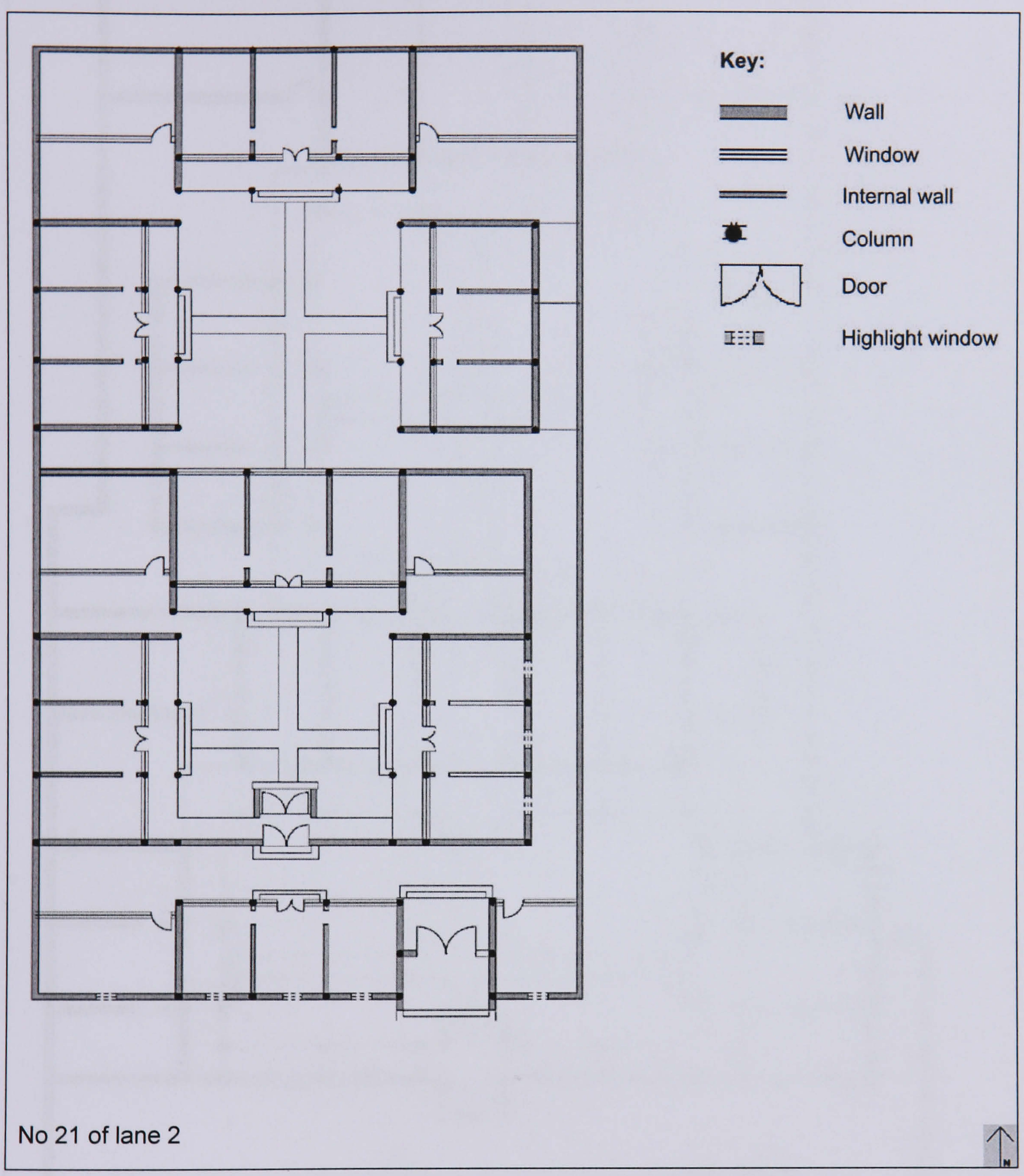


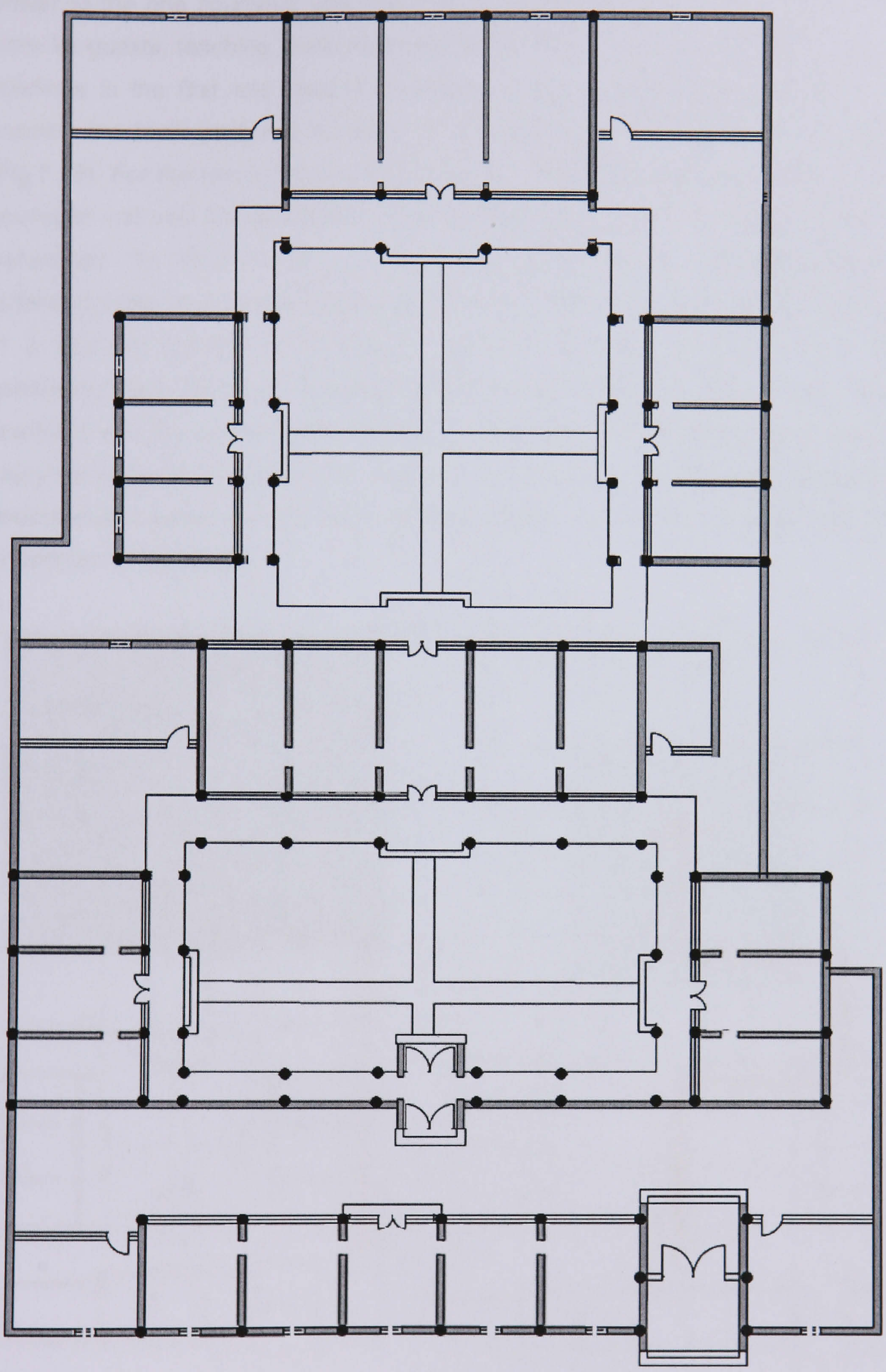
Fig7.15 The buildings arrangement of one courtyard buildings unit No71 of lane 8

From this one *Yuanluo* (courtyard unit) plan typology analysis, the buildings and the uses arrangements of one courtyard unit (Fig.7.14, 7.15) were not only shaped by the *fengshui* principles but also the Confucian principles of social-hierarchal. The spatial arrangement of visitors and the yard, service members and the yard, family members and the courtyards of a courtyard unit (*Lu*, 2000) not only indicated the social identity of the residents through the physical layout and orientation of the buildings, but also helped to shape the social-behaviour of different members of the family. This spatial arrangement of the Chinese courtyard house revealed the hierarchical social order and also implied the traditional Chinese social order, 'males being considered superior to females' (Lu, 2000:363). The 'older generation were regarded as the instructors of the younger and were seen as the embodiment of wisdom and experience handed down through the generations' (Qin, 1978:59-51). Also, the family members were more important than the visitors and servants. It was as a member of a family that an individual was located in time, in space, in society, in life, in death and in a certain role in the family and society, and these hierarchical family relationships and proper behaviour appropriate to such roles was part of the core principles of the 'Confucian' tradition which continued from teachings of the venerable sage and his later followers.

7.3.2 Two *Yuanluo* (courtyard buildings) units



No 21 of lane 2

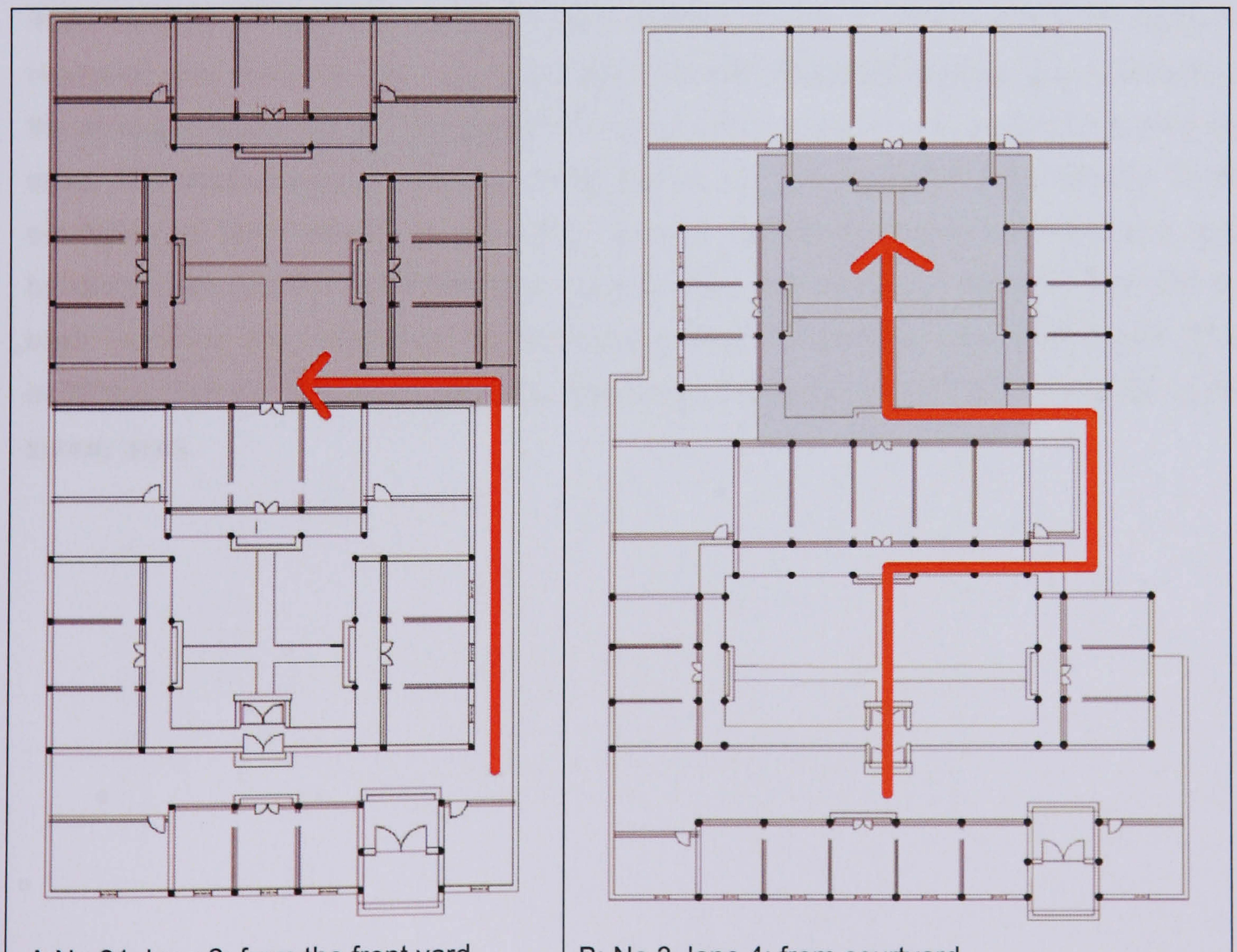


No 3, lane 4

Fig.7.16 The two courtyard buildings unit

Scale 1:200

The internal buildings and uses arrangement for two courtyard units were generally similar to the one courtyard unit, the front entrance gate and buildings at the front yard were for guests, teaching, male servants, and service uses. The wing buildings and main buildings in the first and second courtyard were completely for private use, and also possibly the back yard and buildings for the female servants and service uses as well (Fig.7.16). For the two courtyard unit, the most distinguished characteristic from the one courtyard unit was the extension of the family from one unit generation to the next unit generation. 'To meet the exigencies of Chinese family life, this arrangement can be extended to the rear by new courtyards with their houses for sons and relations, resulting in a kind of 'cellular' development.' (Blaster, 1985:14) (Fig.7.17). Since the older generation were the most respected and honoured members of the family, the second courtyard and the surrounding buildings were a place for the retired older generation to enjoy the fruits of their past work (Fig.7.17). Furthermore, like the one courtyard unit, the ancestral and family worship hall was also located in the deepest place with the oldest generation of the family.



A:No 21, lane 2: from the front yard

B: No 3, lane 4: from courtyard

Fig.7.17 The link route

Note: Grey area represents the deepest area of courtyard unit

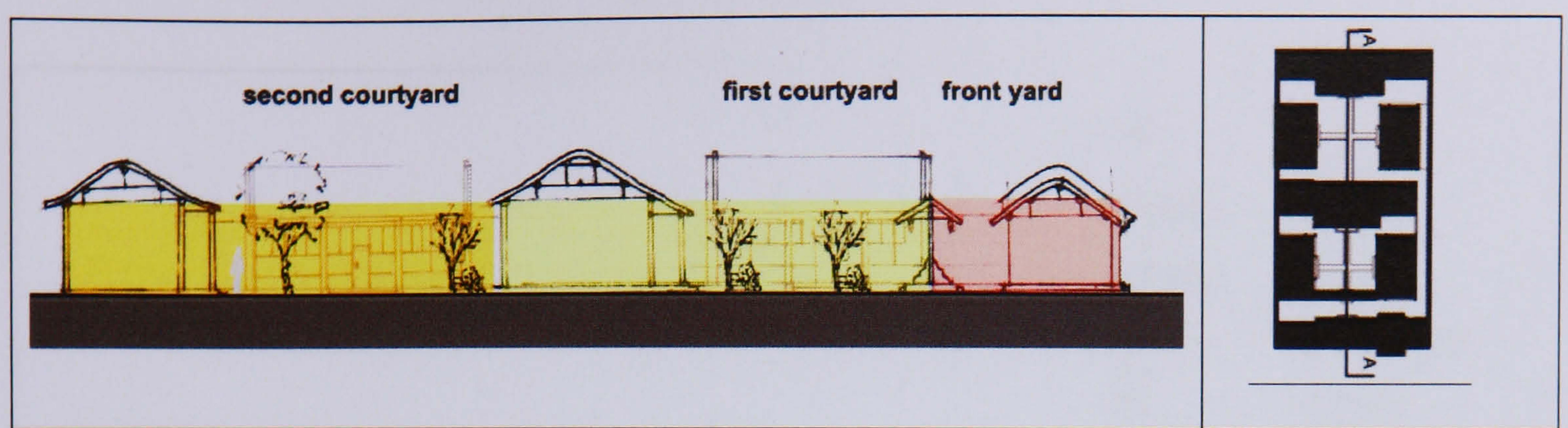
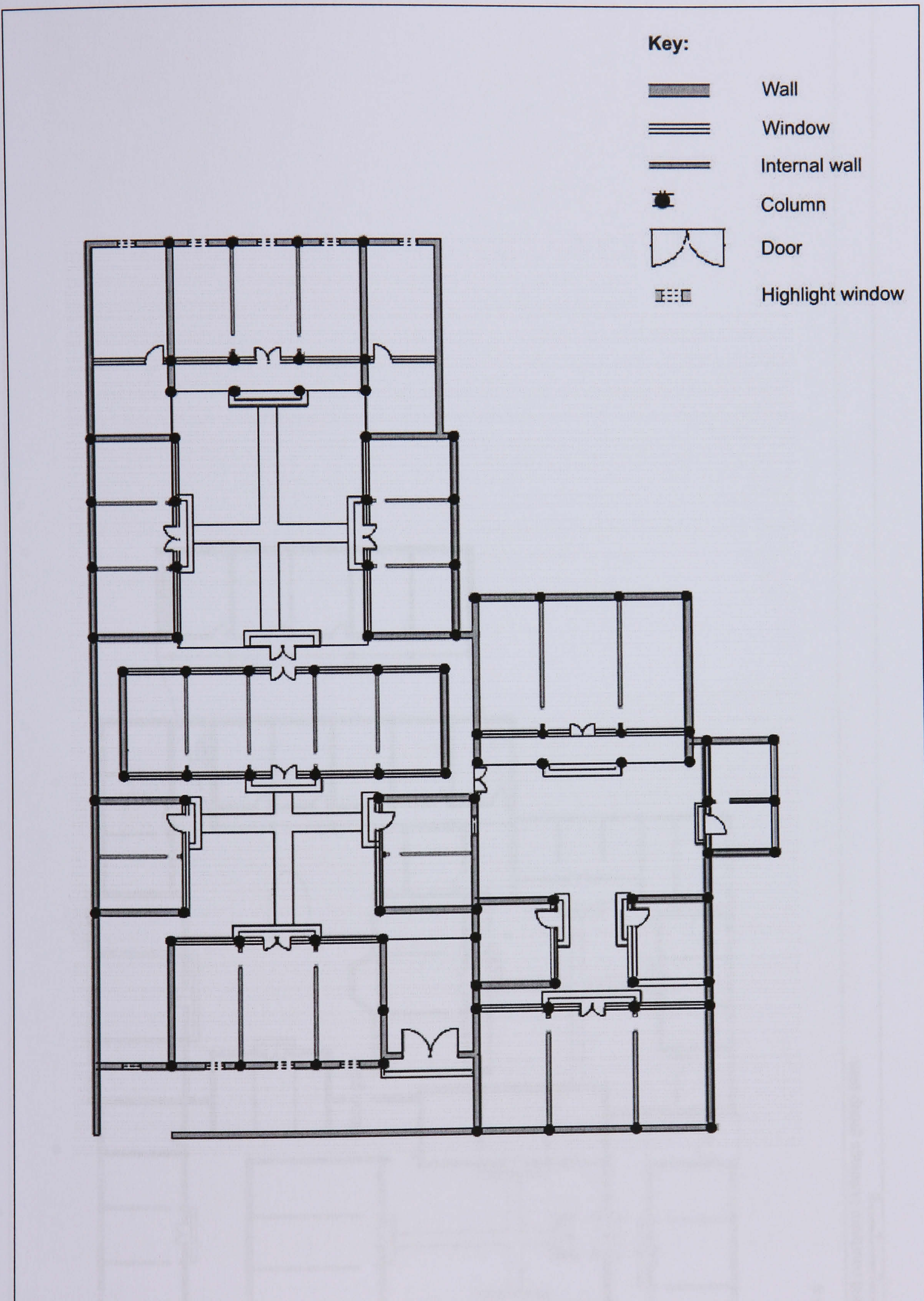


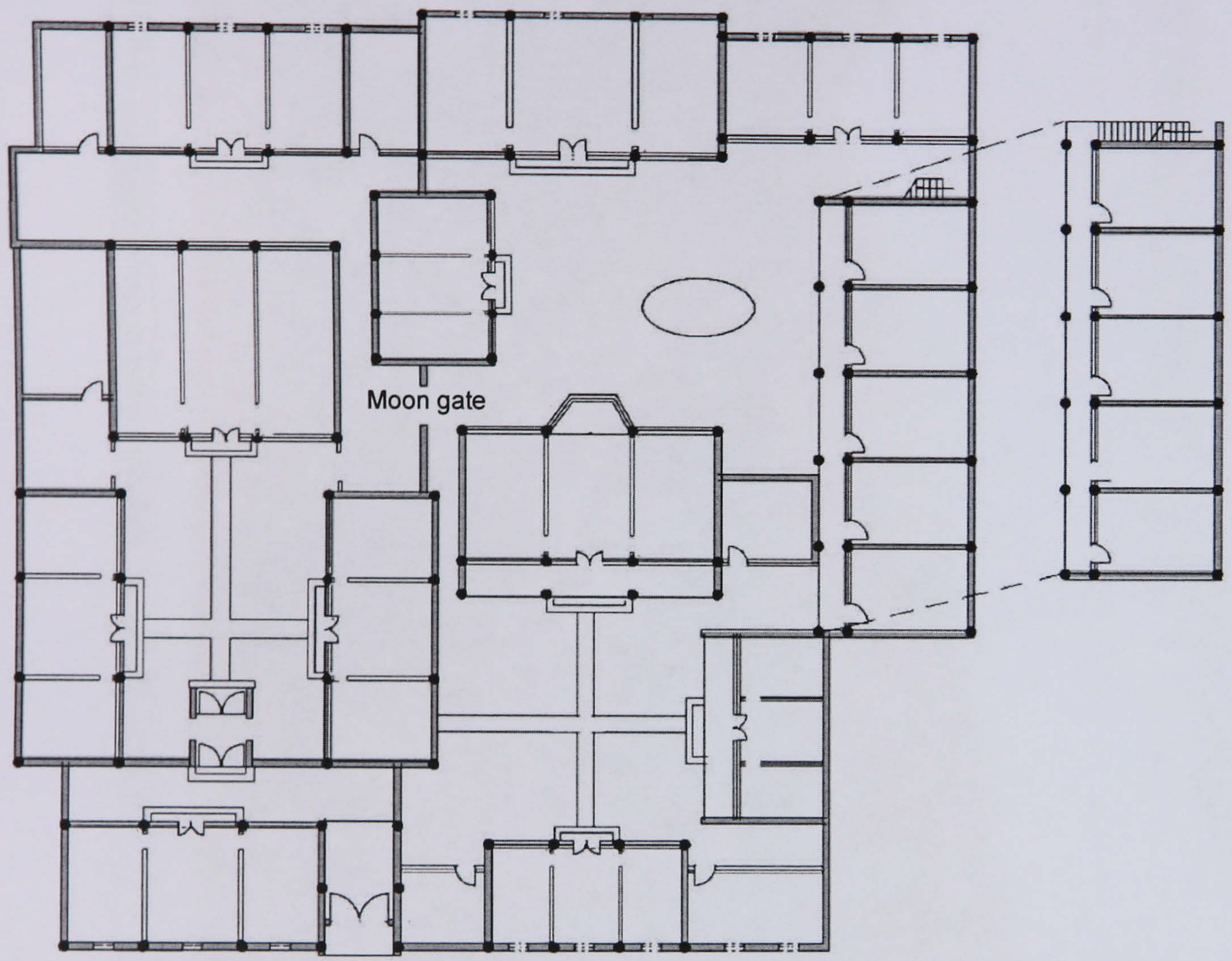
Fig.7.18 A-A section No 21 of lane 2

The connection between these two main *Yuanluo* (courtyards) was either via a corridor located in the eastern parts of the building groups (Fig.7.17:a) or eastern part of the main building (Fig.7.17: b). The central axis was another important connection between these two main *Yuanluo* (courtyards), but the central axis was only completely opened (there is a screen door located at the central axis of the first main building) during important days of the family, such as weddings, funerals, births and so on. The building scale of the two courtyard building units can be much larger than the one courtyard unit; there is a five bay main building for the first courtyard main building of No 3, lane 4 (Fig.7.16: bottom). However, this research has suggested that basically the building scale did not influence the arrangement of the buildings and uses for a two courtyard buildings unit in the survey area. The main buildings were all south facing with the entrance gate located in the southeast of the building groups. The *Yuanluo,* where the main buildings and wing buildings were located, were always encircled by the veranda (Fig.7.18), and front and the back buildings also might have a veranda but this normally did not connect with other buildings. For the two courtyard unit, there was normally one front service yard in the survey area.

7.3.3 Three *Yuanluo* (courtyard buildings) unit

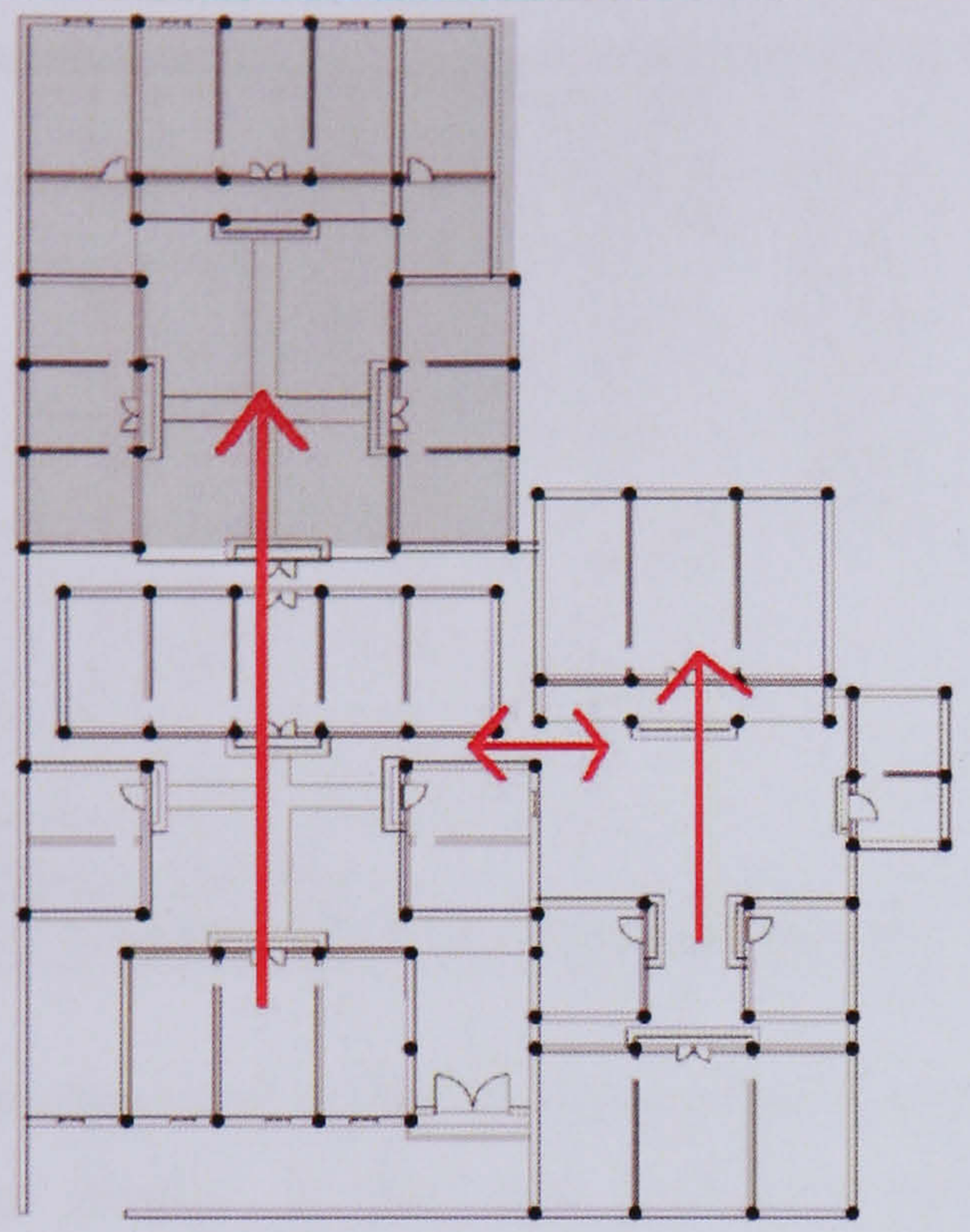


No 111 of lane 8

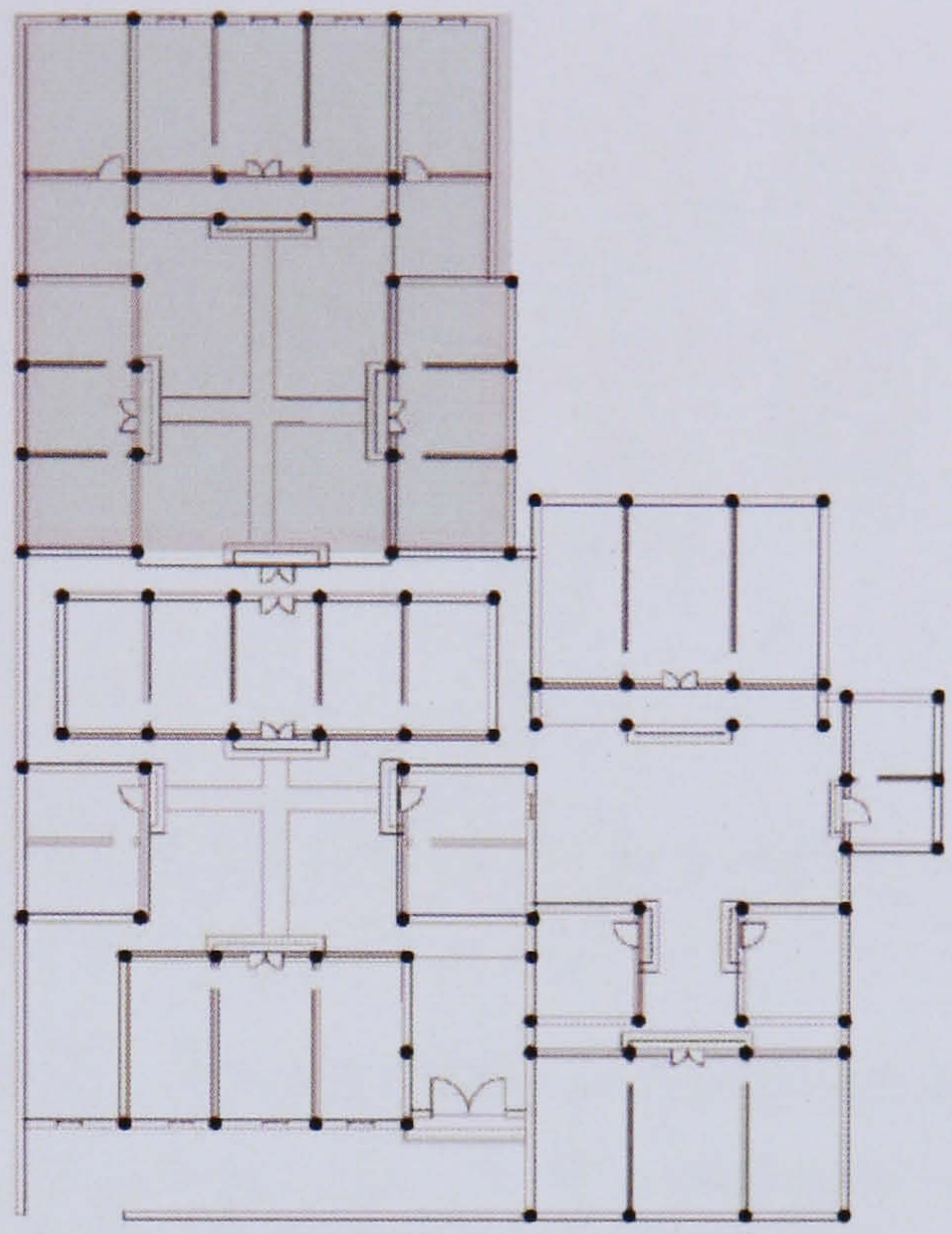


No 51&53 of lane 6

Fig.7.19 Three unit courtyard buildings group plan
Scale:1:300



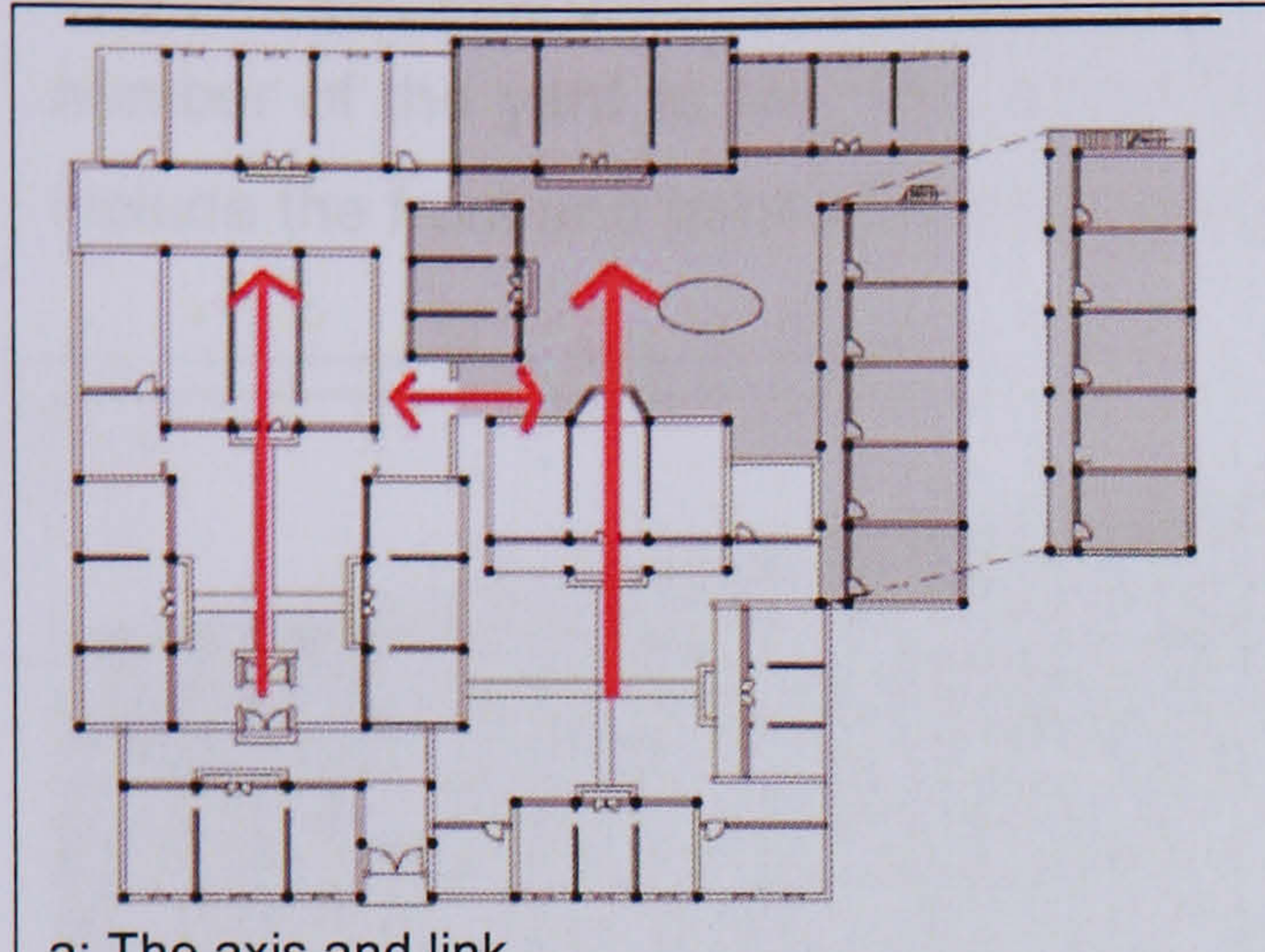
a: The axis and link



b: The social status of the courtyard unit (grey represents the highest)

Fig. 7.20 The plan of no 111 of lane 8

Fig.7.21 The connecting moon gate between two courtyard units



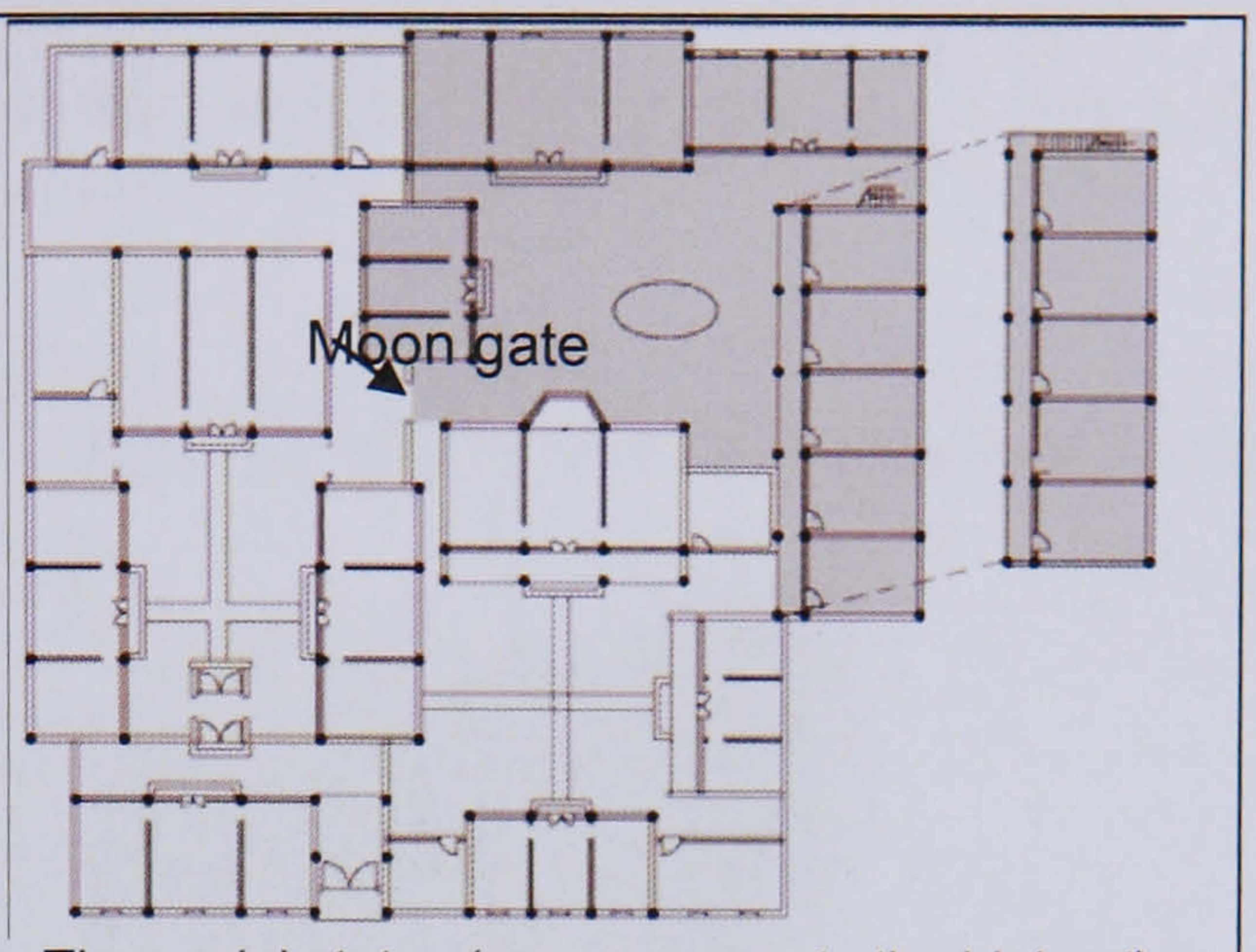


Fig.7.22 the plan of no 51&53 of lane 6

The uses and buildings arrangement of a three *Yuanluo* (courtyard buildings) unit were also similar to the one and two courtyard buildings unit. In the courtyard unit arrangement, there were two axes rather than simply one central axis as in the one courtyard unit; No 111 of lane 8 (Fig.7.20: a) has a two courtyard unit plus one eastern courtyard buildings unit. The axis arrangement of Nos. 51 & 53 was similar to that in No.111 of lane 8 with the western one unit plus an eastern two courtyard buildings unit. The link between these two courtyard building complexes was normally a moon gate located between the two courtyard units which helps to link the two courtyard buildings groups together (Fig.7.20: a & 7.21). 'The gaps between buildings form open of the central courtyard, sometimes the are covered with partial roofs, but some are left open in order to maintain their connection with the adjacent courtyard' (Knapp, 2000:34).

This spatial arrangement of the buildings reflected the social hierarchy of the residents inside a courtyard buildings group (Fig.7.20: b). The front courtyard units (both east and west in one courtyard unit) were used by those of similar social status (next generation) inside the family (Fig.7.22). The oldest generation was also located in the deepest part of the buildings with the landscape gardens (Fig.7.22: b, 7.24: b). There is a five bay building located at the central axis of the western part of No 111 of lane 8 buildings group (Fig.7.23), and the scale of other buildings inside this building groups is quite diverse, which includes the two bay and three bay buildings as well (Fig.7.21). The first main buildings (east side) facing the landscape garden are very unusual, both in form and scale, as they have a three sided bay window facing the garden (Fig.7.24: b). The east wing buildings are a five bay and two stories building which are located on the east side of the courtyard dwellings (Fig.7.24:a). All the main buildings face south, the number of the yard to No. 111 is one front yard, and No. 51&53 has two yards which include the front and back yard (west axial).

Two bay building | Five bay building with extension

Fig.7.23 The buildings scales, no 111 of lane 8

a: Two stories five bay wing building | b: The garden and the three bay sided window

Fig.7.24 The buildings of no 51 & 53 of lane 6

7.3.4 *Fuwangfu* Mansion (four courtyard buildings unit in the central axis)

As the previous courtyard buildings classification studies indicated, the imperial buildings group of *fuwangfu* mansion was a completely different standard buildings group in terms of scale, building types, buildings colour and so on. *Fuwangfu* mansion was originally built in 1730 for the son of the Emperor; the plot area is around 44,000 square meters. There were three main axis to the plan layout of this courtyard unit (Fig.7.25) which include the left and right part of the courtyard units used by the owner's relatives and the servants. It is very difficult to identify the number of the courtyard unit based on the current survey data because of the transformation of the east and west side the courtyards buildings groups, and also the vast scale of the buildings groups. Therefore, this part of the analysis will mainly focus on the *Yuanluo* (courtyard buildings) unit that is located in the centre where the owner and his family worked and lived.

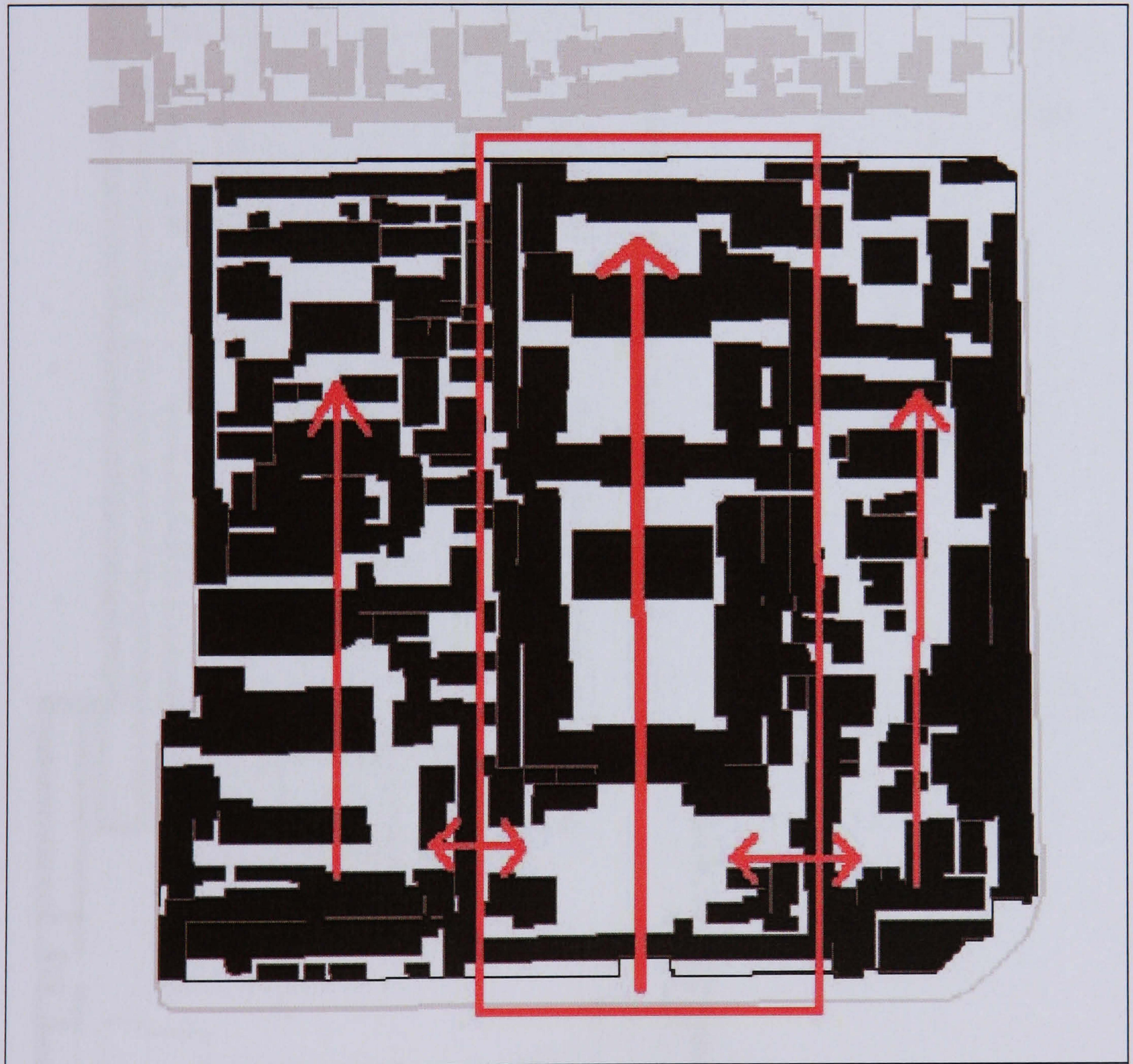


Fig.7.25 *Fuwangfu* mansion buildings group
Scale: 1:2000

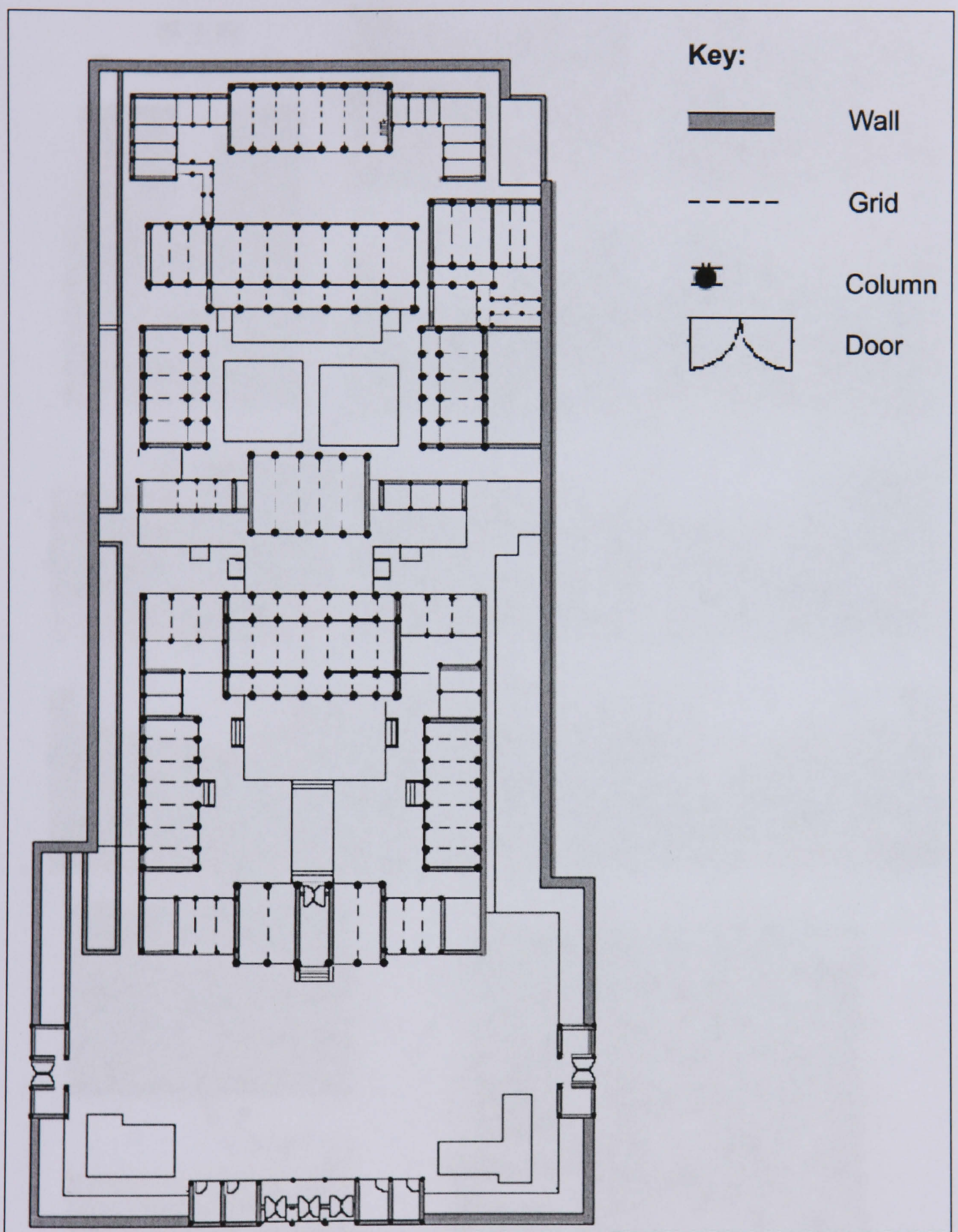


Fig.7.26 Four courtyard unit *Fuwang fu* Mansion
Scale 1:1000

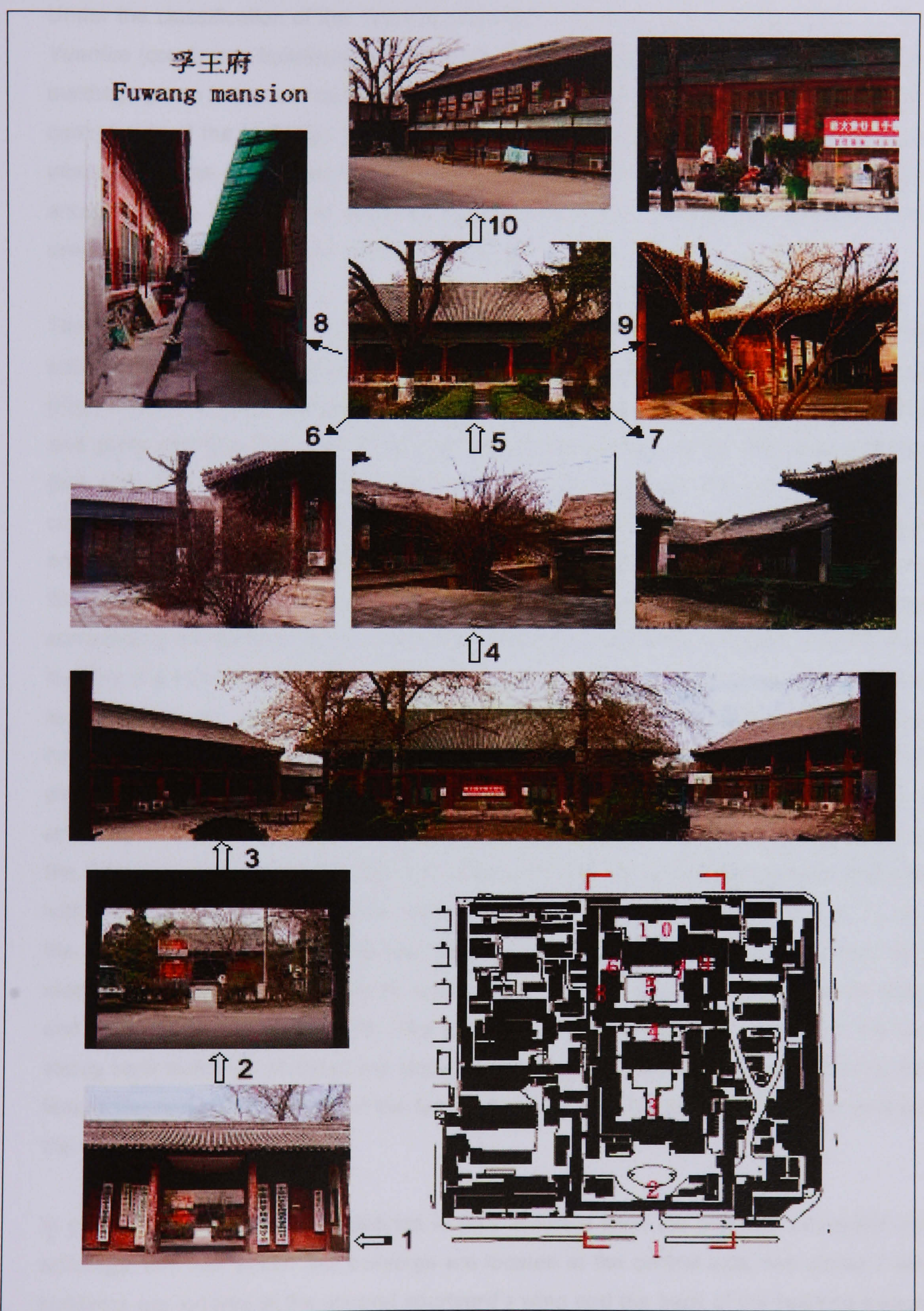


Fig. 7.27 *Fuwang Fu* (*Fuwang* mansion)

Under the classification of the *Yuanluo* (courtyard buildings) unit strategy, there are four *Yuanluo* (courtyards buildings) units located at the central axis. The entrance gate to the buildings group is not a simple gate but a seven bay building located in the middle of the central axis of the buildings group (Fig.7.26, 7.27:1). From the previous study, we can observe that the central place represents virtue, sanctity, power and the royal family in ancient China. This type of entrance layout in traditional Chinese architecture is only used for the royal family and religious buildings.

The front courtyard was encircled by a veranda and used as the entrance to the buildings groups for the relatives located on both sides of the main building groups (Fig.7.26). Here, the entrance buildings to the central axis are five bay buildings with hip and gable roof type (Fig.7.27:2), and for the relatives there are the three bay buildings (but only with the flush gable roof) located on the east and west sides of the first courtyard. The second courtyard (the front hip-and-gable roof building is the formal entrance mansion to the central courtyard unit) has the central platform starting from the five bay entrance building and it leads to the main building. The type of buildings surrounding the second courtyard is very different from the other courtyard unit; the front building is a hip-and-gable roof building with a huge entrance door located at the central axis (Fig.7.27: 3). The wing buildings are two stories, seven bay buildings and the main hall is a seven bay building with a gable-and-hip roof, used as the working and meeting place for the royal family (Fig.7.27:3). Following this main courtyard unit, there is a relatively small sized yard which mainly provides the transition from the working space to the living space (Fig.7.27: 4). The third courtyard with the landscape gardens and also with two secondary yards was the residence place of the owners (Fig.7.27: 5, 6, 7), and the secondary buildings *er fang* (ear building) which are located on the left and right sides of the main buildings help to create two nice quiet places for the family to study and meet (Fig.7.27:6,9, Fig.7.28). The last courtyard (the fourth courtyard) with the two storey back buildings provided the protection to the main buildings and was used by the female servants and females of the family (Fig.7.27:10). There is a veranda to connect the back and main buildings.

In general, the scale of the buildings is very different from the previous courtyard unit buildings; five and seven bay buildings are located at the central axis, two storey 7 bay buildings are located at the second courtyard's wing and the back of the building groups

(Fig. 7.27: 2, 10). The uses were also more extensive than in the previous ordinary courtyard unit. In *fuwangfu* mansion, the linkage uses for the first courtyard, the office and meeting uses for the second courtyard and the buildings, the transition uses for the yard, and the living place of the third (with two secondary yards and also the landscape garden) courtyard, the fourth courtyard with the two storey buildings for the servants all show the significant social and economic status of the owner.

Fig. 7.28 The left *er fang* (ear building and the court) for the main building

7.3.5 The gardens and the courtyards

The landscape elements inside the courtyard and yard are important elements of the courtyard buildings. 'The home in China, physically considered, consists of two distinct but inseparable elements - the house and the garden' (Chen, 1940:3). Unlike the traditional Chinese buildings which have strict regulations and standards, Chinese gardens only have design guidelines which is '*Yuanzhi*' (garden construction) written by *Jicheng* in 1631. It is very difficult to find a well conserved Chinese garden, but this part of the study will try to provide a fundamental Chinese garden layout, and also explore its social culture values. From the survey, we can see that in most of the relatively small courtyard building groups such as No 39 of lane 8, *Yeshengtao* House (No 71 of lane 8, Fig. 7.30) and No 21 of lane 2 (one and two courtyard units), the courtyard itself is invariably a garden courtyard with covered verandas, a single tree and large flowers. Water and mountains are represented symbolically, a world in miniature (Blaser, 1985). Inside the courtyard, the cross-shaped walking lane was created to connect the entrance of the main and wing buildings, and mostly, there was a lotus jar or goldfish jar in the middle of this crossing to represent the heavenly '*Qi*' (energy). The landscape and the enclosed courtyard where the '*Qi*' is held (Chapter 4) were regarded as a micro cosmos with the buildings, residents, planting, water and the gardens together creating a harmonious place for man to experience, and all these symbols work harmoniously with nature to attract good fortune for the residents. 'Like the plans of Gothic cathedrals, Chinese gardens are cosmic diagrams, revealing a profound and ancient view of the world, and of man's place in it' (Keswick, 2003:14). For the larger courtyard buildings complexes such as Nos. 51 & 53 of lane 6 (Fig. 7.29) and *Fuwang fu* mansion, the courtyard was created as a landscape garden, and even an open Beijing opera stage was originally built in the central courtyard of No. 63 of lane 6. 'In Spring the window covering would be rolled up, the rooms fully opened to the air, the verandas, the courtyard itself, were constantly in use, for meals, for sitting, for parties.

The garden, 'where there was a garden, was a further extension of the living space and used for study and contemplation as well as for recreation, music and the entertainment of friends '(Boyd, 1962:112-113). Apart from green landscape, artificial hills, water and the pavilion were also important elements of courtyard gardens. Artificial hills have been built in the east courtyard of Nos. 51 & 53 of lane 6 (Fig.7.29). The general appearance of these rock compositions might not precisely resemble real mountains, but it would be artistic enough for viewing pleasure and realistic enough to provoke the image of touring through an extensive range of mountains' (Zhu, 1988:22). The pavilion building which is 'small in size and varied in form, is the basic and ubiquitous feature of the Chinese garden' (Zhu, 1988: 78).

West courtyard

East back courtyard

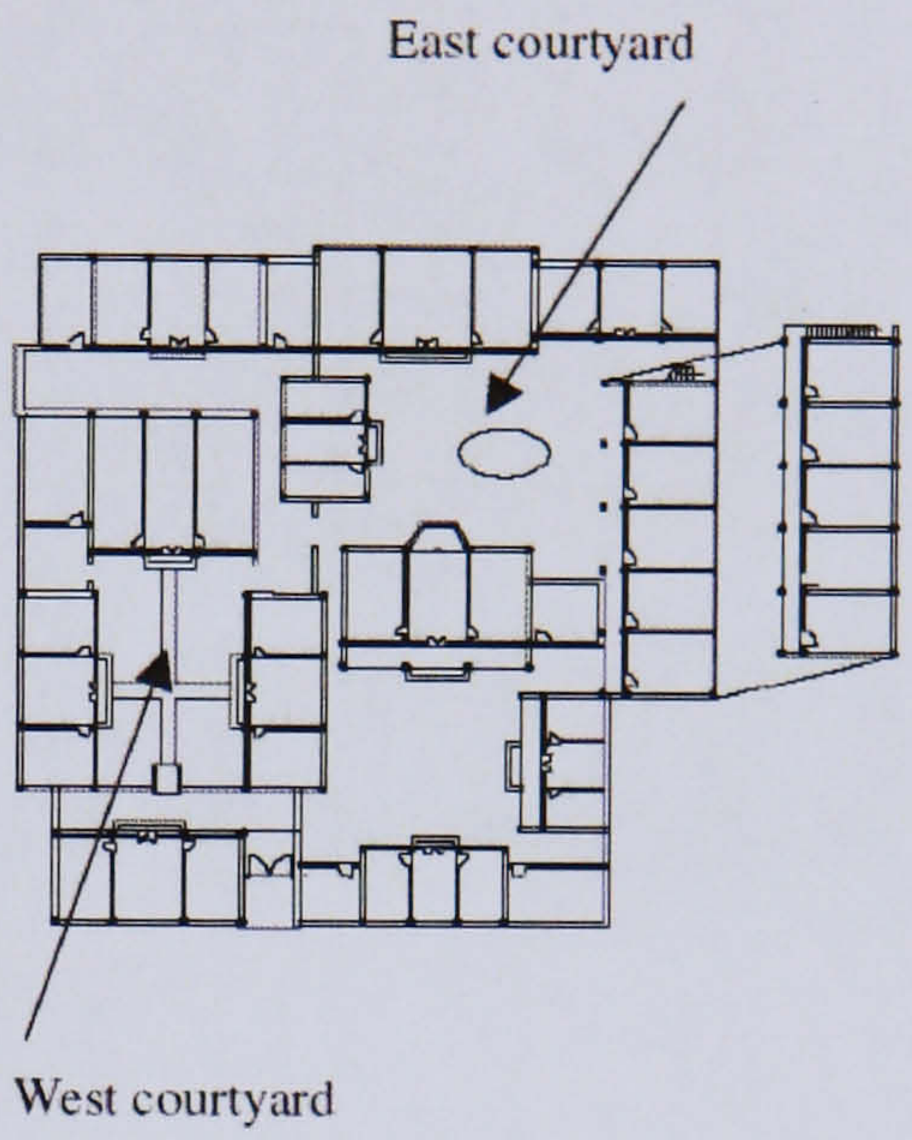
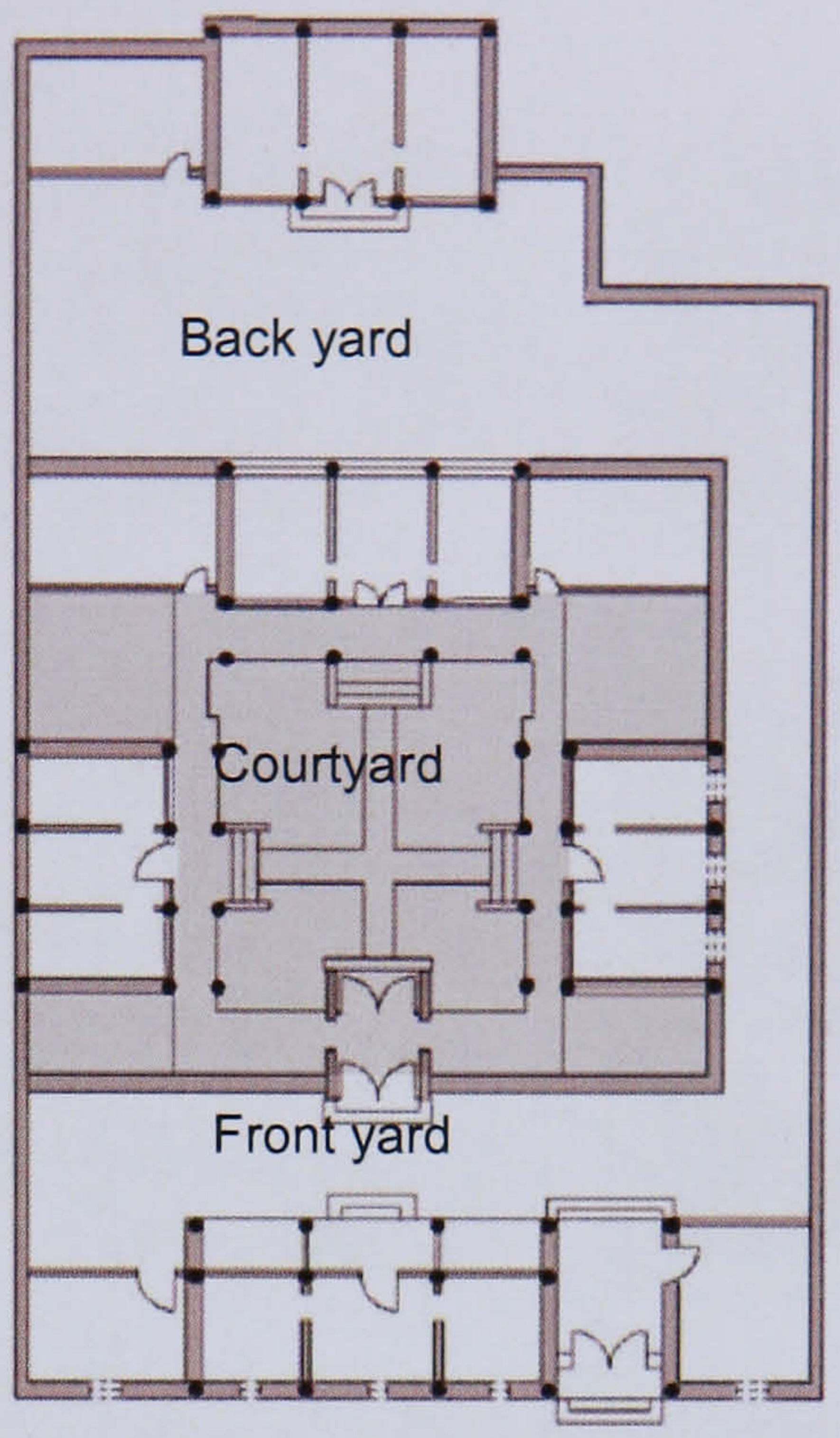


Fig. 7.29 The landscape of no 51-53 of lane 6

In general, the natural elements of the courtyard garden are: 'the earth itself and its modelling; water; rocks, stones and sand; trees and shrubs; flowers and moss' (Boyd, 1962:113), and these elements not only played an important role to help to create a 'microcosm for living' (Zhu, 1988:23), but were also 'a refuge designed for leisure, conversation, meditation and refined pleasure involved in drinking wine, reciting poems, examining a work of art (Bouvier, 1971:176). Furthermore, the landscape of the courtyard also played an important role in achieving a good living environment both socio culturally (include the aesthetic values) and physically (see Chapter 8, the section study).

Back yard landscape



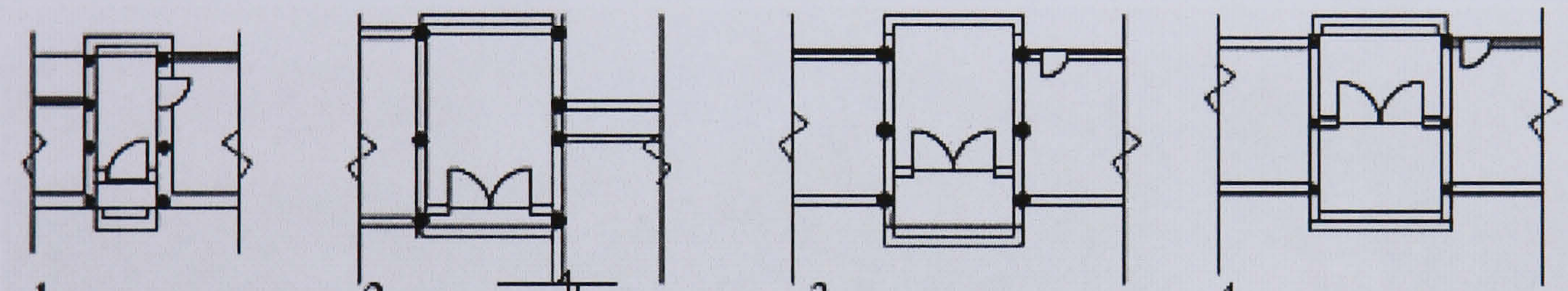
Courtyard landscape

Front yard landscape

Fig.7.30 The landscape of no 71 of lane 8

7.3.6 The entrance gate

	1:zai (narrow) entrance gate	2:Ruyi (free) entrance gate	3: Jinzhu (gold post) entrance gate	4:Guangliang (broad) entrance gate	5: Wangfu (imperial) entrance gate
The location of the gate	various	Southeast	Southeast	southeast	middle
The width	Half bay (2.1m)	One bay (3.9m)	One bay (3.9m)	One bay (3.9m)	Five bays (21.6m)
Door location	The front	The front	Located at the Jinzhu (gold post) position	Located at the middle ridge of the gate	Located at the back of the central bay
Courtyard Buildings	Mainly used by one courtyard unit	No 111, lane 8	Nos 51 & 53, lane 6	No 21, lane 2 No 3, lane 4	*Fuwangfu* mansion



1 2 3 4

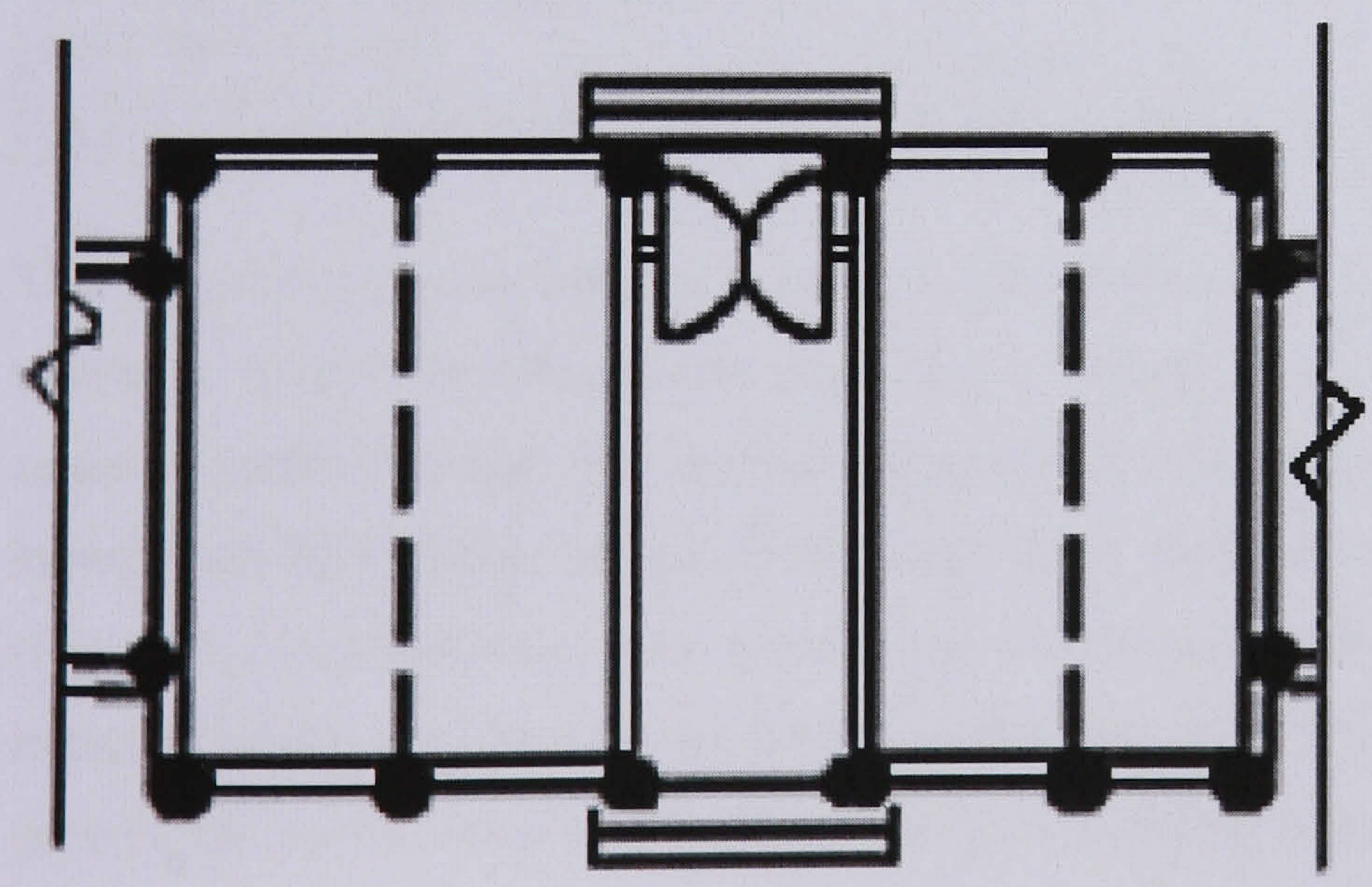


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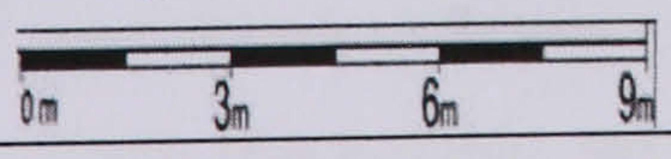
Table: 7.2 Entrance gate characteristics
Scale:1:250



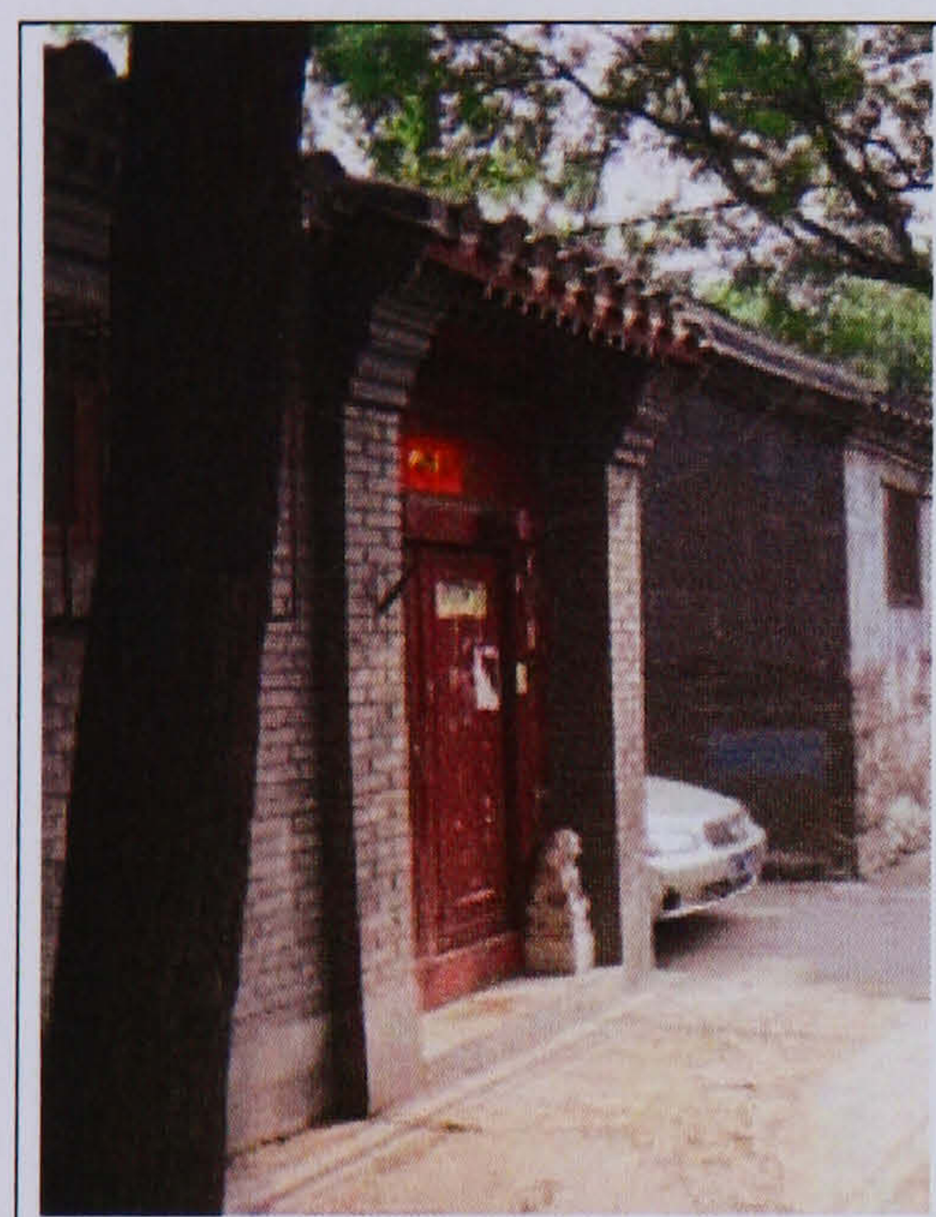
The plan typology study analysed the location of the entrance gate and its socio-cultural values (section 7.1.2). The central location was the most noble and holy location and can only be used by the imperial family as in the *FuwangFu* mansion. The southeast was the most privileged location for the ordinary residential building groups. The next most privileged location was a northwest location, which was on the opposite side of the privileged diagonal. As Chapter 4 indicated, the southeast to northwest direction represents the entrance leading to heaven, happiness, wealth and longevity. At the same time, there were no entrance gates located in the southwest to northeast direction in the survey area which represents the entrance leading to hell and bad fortune. 'The main entrance or gate in Chinese architecture has some specific significance. It is the only part of the group of structures that gives access to the outside world' (Xu, 1964:225). Furthermore, the typology of the entrance gate should also be studied to disclose the design values of the entrance gate.

		
The west two bay (view from inside the front yard)	The central three bay	The east two bay (view from outside)

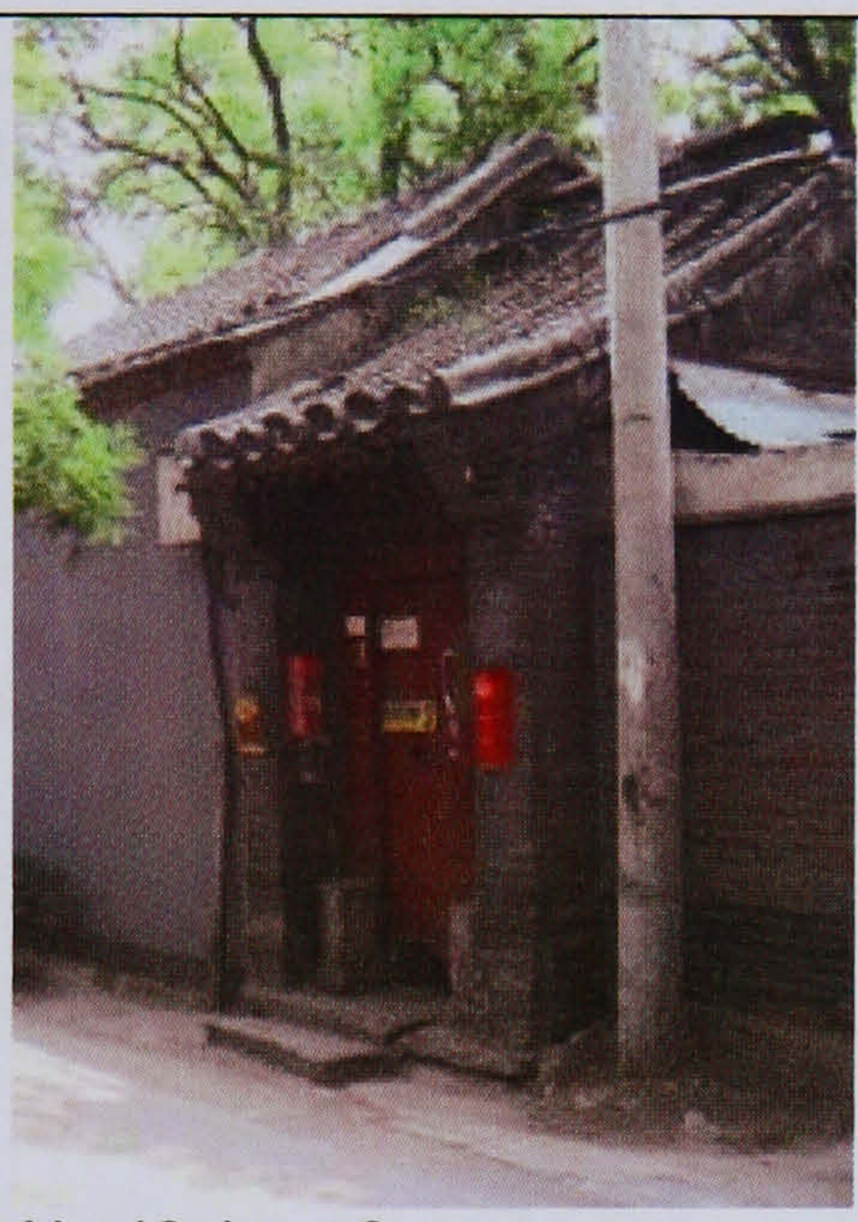
Fig.7.31 The entrance building to *FuwangFu* buildings groups: seven bay buildings

The general entrance gate to *Fuwangfu* mansion buildings group is a seven bay building which is located at the central axis of the buildings group. There is a three bay door opening located under the central ridge of the building, and also two bay buildings are located on both sides of the three bay doors and normally used as the guard rooms (Fig.7.31). Furthermore, this seven bay entrance building could only be used by the imperial family and its use by ordinary families was forbidden, but the formal entrance gate to the central axis is a five bay mansion building with the royal hip and gable roof.

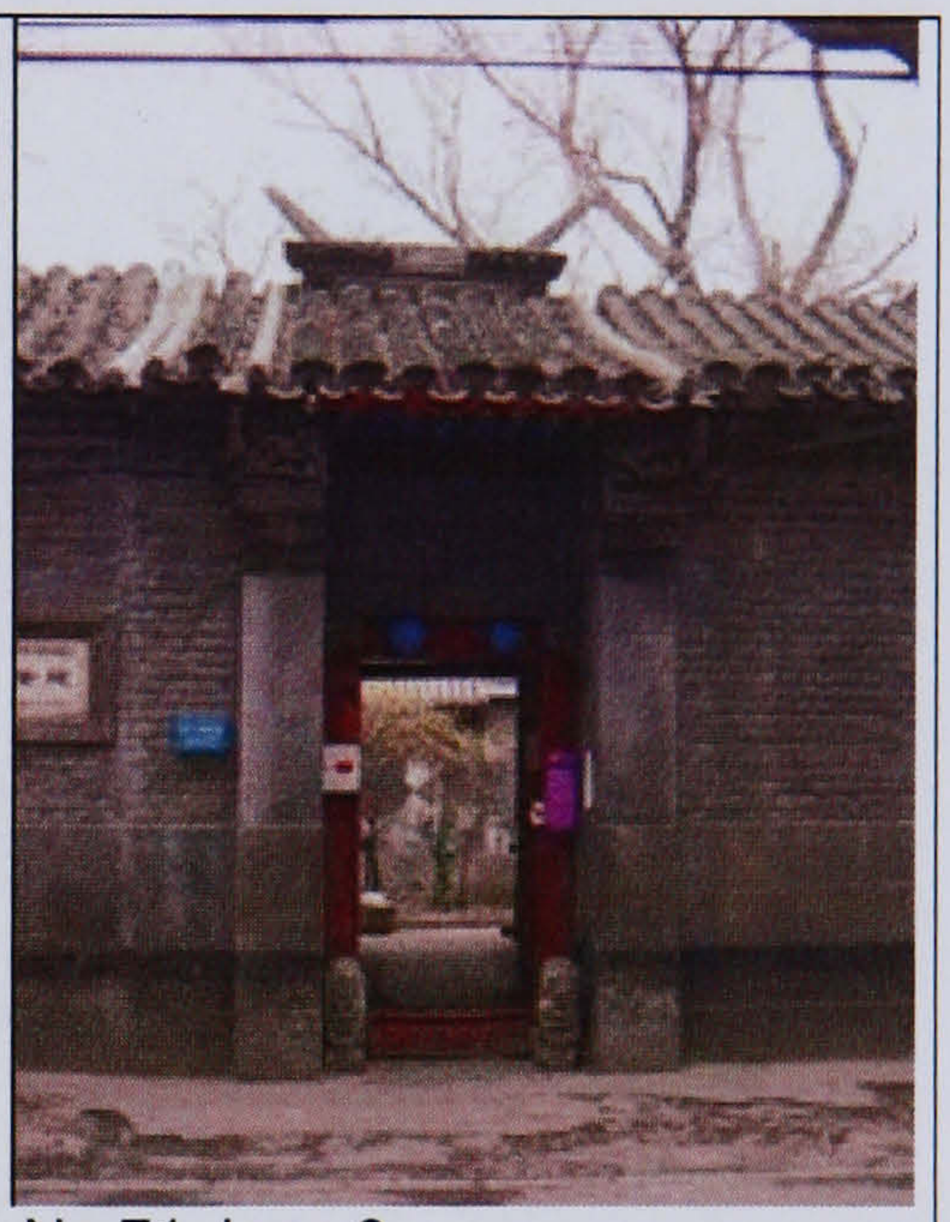
The entrance gate to an ordinary courtyard building group may vary in the location and also the type. From the survey, we can observe that the height of the entrance gates of the one courtyard units are equal in height to or even lower than the front attached buildings, and the narrow door frame is located at the front of the entrance buildings. In traditional Chinese architecture, these gates are called '*Zai*' (narrow) gate (Table, 7.3:1). The entrance gate to the courtyard normally only occupies half a bay of the building and was without too much extra decoration (Fig.7.32), but a stone sculpture might stand at the front of the entrance gate. There were also some one courtyard buildings units that did not have a formal entrance gate, and the informal entrance gates were normally of a relatively low quality and can easily be transformed, therefore, this part of study will not study these gates in detail.



No 39, lane 8
Narrow entrance gate

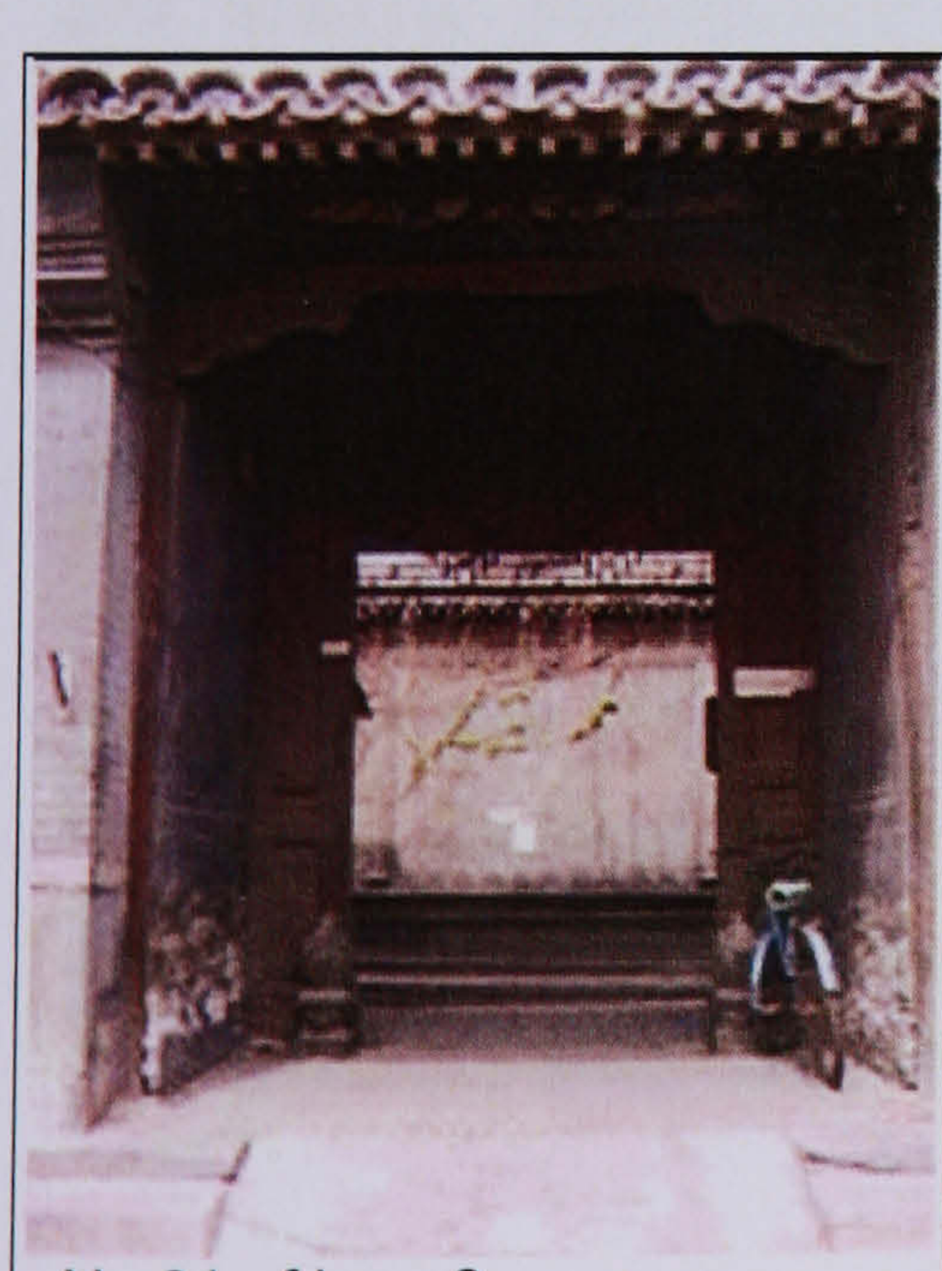


No 48, lane 8
Narrow entrance gate

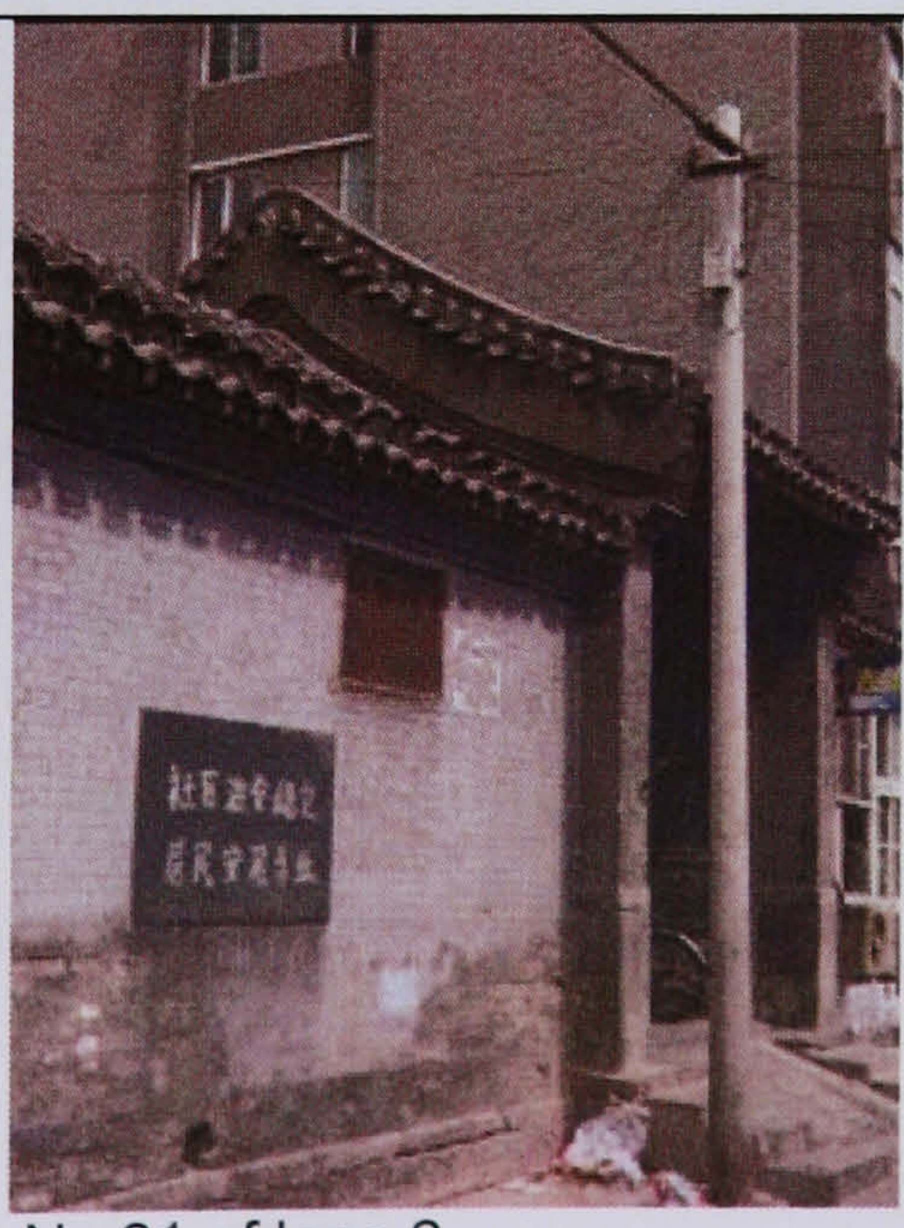


No 71, lane 8
Narrow entrance gate

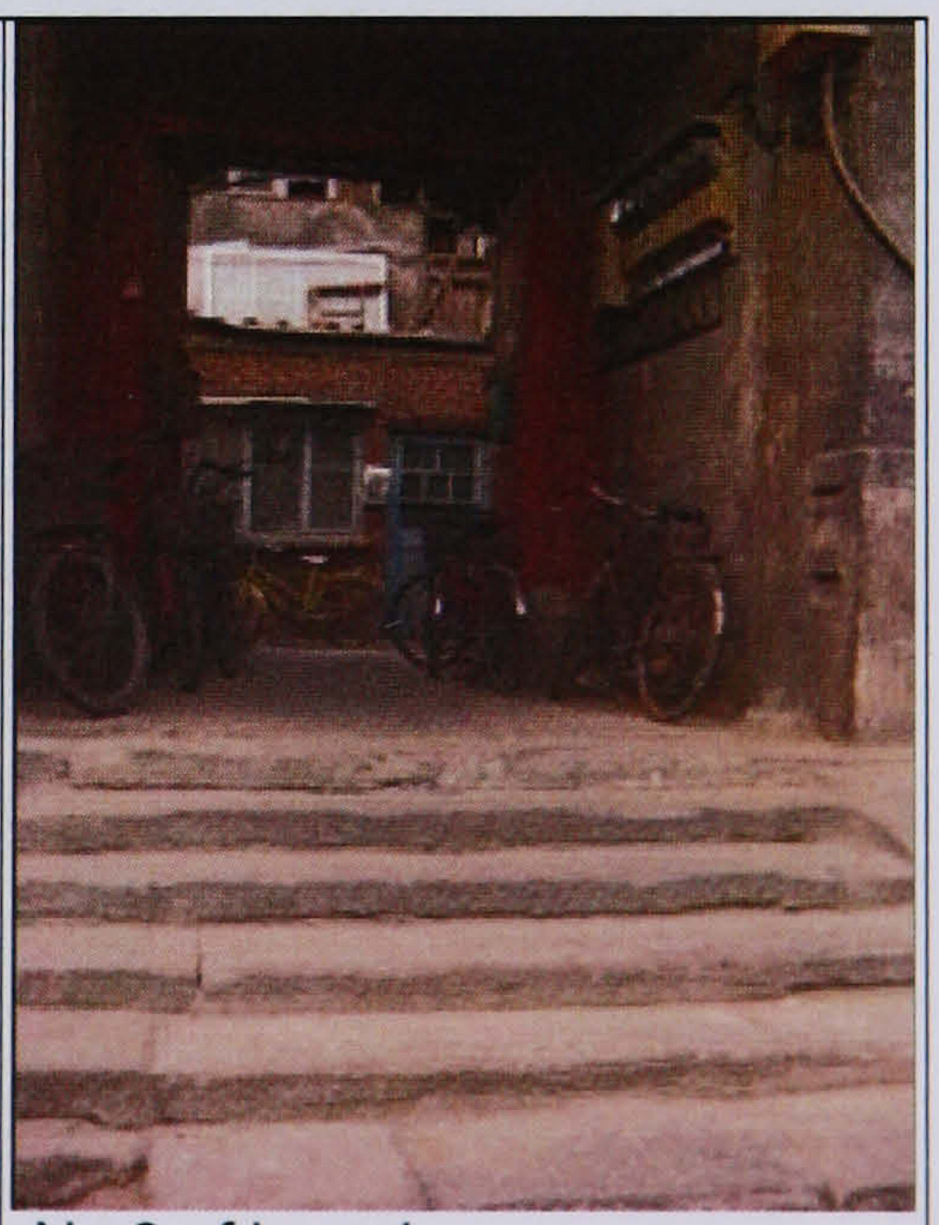
Fig. 7.32 The entrance gate of one formal courtyard unit



No 21 of lane 2
Broad entrance gate



No 21 of lane 2



No 3 of lane 4
Broad entrance gate

Fig. 7.33 The entrance of the two courtyard unit

No.3 of lane 4 and No.21 of lane 2 are two courtyard building units (Fig.7.33). Both gates occupy the southeast part of the building groups. From the survey, we can see that the height of the entrance gate is higher than the attached front buildings and occupies one bay of the front buildings which makes the entrance gate more prominent. The opening doors are located under the central ridge of the entrance gate which makes the entrance look deeper than the one courtyard unit, and these entrance gates are the *GuangLiang* (broad) entrance gates (Table 7.3:4) which indicates the highest social status for the ordinary buildings group. Furthermore, with the wooden sculptures that represent various myths and bring good fortune and happiness to the family, the decorative entrance frame of a *GuangLiang* (broad) entrance gate is located at the front part of the entrance gate (Fig.7.33, left). No. 111 of lane 8 and Nos. 51 & 53 of lane 6 are the three courtyard units (Fig.7.34), the front elevation to No. 111 of lane 8 entrance gate is mainly constructed of sculptural brickwork, and the door frame is located at the front of the entrance gate building; this type of entrance gate is a *RuYi* (free) entrance gate (Table 7.3:2; Fig.7.34). Furthermore, the three courtyard unit indicates the economic status of the family in No. 111 of lane 8 but at the same time, the *RuYi* entrance gate also indicates the relatively low social status of this family, however the rich decoration of the front entrance gate again helps to show the economic status of the family.

The entrance gate of No 51 & 53 of lane 6 also has a decorated front door frame and the entrance door itself is quite similar to the '*Guangliang'* entrance gate of the two courtyard unit, however, down to detail, the entrance door is located at the golden post (the middle position between the front and the middle ridge of the entrance gate) (Table 7.3:3) of the entrance gate rather than on the middle ridge of the gate where the '*GuangLiang*' entrance door is located (Table 7.3.4). This type of entrance gate is known as '*JinZhu*' (gold post) entrance gate, which has a lower social status than the '*Guangliang*' (broad) entrance gate (Table 7.3). The formal entrance to the *Fuwangfu* mansion is a completely different type of building. A five bay mansion with the hip-and-gable roof were located at the central axis of the imperial buildings group, and were used to identify the formal starting point to the imperial entrance gate.

No 111 of lane 8
Free entrance gate

Nos 51 & 53 of lane 8
Gold post entrance gate

Fig. 7.34 The entrance gate of a three courtyard building unit

Chapter 7.4 Secondary buildings and building elements

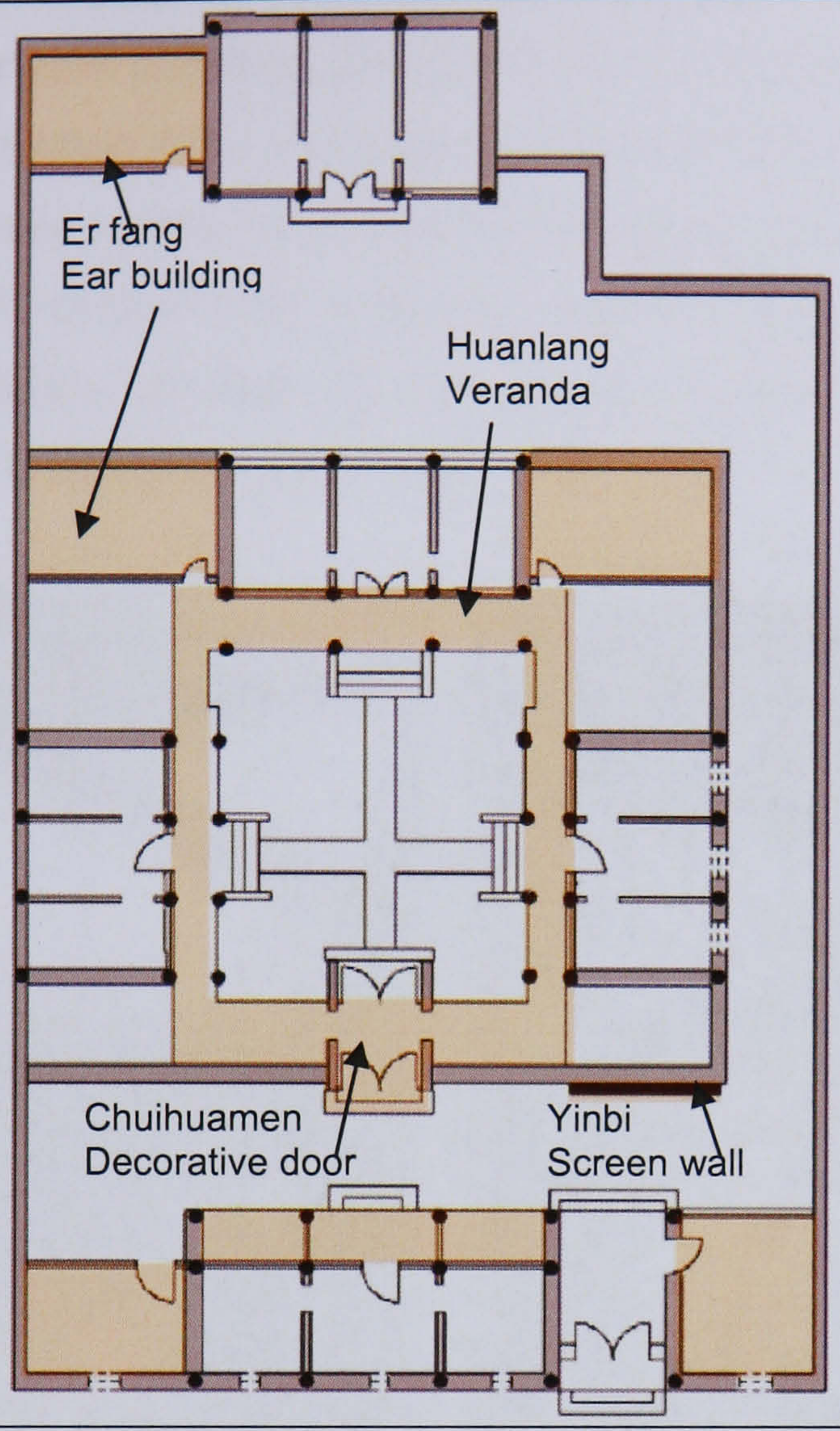


Fig 7.35 The secondary building and building elements, based on no 71, lane 8

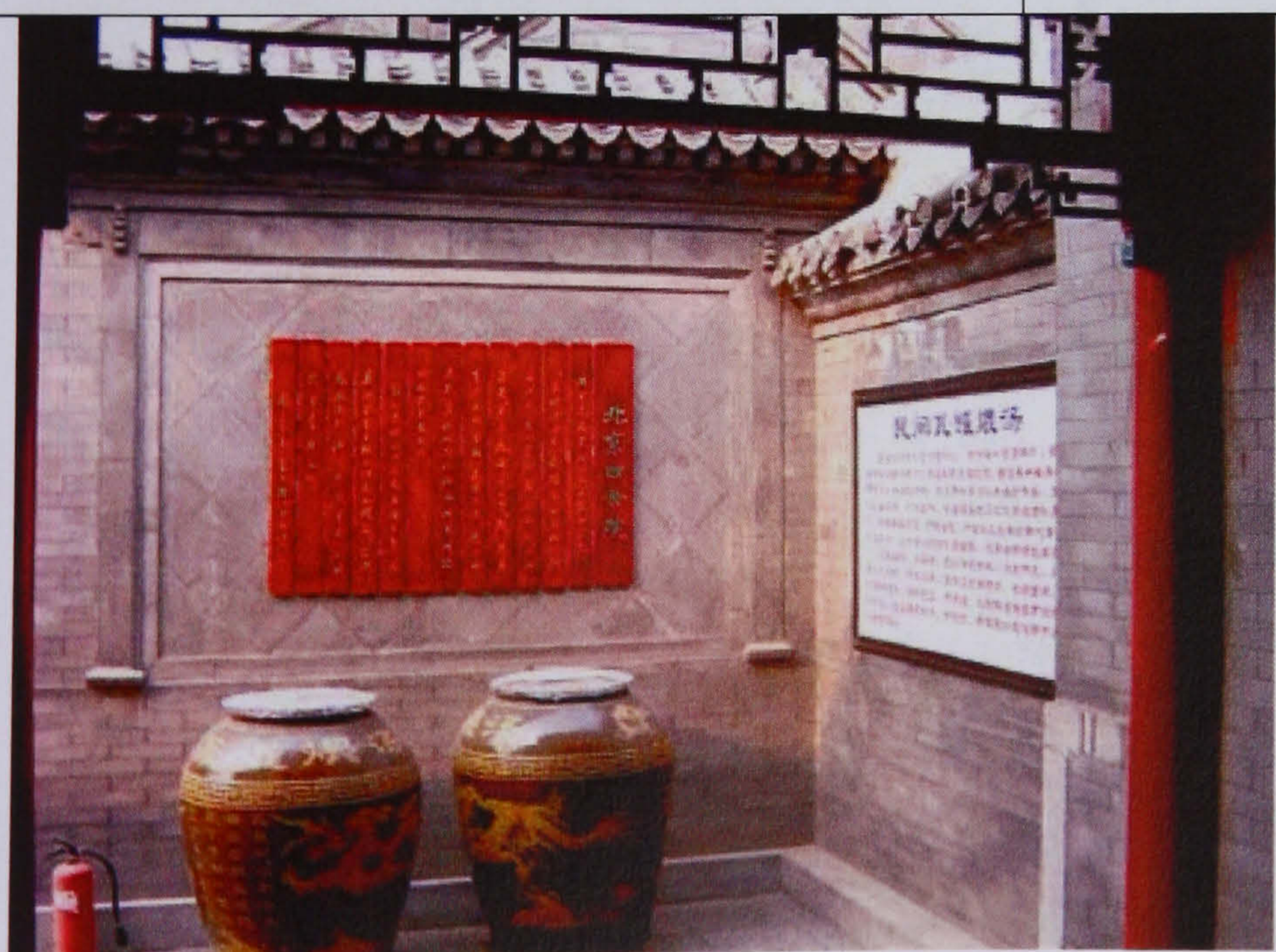
The building classification in Chapter 7.2 has identified the four types of secondary buildings of the courtyard buildings groups. These include the screen wall, the decoration gate, the verandah and the 'ear' building, which together with the main buildings help to compose a formal courtyard unit. This part of the study will examine and analyse the social culture values of these secondary buildings (Fig.7.35).

7.4.1 The screen wall

The screen wall of an ordinary courtyard building group such as No.39 of lane 8 normally faces the entrance gate, and has a tiled decorated roof on top and a brick or stone podium beneath (Fig.7.36, 7.37). In an ordinary courtyard buildings group, the screen wall is constructed of bricks or stone, and was located at the southern end of the east wing building (Fig.7.37). The use of the screen wall was to welcome good fortune and prevent bad fortune from entering via the front entrance gate. In front of the screen wall there were normally potted flowers or plantings (Fig.7.36) to help to create more layers to the layout of the courtyard buildings group and add to the richness of the space. The screen wall works together with the landscape, indicating the time changing by the shadow of the plants on the wall, and the landscape indicates the seasons changing as well. In general, the screen wall not only added to the richness to the courtyard buildings group but also worked with the entrance gate to help to provide a transition from the outside public space to an internal transition point from which different routes may lead for different users. From this point, a servant working at no 71 of lane 8 for example, might turn right and use the aisle to go to the back yard, a family member can turn left to the courtyard, the visitors might turn left to use the front building and so on (Fig.7.37).

No 39, lane 8

No 21, lane 2



No 51 & 53, lane 6

Fig.7.36 The screen wall of different courtyard buildings groups

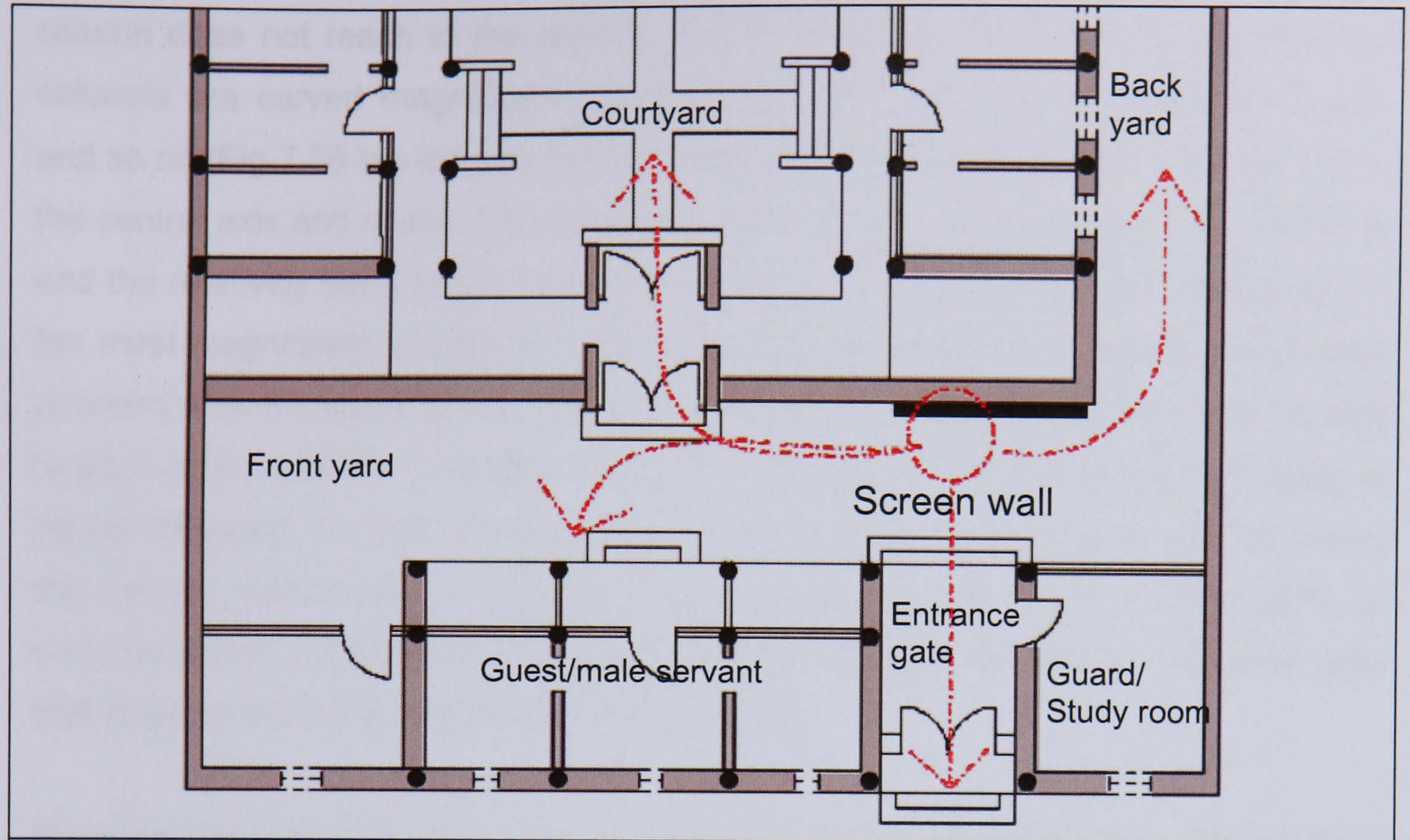


Fig.7.37 The screen wall
Note: based on No 71, lane 8 courtyard plan

7.4.2 *ChuihuaMen*: the decorative gate


View from front yard


View from inner yard

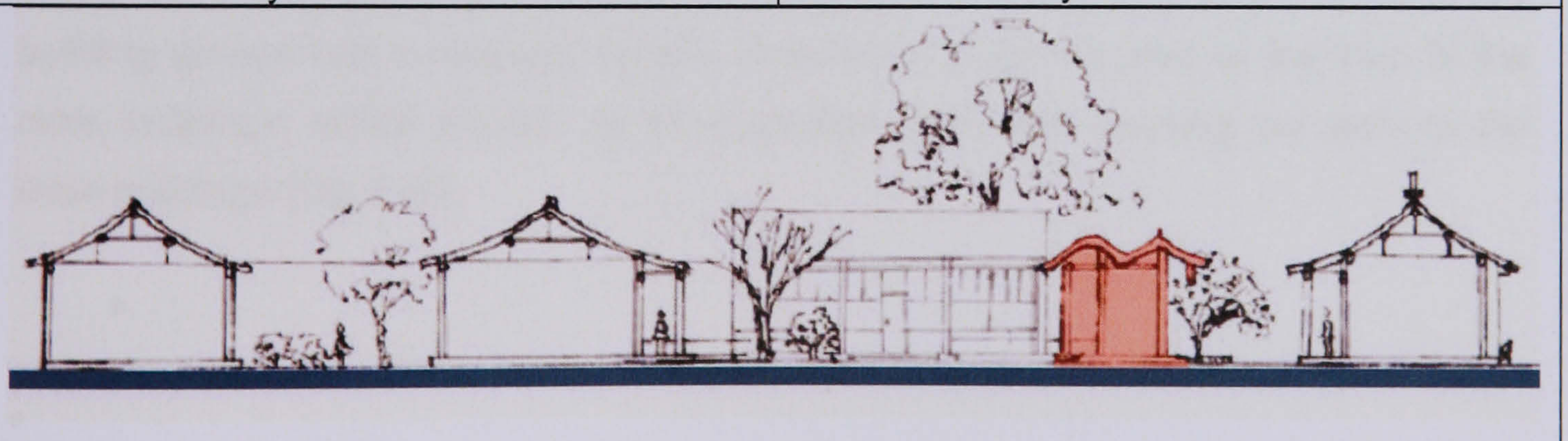

The section through the decorative gate, no 71, lane 8

Fig. 7.38 The decorative gate, no 71 of lane 8

The decorative gate of No 71 of lane 8 is located at the central axis of the buildings group. It is mainly made from timber with two rows of overhang roof; the overhanging gable roof at the front and a rolling overhanging roof at the back. The front eave column does not reach to the ground, and at the bottom of these two overhanging columns are carved magnificent woodcarvings such as lotus flower petals, leaves and so on (Fig.7.38 top left and bottom). Because the decorative gate is positioned in the central axis and is also the connection point between the private family members and the relatively semi-public place of the front yard buildings, the decorative gate is the most magnificent building in the entire building group. The decorative gate also provides a direct connection to the internal enclosing verandah which allows access to each building of the courtyard (Fig.7.38, 7.39). 'A *chuihuamen* (decorative gate) is placed between the outer peripheral and inner central courtyard at a position along the central axis where it provides not only security but offers a focal point of ornamentation...*Chuihuamen*, are generally more resplendent than the outer gate that leads to the world outside' (Knapp, 2000:66).

Normally, there are two sets of doors to this decorative entrance gate, the first front one was only closed during the night time, but the internal one was closed most of the time, except on important ceremonies or events for the family such as weddings, funerals, births and so on. This arrangement also indicates that the central north to south axis still could not be used in ordinary daily life. Meanwhile, the internal door (the second pair of doors) also helped to provide a screen to the internal family life from the visitors and servants during the day when the front doors are open. Access to the courtyard was normally through the verandah on both sides of the decorative gate, before reaching each private building (Fig.7.39). The decorative gate was the most important transition point from the relatively semi-public space of the front yard to the completely private courtyard that is used by the family members. The visitors and even the servants could not access this area without the owner's permission. However, not all grouped courtyard buildings had a decorative gate. Some of the building groups had a relatively simple decorative screen located at the front of the main buildings, which worked as the transition point and blocking the view to the main buildings (Fig.7.40).

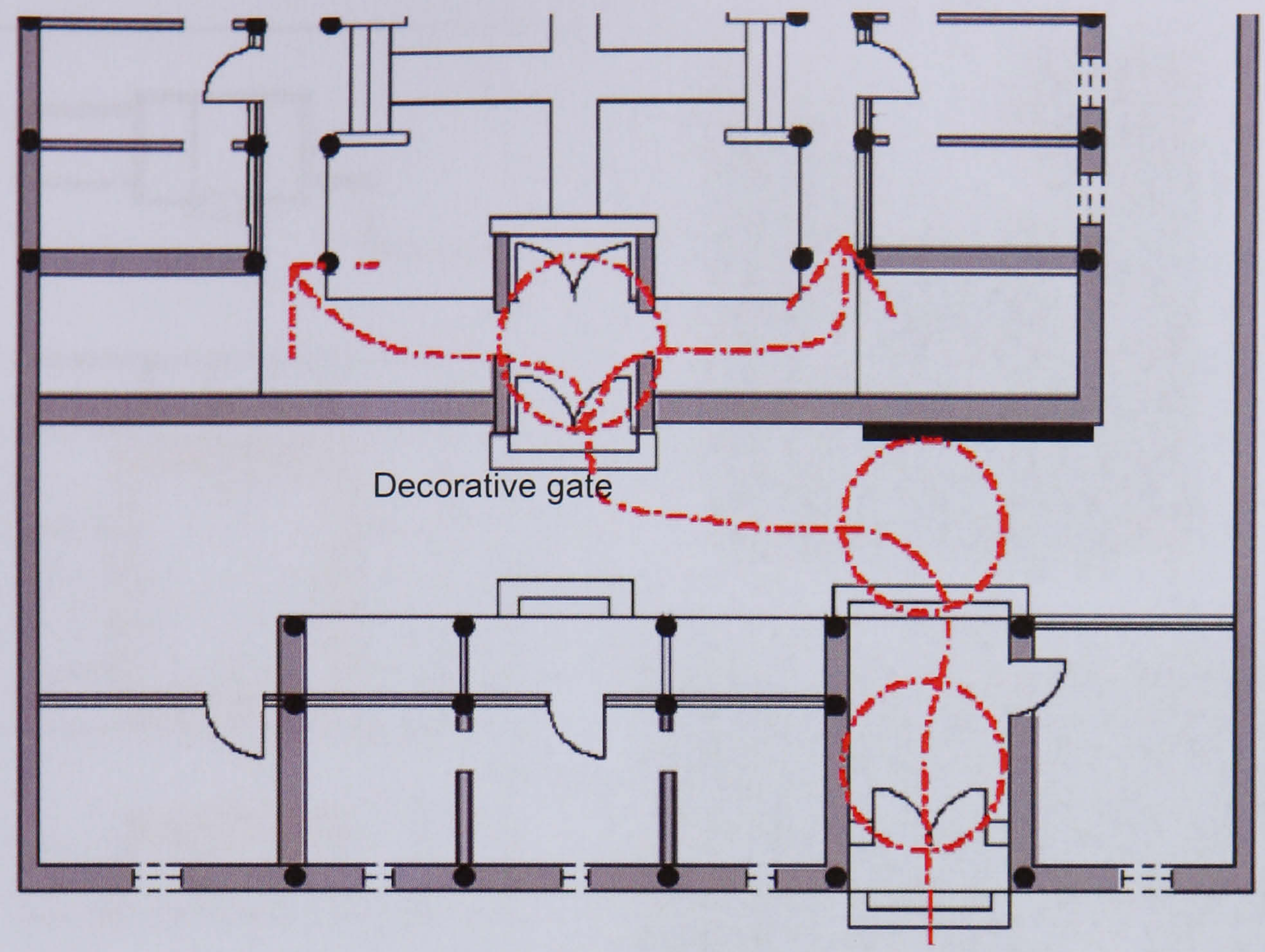
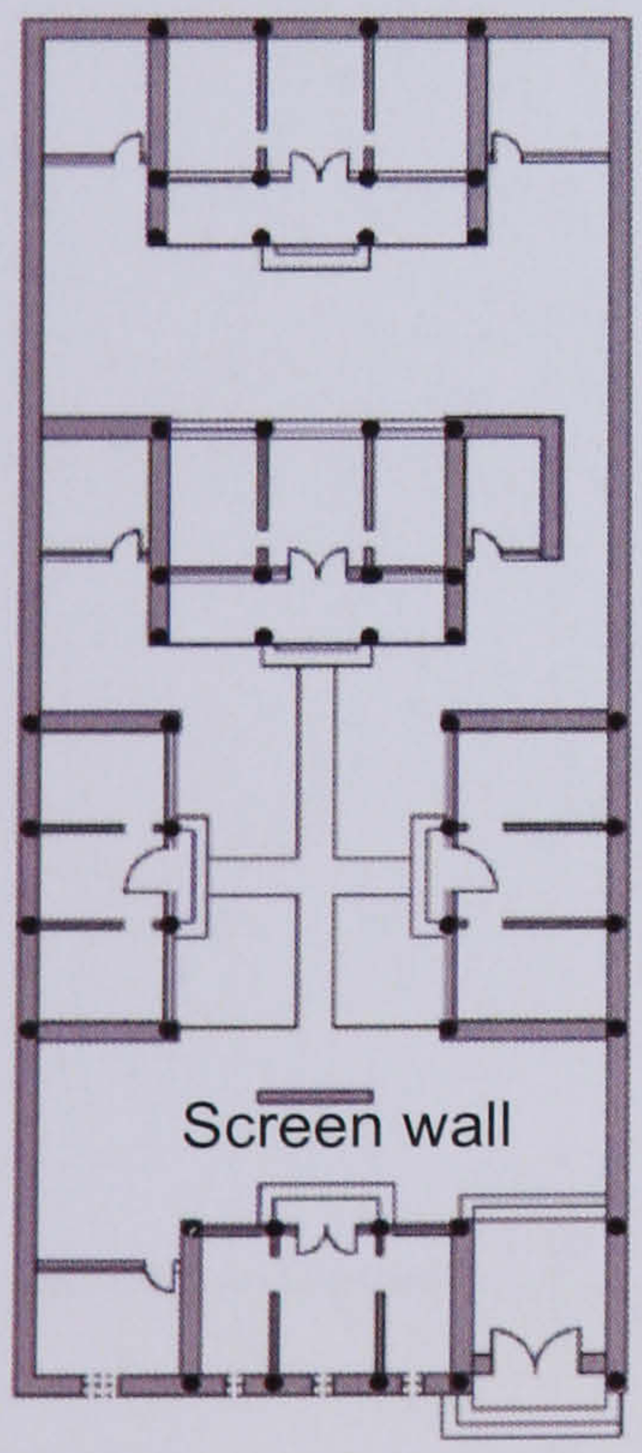


Fig.7.39 The location and use of the decorative gate

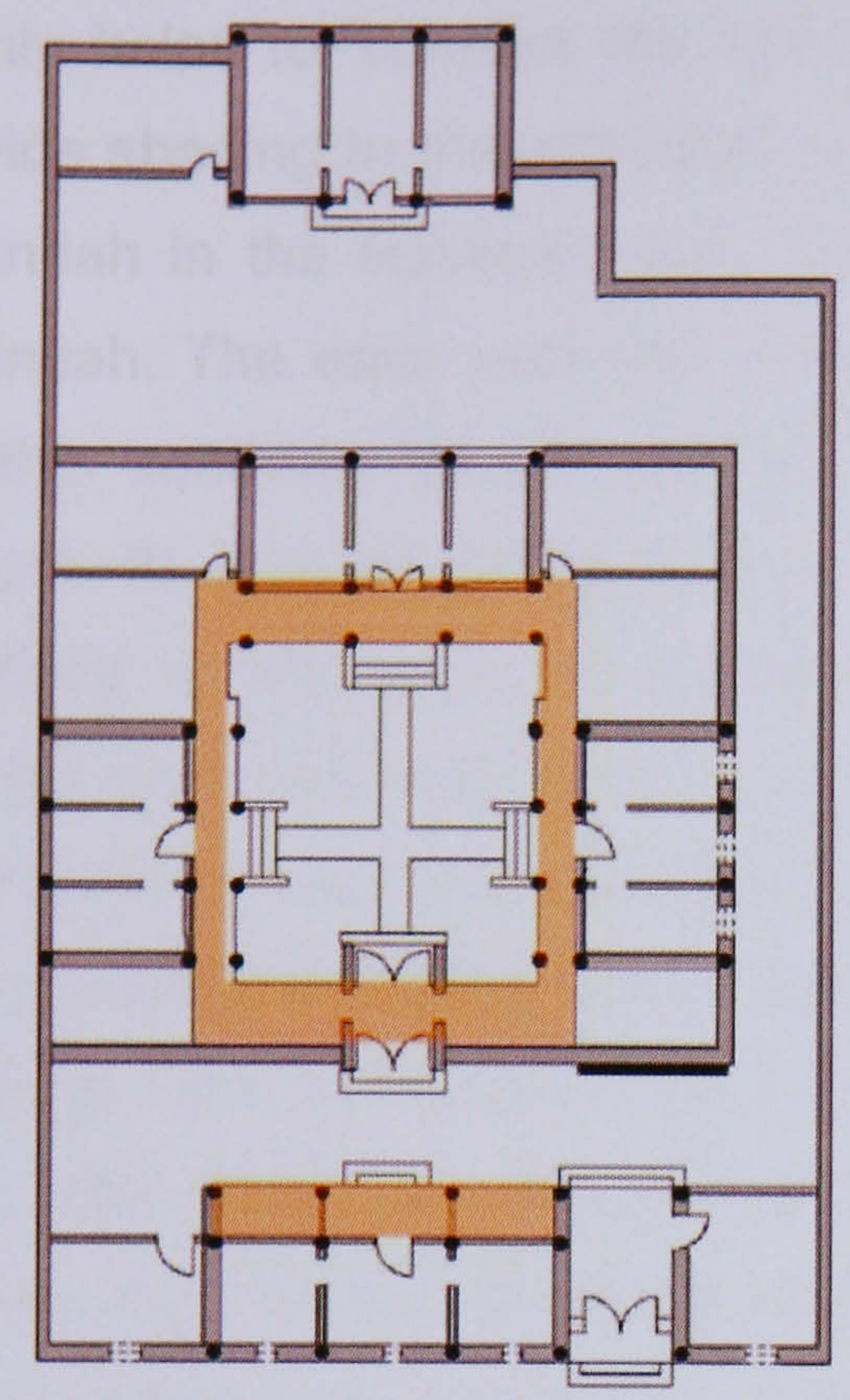


No 129, lane 8

Source: Fu, 2002:303

Fig. 7.40 The screen

7.4.3 The veranda

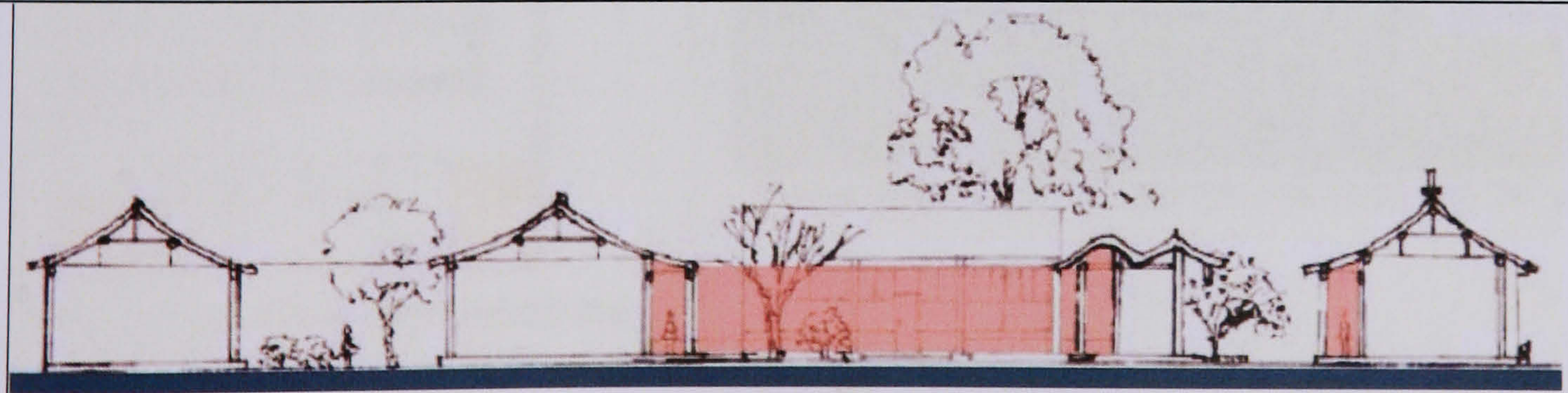


The orange colour represents the location of the verandah

A connecting verandah

A connection verandah

An eave verandah

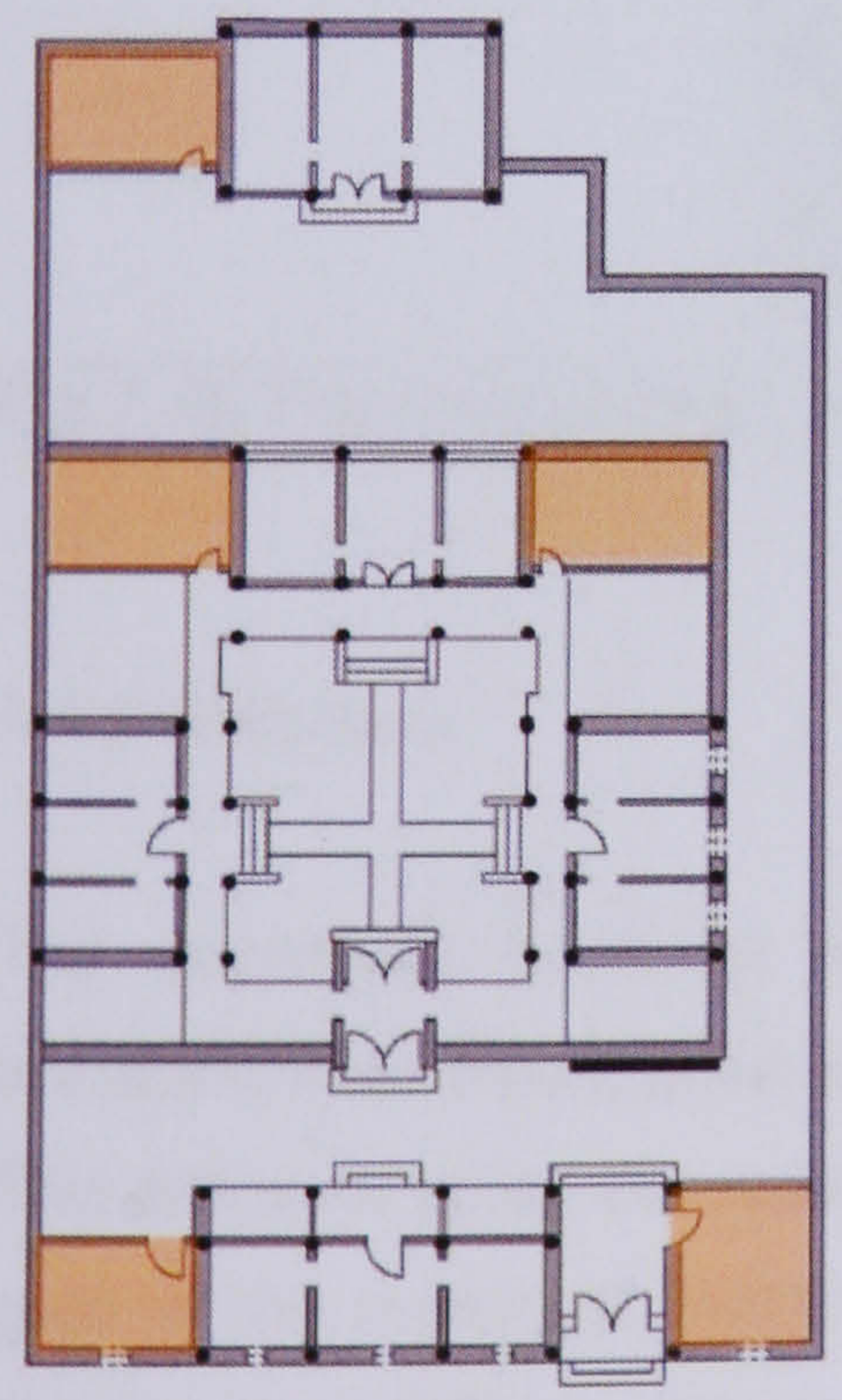


The section which shows the verandah

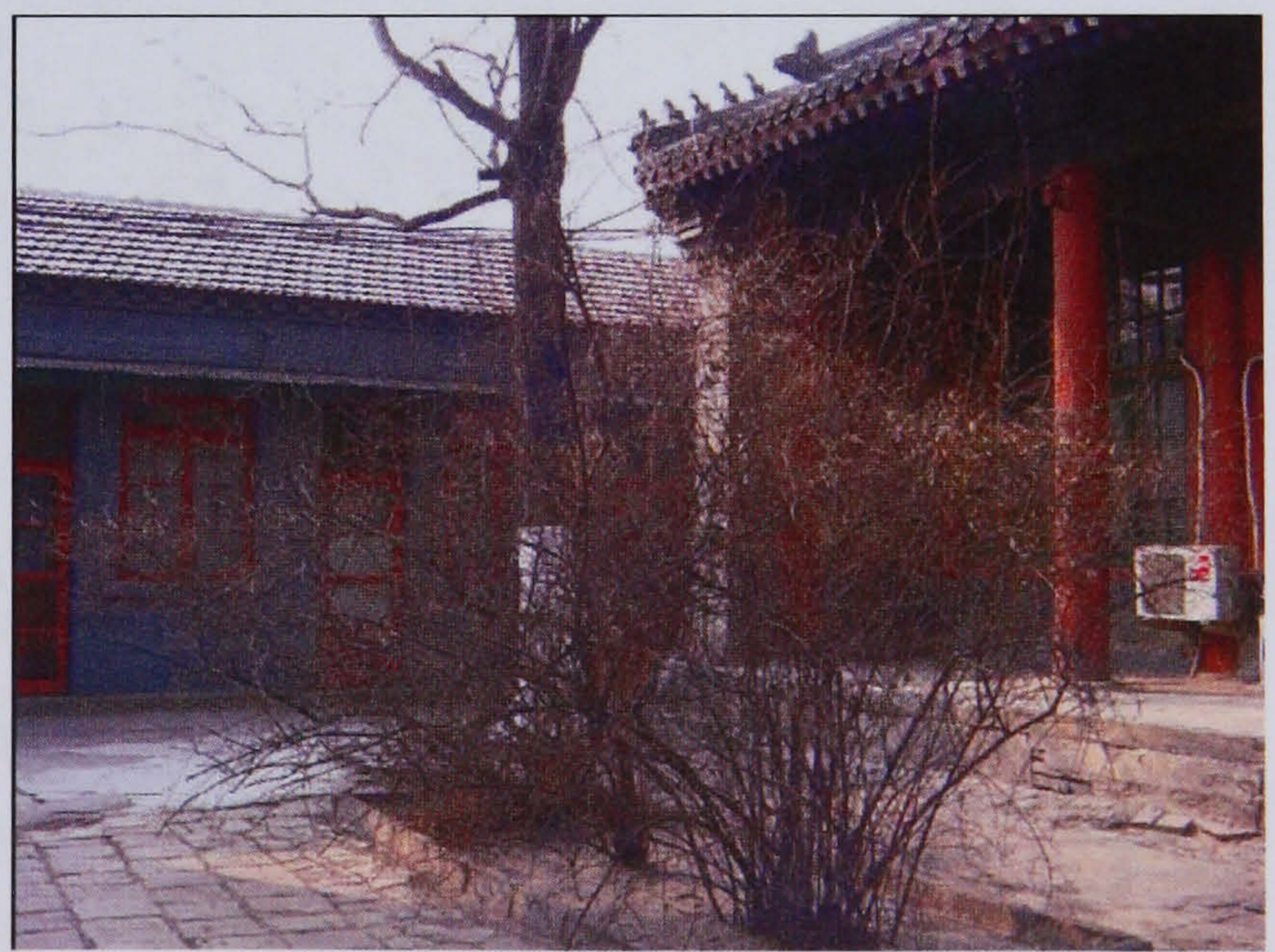
Fig.7.41 The verandah, no 71 of lane 8

From the survey, we can see that most of the courtyard buildings such as No. 71 and No. 129 of lane 8 and the multi courtyard units have a verandah. The verandah mainly helps to 'connect the buildings together into one unit' (Xu, 1964:209) and provide shading to the individual building (Fig. 7.41). There are mainly two types of verandah in the surveyed area, these are the eave verandah and the connecting verandah. The eave verandah works as part of the buildings' roof and acts as the weather controller for the main and wing buildings (for physical characteristics see Chapter 8), and this characteristic makes it possible to open the front façade of the buildings to the courtyard gardens. The connecting verandah mainly provides a shaded space between the main buildings, wing buildings and also the 'ear' buildings. Both of these two types of verandah work together to provide an enclosed arcade to the courtyard buildings group, and inside the verandah is the courtyard which the buildings face. Furthermore, the verandah was also used as the place for residents to relax, chat, view the landscape, or for children to play inside the courtyard and so on. Indeed, the concept of the courtyard buildings groups in China rarely included just one building, but signifies a group of buildings and building elements that are connected by the verandah (Fu, 2002; Liu: 1956).

7.4.4 *Er* (ear) room



The orange colour represents the er (ear) room, No 71, lane 8



The er (ear)room of *Fuwangfu* Mansion and the yard

Fig.7.42 The er (ear) room.

The *er* (ear) room is located at both sides of the main buildings that have principally been used to provide the service to the main buildings (Fig.7.42). In a small scale courtyard unit, there are mainly one bay buildings located at both sides, though two bay buildings may be located at both sides of the buildings for a larger scale of courtyard unit. For the imperial family in *FuwangFu* mansion, three bay buildings are located at both sides of the main buildings, and the space between the '*er*' (ear) buildings and the gable of the wing buildings comprises a relatively small yard which has been identified as the secondary yard to the main courtyard; this yard normally provided the landscape garden to the '*er*' (ear) buildings. For a multi courtyard buildings group, different secondary service yards can be located at the front of the '*er*' (ear) buildings to provide extra space. For different conditions, the service yard and buildings can be located to the left or right of the main buildings (Fig.7.43).

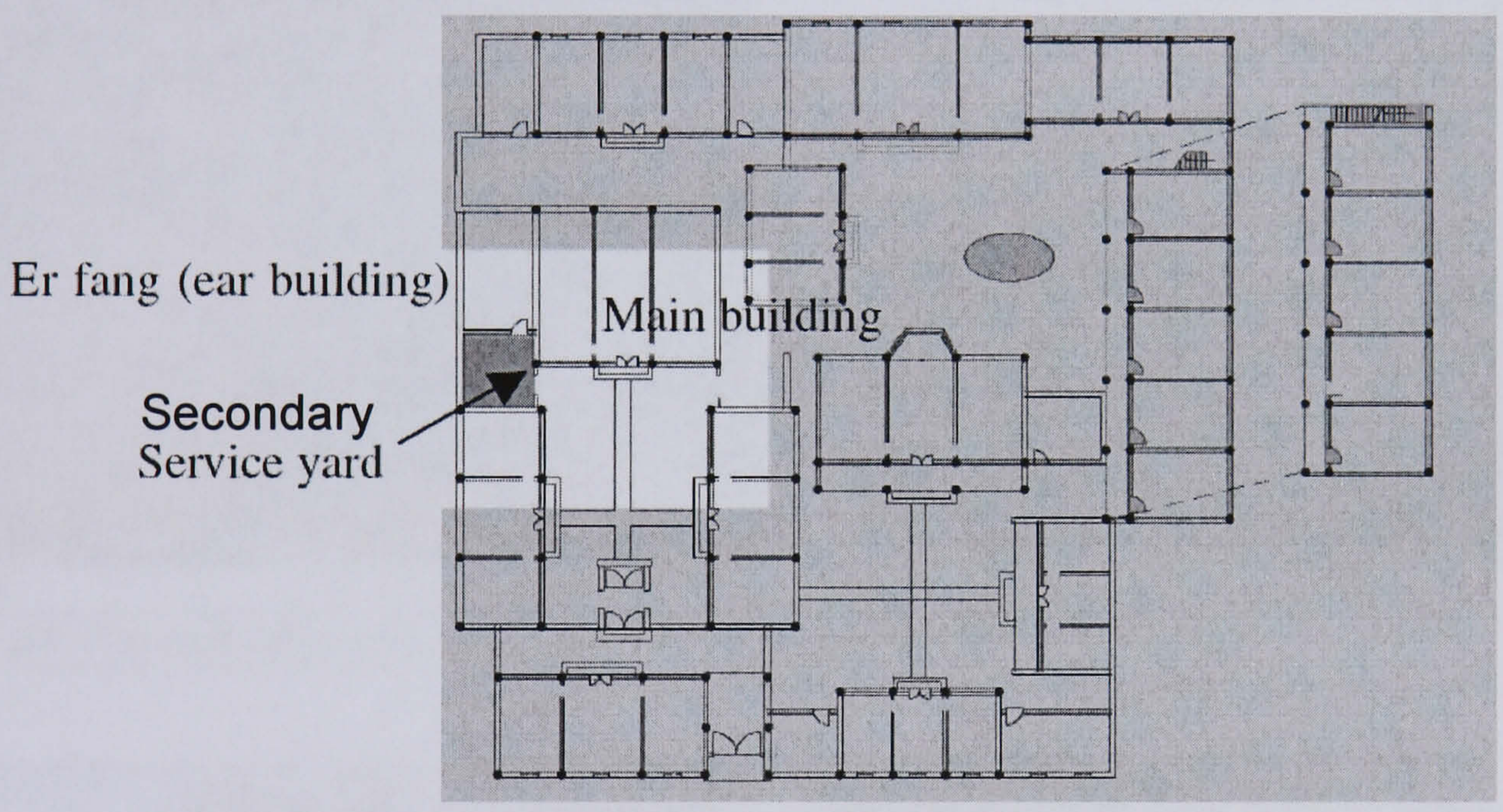
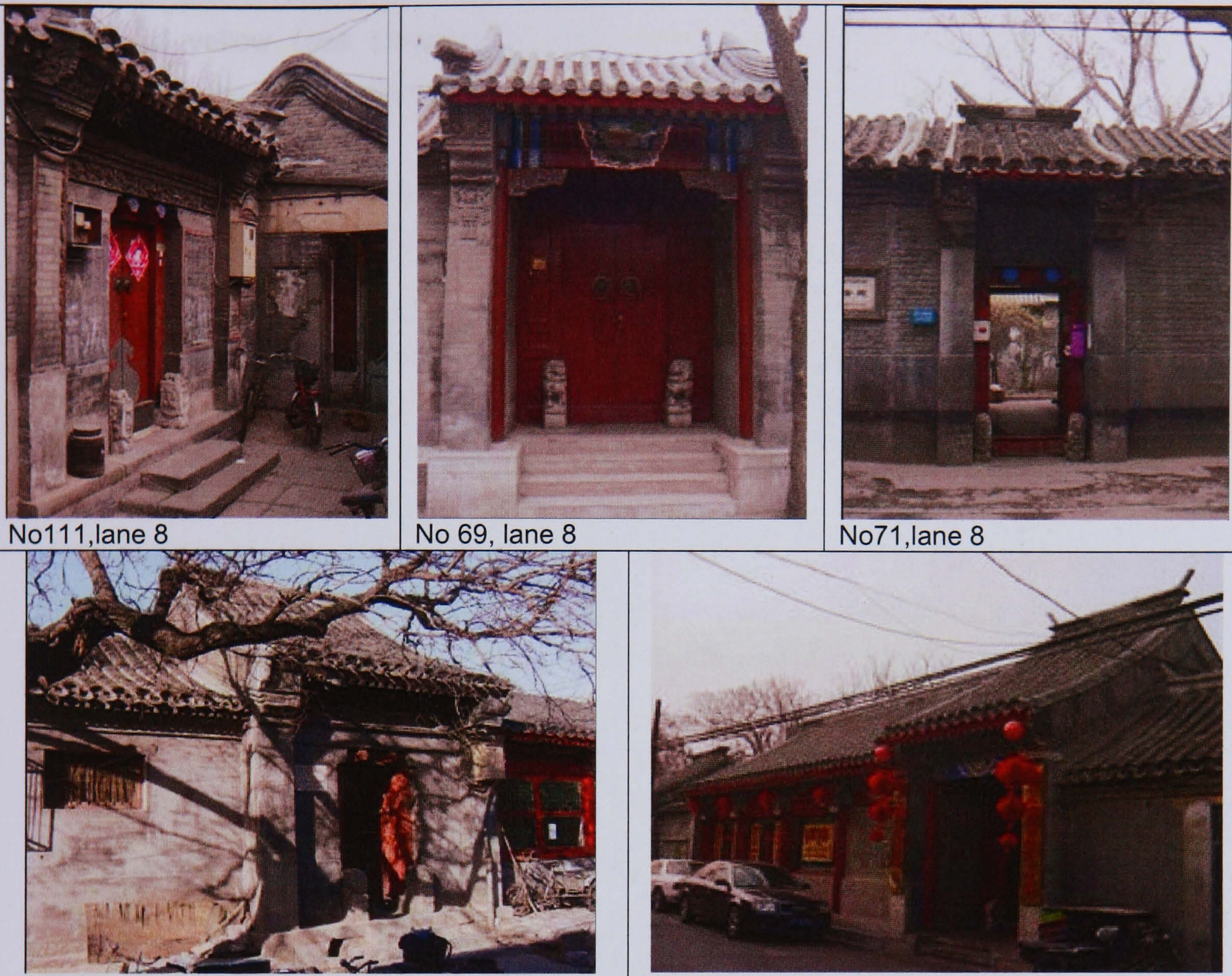


Fig.7.43 The arrangement of the service yard and buildings, nos 51 & 53, lane 6

7.4.5 Summary

The secondary buildings worked closely with the entrance gate to provide the transition from the external space of the courtyard to the internal of the private rooms. The entrance gate, the screen wall, the decorative gate, the verandah, the entrance gate of the individual buildings together provided a smooth, spatial transition to the courtyard buildings groups. These transition points created by the secondary buildings/building elements give a clear direction to each member of the family and the visitors.

7.5 Colour typology studies



No111,lane 8 | No 69, lane 8 | No71,lane 8

Lane 4 | No 51, lane 6

Fig. 7.44 The colourful entrance gate of the courtyard building groups

Fig. 7.45 The yellow colour on the hip of the roof of *Fuwang Fu* mansion

Upon walking into a typical courtyard building complex, one is most impressed with the dominant grey wall and roof, red columns, red entrance doors, green-panelled windows, and colourfully decorated doors and girders (Fig.7.44). *Fuwangfu* mansion, however, conveys more status with its ornament and colour, namely by its green terracotta glazed tiles (Fig. 7.45), interior motif paintings, and the use of the royal colour of yellow (see Chapter 4). Here 'the unity and variety of colour also strengthens the artistic effect of the architectural complex' (Wu, 1999:13).

From the survey, we observe that the most popular colours in courtyard buildings are grey, red, green (blue), white, and yellow, and 'there are rules and principles with regard to colour schemes applied on the buildings and its components'. These rules were written in architectural records such as the *Yingzao fashi* (Building standards in 1107)' (Lip, 1995:29). In all the buildings, the pillars, windows and door frames are normally painted red (Fig.7.45), and this is linked to the *Five Elements* of *Fengshui* theories (see Chapter 4.2.1.1), which describes red as representing Fire and is associated with southern orientation, and therefore, happiness and blessings. In China, the southerly direction is where the mild sunshine and wind comes from and is the place for planting and growing. Therefore, this colour system is not a blind worship or superstition, but bears a strong psychological feeling for the physical environment where the Chinese live.

Green is used on girders, window panels, inner door frames, terracotta glazed roofs, and *Fuwangfu's* wall and ceiling decoration, which is more focused on the smaller scale structural elements. 'Blue, together with its secondary colours, such as green, is the colour of Spring and of the leaves of trees. It has its position in the east, and denotes the time of sunrise' (Xu, 1964:224). Green therefore represents the eastern direction, wood, posterity, the male gender, and peace. It is used 'because of its soothing effect, also to represent harmony' (Lip, 1995:29). White has been used for the paintings on the girders and also ceilings, and represents the element of metal, peace, purity, the western direction, and the female gender. Yellow is specific for the *Fuwang Fu* mansion which has only been painted on the hip of the roof (Fig. 7.45) and represents the house owner's power and wealth. In traditional Chinese culture, yellow represents earth, the central direction, and is furthermore symbolic of the emperor, as the Chinese believe that China is located centrally in the world, and the emperor occupies the centre of China. The strict social culture prescribes that the yellow colour is specific to the emperor; other royal family members cannot use it if there is no specific permission. In contrast, black represents water, and is rarely used in courtyard building decoration, as it represents north, and also means the cold and dry Siberian winter with the possibility of an attack from minorities in the North.

a: The entrance gate

b: The decorative gate to the main courtyard

c The left building

d: The main hall

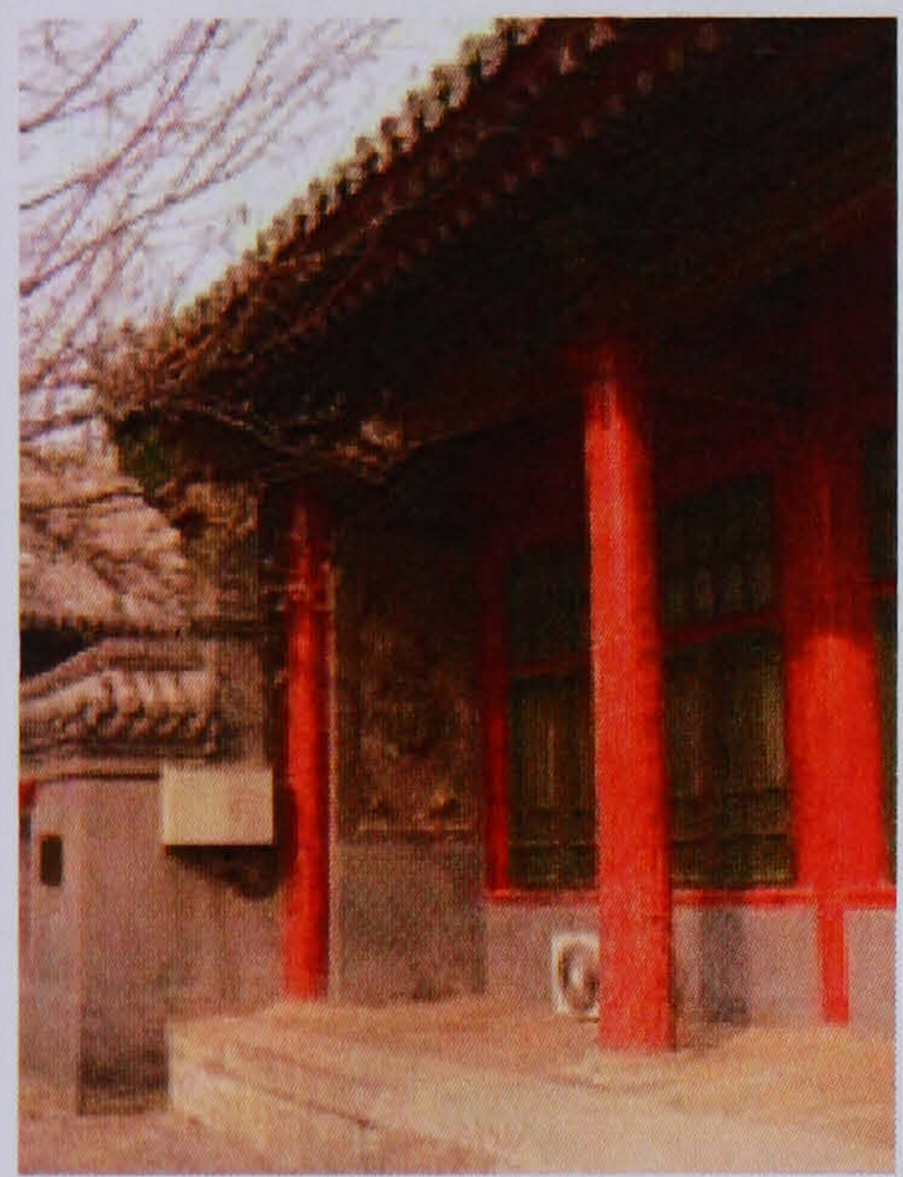
Fig. 7.46 The colour of no 71, lane 8

a: The entrance to the main courtyard

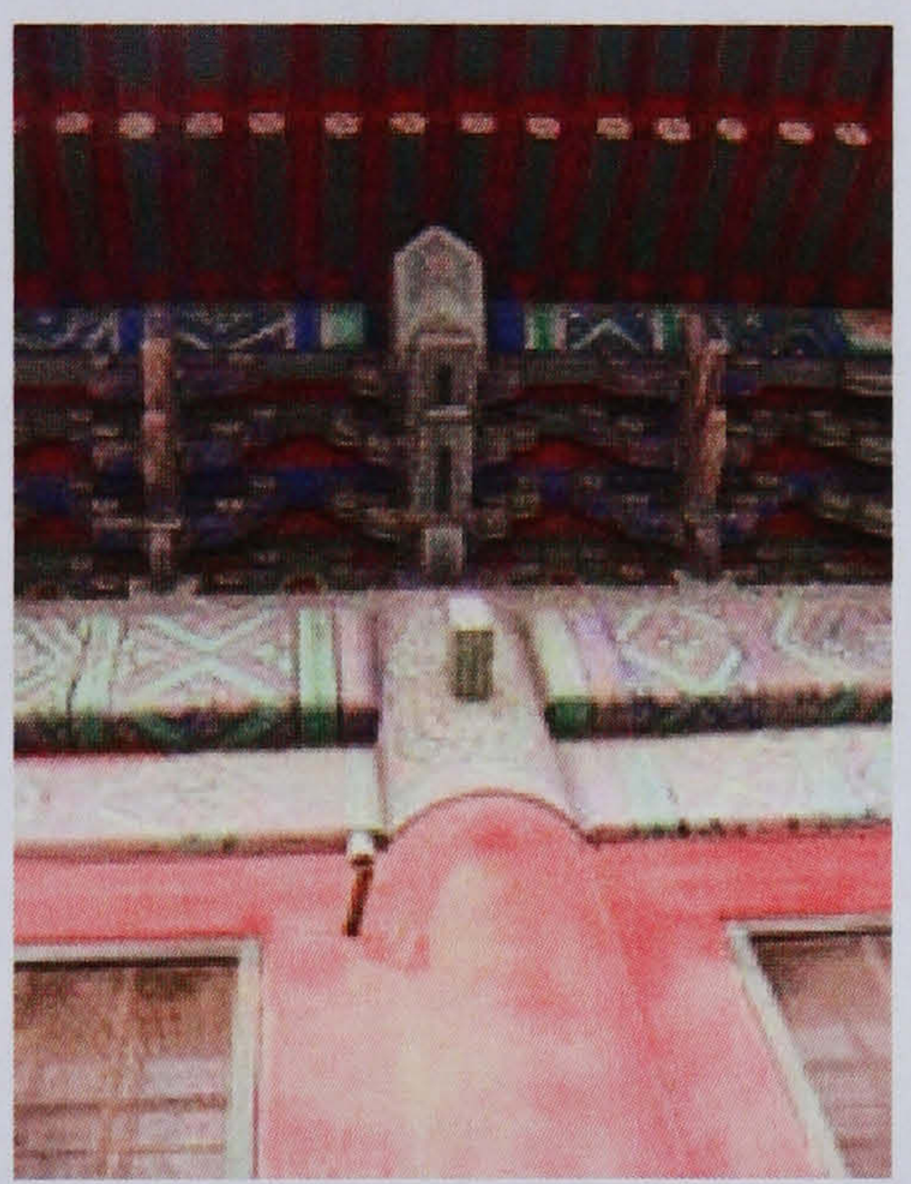
b: The ceiling decoration

c: Youxiangfang (left building)

d: The main hall



e : Zuoxiang fang (left building)



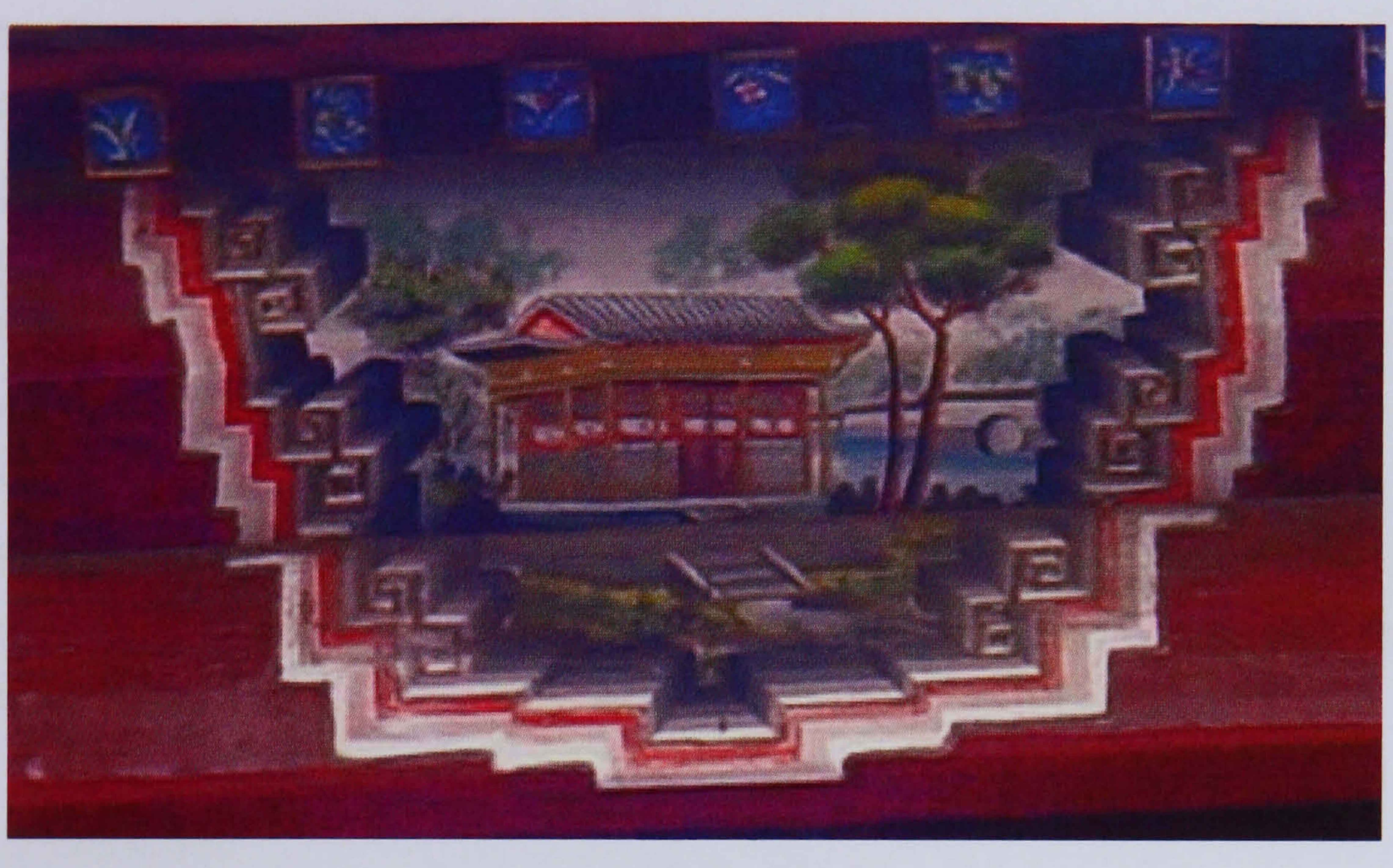
f: The main structure for the main hall

g: Er fang (ear building)

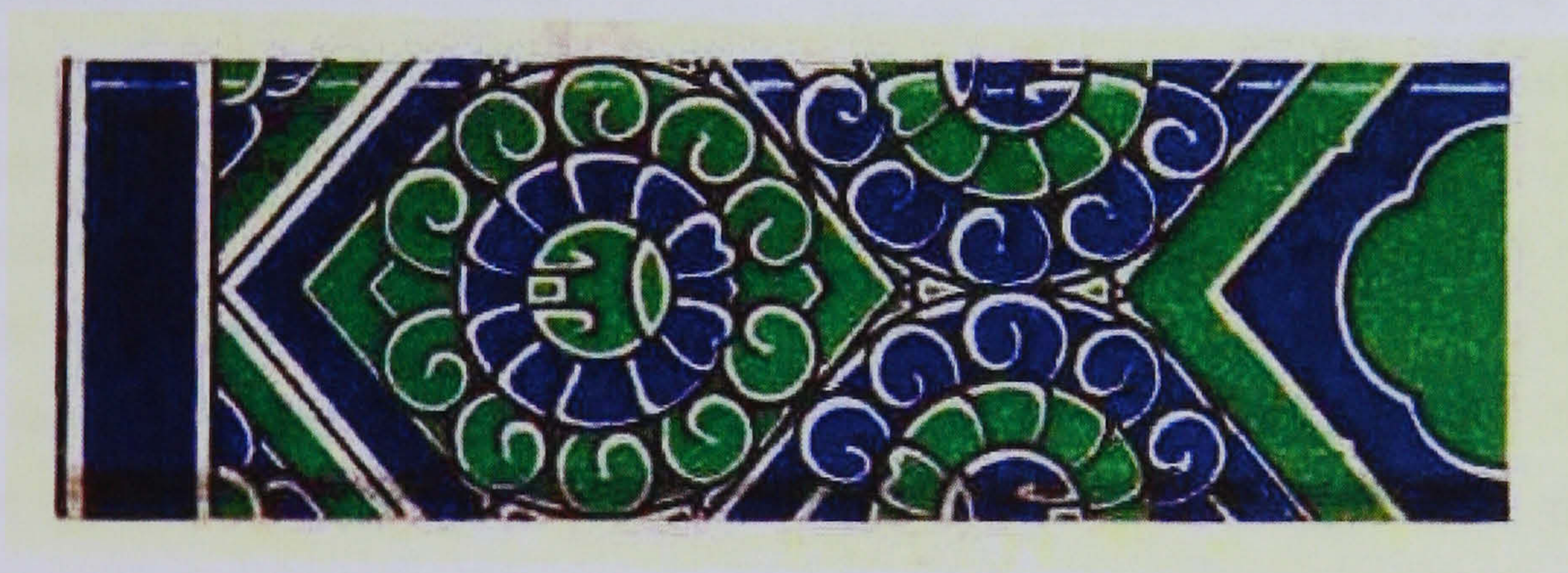
Fig. 7.47 The colour of *Fuwang Fu* mansion

However, besides these five basic colours that link with the five elements and the five directions (Lu, 2000) which the above studies mentioned, the grey colour of the brick and tile is the dominant colour of the neighbourhood. Grey bricks are the main material for enclosure for the courtyard unit and the buildings. Grey tiles are also important because, unlike the green glazed tile of the *Fuwangfu* mansion, the grey bricks and tiles are made in the Beijing suburbs, are native materials, and are easy to transport to the city centre.

Colourful motif story paintings on the girders and ceilings (Fig. 7. 47) are another important identifier of traditional Chinese architecture. These paintings are normally traditional fairy tales and represent good fortune for the family. Basically two types of traditional Chinese painting were revealed by the survey. *Xuanzi* painting was used for the *Fuwangfu* mansion main buildings. *Xuanzi* painting uses the cycle as the basic painting elements, and the colour of the painting is strictly regulated, and therefore is a formal type of painting. *Susi* painting was normally used for ordinary buildings (it can also be used by the imperial buildings, but generally they had more freedom of choice of context and style (Fig.7.48).



Sushi Style Painting: the entrance gate at lane 8



Xuanzi Painting: used by *Fuwangfu* mansion

Fig.7.48 The Chinese painting

These lacquer paintings in 1st to 10th lane of *Dongsi* neighbourhood are not just a decoration; they also protect the Chinese timber system, 'lacquer has also been another important material in the history of Chinese building. Its use dates back to the *Shang* period and then, as now, it was used for preserving and decorating wood. Lacquer is derived from the sap of the lacquer tree, and when applied in a series of thin layers, forms a surface that is resistant to acid as well as water' (Chan, 1991:21). This protection is essential to the Chinese timber structural system, 'Paint was and has remained an important element in decorating buildings. Because Chinese buildings traditionally had an open framework where the interior beams and rafters were left exposed to the eye, there was much scope for painted decoration on the internal and external woodwork of the buildings. Paint, like lacquer, also helped to preserve the timber' (Chan, 1991:21). This protection makes it possible for a timber structure to be preserved into contemporary times (Fu, 2002).

The traditional Chinese architecture colour system is an important element of the traditional courtyard buildings complex of *Dongsi* neighbourhood and also of Beijing as a whole. 'From the use of paint, colour schemes were devised. The selection of colours was based on the principle of harmony and composition which would enrich and beautify architecture' (Xu, 1964:222). Grey, red, green (blue), yellow and white are used specifically in the orientation, social hierarchy, worship rituals, and reinforce the sense of the physical living environment. Furthermore, the other important aim of the coloured oil painting is to protect the Chinese wooden structural system from decay, sepsis, and fire. This colour system enables cultural symbolism and building functionality to co-exist.

7.6 Conclusion

The diverse courtyard buildings groups have been classified following the primary shaping forces on the courtyard dwellings in Beijing, which help to classify and analyse the collected materials. There are five buildings grouped into one courtyard unit following *Daoist*, Confucian and *Fengshui* principles. The plan of typology studies indicates the location of the family. Each member of the family has to strictly follow his social duties and status inside the neighbourhood and the family. The front *Yuanzi* (yard and buildings) generally provides service to the courtyard unit and were used by visitors and male servants. Following the front yard is a series of *Yuanluo,* and each *Yuanluo* which is comprised of a wing and main buildings was used by one unit of the family. The owner, the family ancestral hall and also the religious ceremonies were held in the main buildings that were located in the deepest place of the courtyard buildings. For the main buildings, the ear room and the secondary yard have been broadly used to provide an extra service space. The back buildings have also been used to provide the service to the main buildings and used by the female servants and possibly the youngest female family members. The axis which is composed of different *Yuanluo* and *Yuanzi* also vary according to the plan typology analysis. There are basically four types of axis arrangement evident from the previous plan studies: (1) All the buildings are in the central south-north axis location (Fig.7.49: a), such as the one and two courtyard unit. (2)There might be two paralleled axes following the north-south direction which include the central axis where the oldest generation is located and the attached axis (Fig.7.49: b), such as No 111 of lane 8 and No 51 & 53 of lane 6. (3)Three axes might follow the north south direction such as *Songli* House (63-65 of lane 6) which is composed of a series of one or two courtyard units (Fig.7.49: c). (4) Three axes with the main central axis (Fig. 7.49: d), such as the *Fuwangfu* Mansion

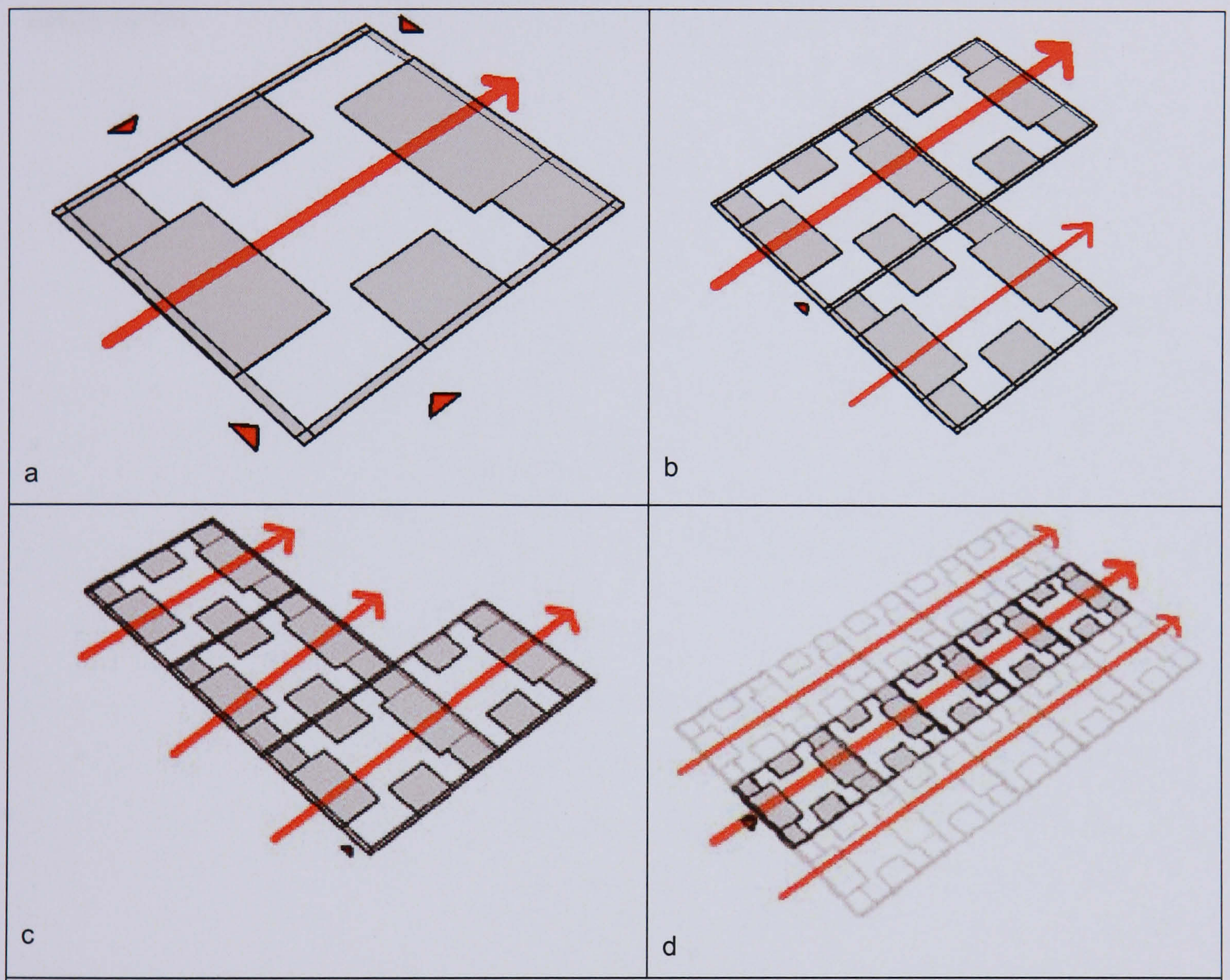


Fig.7.49 The arrangement of the courtyard unit

The link among different *Yuanluo* (courtyard units) may also vary according to the plan analysis. It may be the route behind the wing buildings which leading to the next courtyard unit directly from the front yard for a two courtyard unit. It may also be a connecting door located in the middle of the building group for a three courtyard unit, and for the *fuwangfu* mansion, the formal three bay entrance gates are located at the first courtyard to link the three axes together.

The previous studies identified two general classes of dwelling as a result of the roof studies: the imperial family mansion and ordinary courtyard buildings. Furthermore, five types of entrance gates help to indicate the social and economic status of the family, particularly in the ordinary dwellings. The secondary buildings, which include the screen wall, decorative gate and verandah, have been used to achieve a good quality spatial transition inside the courtyard building, and also indicate the direction for each member of the resident, visitor and the service people. Finally, the Chinese traditional painting helps to enrich the courtyard dwellings both atheistically and social culturally, and the painting also prevents the timber system from decaying and catching fire.

Chapter 8: courtyard dwellings: architectural economics (structure design aspect) and environmental values studies

The socio-culture values of the courtyard dwellings have been studied and analysed in Chapter 7 and related to the plan typology and colour typology studies. Each *Yuanluo* (courtyard buildings) unit represents a group of buildings, courtyard and yard that assure the principle of Daoism (replication from one to many and harmony with nature); Confucianism (social hierarchy) and *Fengshui* theory (maximize the positive and eliminate the negative '*Qi*'). The studies also reveal the spatial hierarchal, and social behaviours and building layout of the multi courtyard unit. Furthermore, the social cultural values of the entrance gate, the gardens, and the secondary buildings have also been analysed. Meanwhile, as the colour typology suggests, the Chinese colour scheme is not just blind worship or superstition, but bears strong psychology feelings of the local environment where the Chinese live. Following the social culture values study of the courtyard dwellings, this part of the study will focus on the architectural structure and section typology studies, which will help to reveal the architectural economic values (design aspect) of the Chinese traditional structural system and also the environmental values from traditional courtyard dwellings.

8.1 The structure typology studies

From the investigation of the 12 represented courtyard building groups and also the previous plan typology studies, the structural system of an ordinary building in the survey area such as No. 71 of lane 8 normally includes a raised platform which forms the foundation for a post-and–lintel timber skeleton, and a pitched roof system which takes the form of a built-up triangle, consisting of a system of beams of diminishing length placed precisely one over the other between columns, and separated from each other by struts (Bouvier, 1971, fig.8.1). This system is exactly the same as the structure system defined by Knapp and other Chinese scholars of traditional Chinese buildings. 'Earlier in this century, Chinese architectural historians, such as *Liang Sicheng, Liu Dunzhen, and Liu Zhiping,* identified three fundamental elements or components of Chinese buildings: the platform or foundation, pillars and beams skeleton, and pitched roof' (Knapp, 2000:71). Then above the beams and purlins, rafters are placed to support the tiling boards and batten which in turn support the tiles (Fig.8.1).

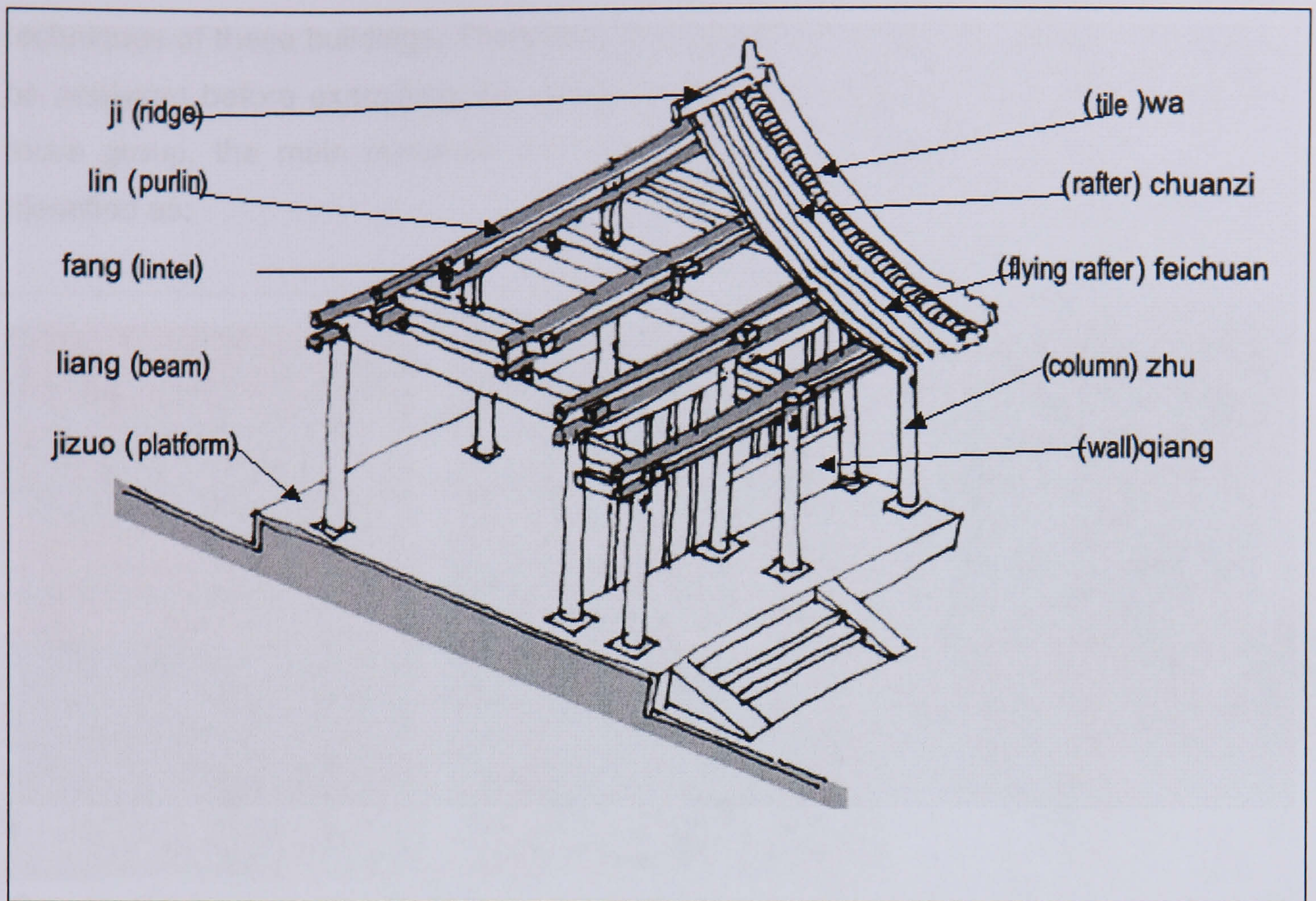


Fig. 8.1 The structure system of an ordinary Chinese building
Based on the main building of no 71 of lane 8

The roof finish consists of one insulating layer of clay on which segmental roof tiles are laid in two interlocking layers. These roof tiles were either unglazed terracotta (for the ordinary buildings) or glazed in green and yellow colours (as on the main buildings of *Fuwang fu* mansion). The survey area reconfirms Bouvier's research defining the colour of Beijing roofs: 'these tiles were only slightly burnt and of a grayish colour for ordinary buildings; for important edifices they were glazed blue, yellow or green' (1971:91). The external wall and openings help to enclose the buildings just like the enclosed wall of the courtyard building groups and the city does. Inside the courtyard dwellings, a series of verandas and transitional gates work together to link a group of buildings together. Following this general description of the building structure, the following studies will go further to study the values of materials, the modular system, space unit, the roof types, the structural types and the buildings elements.

8.1.1 Materials

The platform or foundation, pillars and beams skeleton, and pitched roof have been generally recognized as the main elements of an ordinary courtyard buildings' structure (Liang, 1984; Liu, 1957; Knapp, 2000). The advantages and disadvantages of the construction material will play an important role in the design values and techniques of these buildings. Therefore, the characters of the main materials should be analyzed before examining the design values of the structure system. From the focus group, the main materials and the values of the structural system can be identified as:

Fig .8.2 The timber system, no 71 of lane 8

1: The main material of the structural skeleton system (Fig. 8.2) is timber (Boyd, 1962; Liang, 1984; Knapp, 2000; Zhao, 2001, Fu, 2002) specifically the *Guimu, hualimu and nanmu* (Lip, 1995). These hardwoods 'are light for strength, cheap to transport, easy to work and carve, easy to mass produce and to standardize' (Boyd, 1962:24). Some of the timber is from the local area, and some is transported from the south and north of China by the canal system which includes the Great *jinghang (*from *Beijing* to south of China city *hangzhou)* canal.

Wang (1): The high quality timber is from other areas of China, the timber is the most important material of the dwelling, it is the structure of the buildings, and normally you should set the framework first, and then fit the walls and other parts. These timbers are Guimu, hualimu and so on.
Wang (4): I think most of the materials come from the rural area of Beijing, maybe some wood comes from the south of China.
Yang (4): The traditional courtyard is really good, the structure is all timber, and then uses tiles to cover the roof, and also a lot of animal sculptures.
Zhu (6): However, this good quality timber for the structure is normally from the south of China. It is sent to Beijing though the Great canal. This wood is the most important part of the whole structure, this system is very good. The contemporary structure framework is quite like this, it begins with the structure first and then fits in the walls, windows and roof. It is also easy to extend when the family gets bigger.

2: The physical characteristics of the timber help to resist earthquakes and 'time has proved that Chinese timber-frame buildings can withstand almost any climate and earthquakes as powerful as 7 or 8 on the Richter scale' (Steinhardt, 2002:1), 'in most residential architecture, all the weight of the roof was carried on the wooden columns, not the walls' (Chan, 1991:20) and this resistance was tested during the famous 1976 earthquake. However, timber may be destroyed by fire and also there is a threat of decay. These are the main disadvantages of timber construction. However, it can be durable when protected by a periodically applied protective skin of lacquer (see also colour typology).

Zhang (7): The most important material is the timber. The structure, window, doors, interior partition and the timber corridor are very important. The timber structure is very good for resisting earthquake movement. From the famous 1976 earthquake, the courtyard dwellings are still in a very good condition and the wooden structure plays an important role in this.

Meanwhile, timber has a good aesthetic quality that is comfortable to touch and see (Fig .8.2).

Liang (7): The timber lets us feel very comfortable.

3: Unglazed brick was generally used for the construction of the building's walls, partition wall, paving materials for the courtyard, yard and so on. The main character of the ancient brick is that it is larger than those commonly used today and not glazed. The size of the brick is '250x125x55mm, the gable walls of the main building are 500mm thick and courtyard walls and those of the subsidiary buildings are 375mm' (Blaser, 1985:8). The unglazed brick is good at absorbing noise, sunlight and water because of its loose internal cellular structure (Fig.8.3), but the sunlight and the water can sometimes create a humidity problem.

No 21, lane 2 | No 3, lane 8

Fig. 8.3 Use of bricks

4: The cavity wall system (Fig.8.4) has also been used across the site, which suggests that the buildings have good insulation from the cold weather outside during the winter and can also avoid the excess heat in summer. The cavity wall system also has a good quality humidity and noise control. However, the drawing is only drawn according to the interview materials, and construction techniques of the cavity wall system need further study and analysis.

Zhang (1): These bricks are really good; they absorb water, and the old buildings are always built with a cavity wall.
Wang (2): We know the original wall is a cavity wall with a gap in between, and the scale of the brick is larger than today's.
Guo (3): ...and these grey brick walls normally have a cavity wall system, with a hole in the middle, and absorb sunlight and sound, so one feels cooler during the summer and warmer during the winter.
Rong (7): The walls and roof tiles are normally double layered, this is why we feel cool in the summer and warm in the winter.

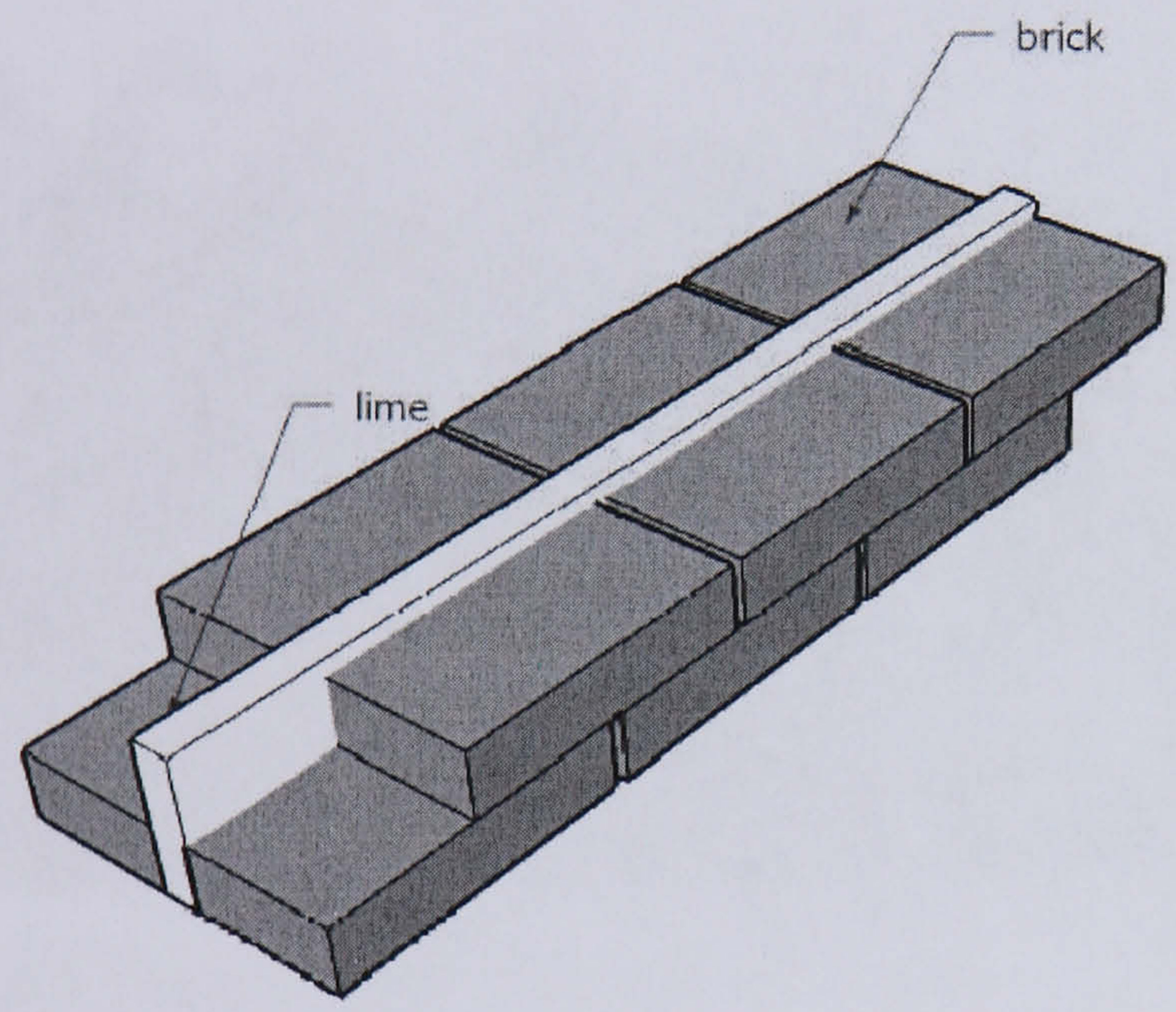


Fig.8.4 The cavity wall system

5: The bricks and tiles are mainly produced from the rural area of Beijing and are easily transported to the construction site area.

Zhang (1): Most of the materials are from the local area, such as the large bricks and tiles, but some of the timber material is from north China.
W (2): Almost all the materials are from the local area, where we are familiar with the particular colour, the grey bricks and tiles, the beautiful wooden framework, and also the stone plate on the earth.
Guo (3): All these materials come from the rural area of Beijing, they are of high quality for working, even today we could not build the same courtyard house as in the past.
Tian (5): The bricks and tiles were made in the rural area of Beijing, these bricks are larger than today's brick, and the colour is grey. The materials of the structure sometimes came from the south of China...
Zhu (6): Most of the materials are from the local area, the rural area of Beijing, like these bricks, tiles and stone.

6: From the previous study of the entrance gate, the sculptural bricks (Fig.8.5 left) can be an important decorative element to the entrance gate. Meanwhile, most of the roofs from the study area have roof ornaments on the roof ridges or corner ribs. The lion, the chimera, the horse and unicorn represent *yang* while the phoenix and floral sculptures symbolise *yin* (Fig.8.5 right), which have all been used to avoid the evil influence and capture good fortune (Lip, 1979). All these materials are also mainly made in the Beijing area.

Zhang (2): The traditional tile is very beautiful; there are various sculptures on it which also have their own social cultural meaning.

Wang (3): ... however, I like the tiles and animal sculptures on the roof; they have various styles and special meaning.

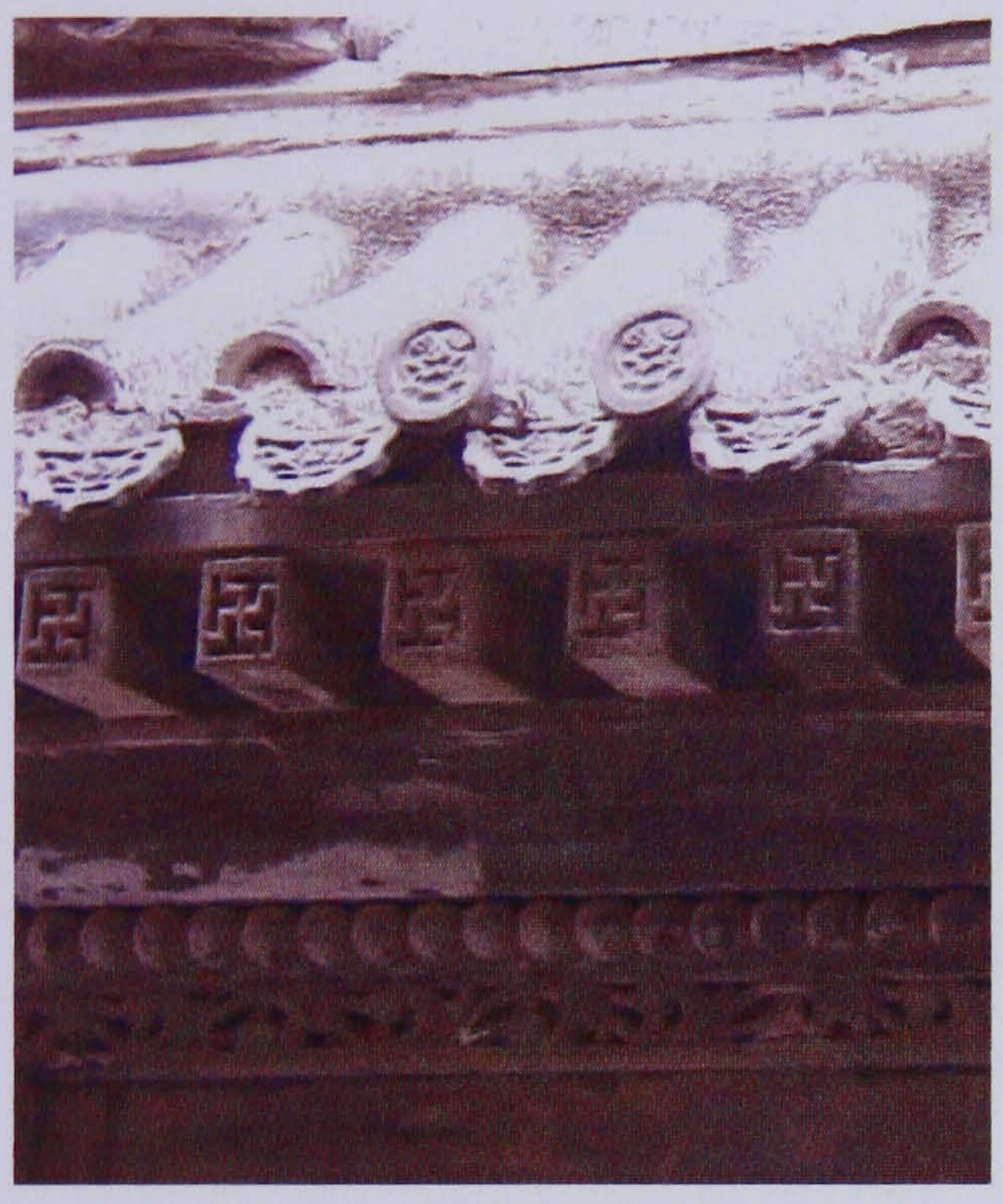
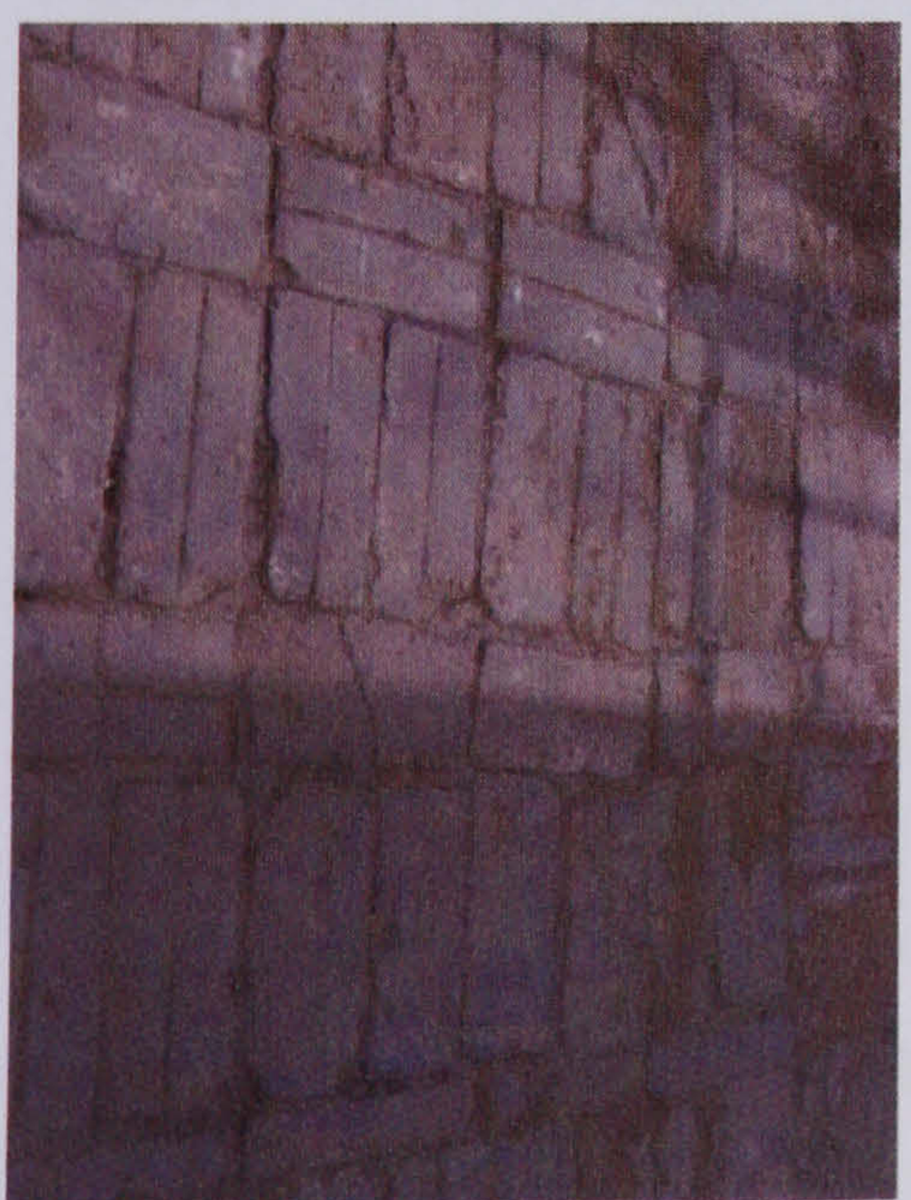



Fig.8.5 The sculptured tiles of No 111 of lane 8 and the sculptured tiles of *Fuwangfu* Mansion

7: The paving materials in the yard and courtyard could be the stone slabs, bricks etc. (Fig. 8.6).

Zhang (7): The materials in the courtyard are also quite different from those used today, it normally has a stone slab, not like today, covered in small bricks.


No 21 of lane 2


No 71 of lane 8


Fu wangfu mansion

Fig.8.6 The paving materials in the yard and courtyard

Stone, marble and granite have also been found in the investigated area and are mainly used for the podium of the column and the platform of the buildings; they are also used as the padding materials for the yards with higher social and economic status, and these heavy weight materials may also come from the rural area of Beijing.

8.1.2 Chinese modular system and the structure

The studies on the Structure Regulations from Qing authority (1734) in Chapter 4 indicated that the chosen size of '*Doukou*' (which has 11 grades) will determine the buildings standard and furthermore the buildings size and proportion. The Structural Regulation also rigidly determined the size of each building element when the *Doukou* was chosen. However, this study will mainly focus on the architectural economics values (structural design aspect) of this unique structural system. The structure design principles of this modular system are of key interest rather than the size of the each building element. The research starts with the standard of the building chosen according to the social and economic status of the original resident (the dimension of the central bay). Then the basic module for each type of building will be examined.

From the field investigation, we can see that the *Dougong* (bracket) system is only applied to the main buildings that have gable-and-hip roofs inside the *FuwangFu* mansion building groups (Fig.8.7). The eave column's diameter of the main hall (the second main buildings) is 40 cm, the height of the column is 400cm (without calculating the size of the *Dougong*), and the height to diameter proportion exactly matches the *Qing* regulation which specifies the diameter of a column as 6 *Doukou*, and the height of column is 60 *Doukou* (Fig.8.9). Based on the basic module, a *Doukou* is 1/6 of the diameter of the column (Chapter 4), the basic module (*Doukou*) is 6.7 cm for *Fuwangfu* main hall buildings, which is number 9 of the 11 grades of *Doukou* table (Fig.8.8, also see Chapter 4), which is quite a small size compared with the 11 standard (3.3 cm to 19.8 cm). However from other surveys, we can see that there is no evidence that the 1 to 4 grades have been found anywhere in Beijing city (Liang, 1984). Furthermore, all the buildings' dimensions are determined by multiples or a percentage of this basic *Doukou*. However, for the majority of buildings in the survey area which do not have the *Dougong* (bracket) support system, the modular system is normally determined by the eave columns' diameter, as established in the Qing dynasty (Bai & wang, 2000).

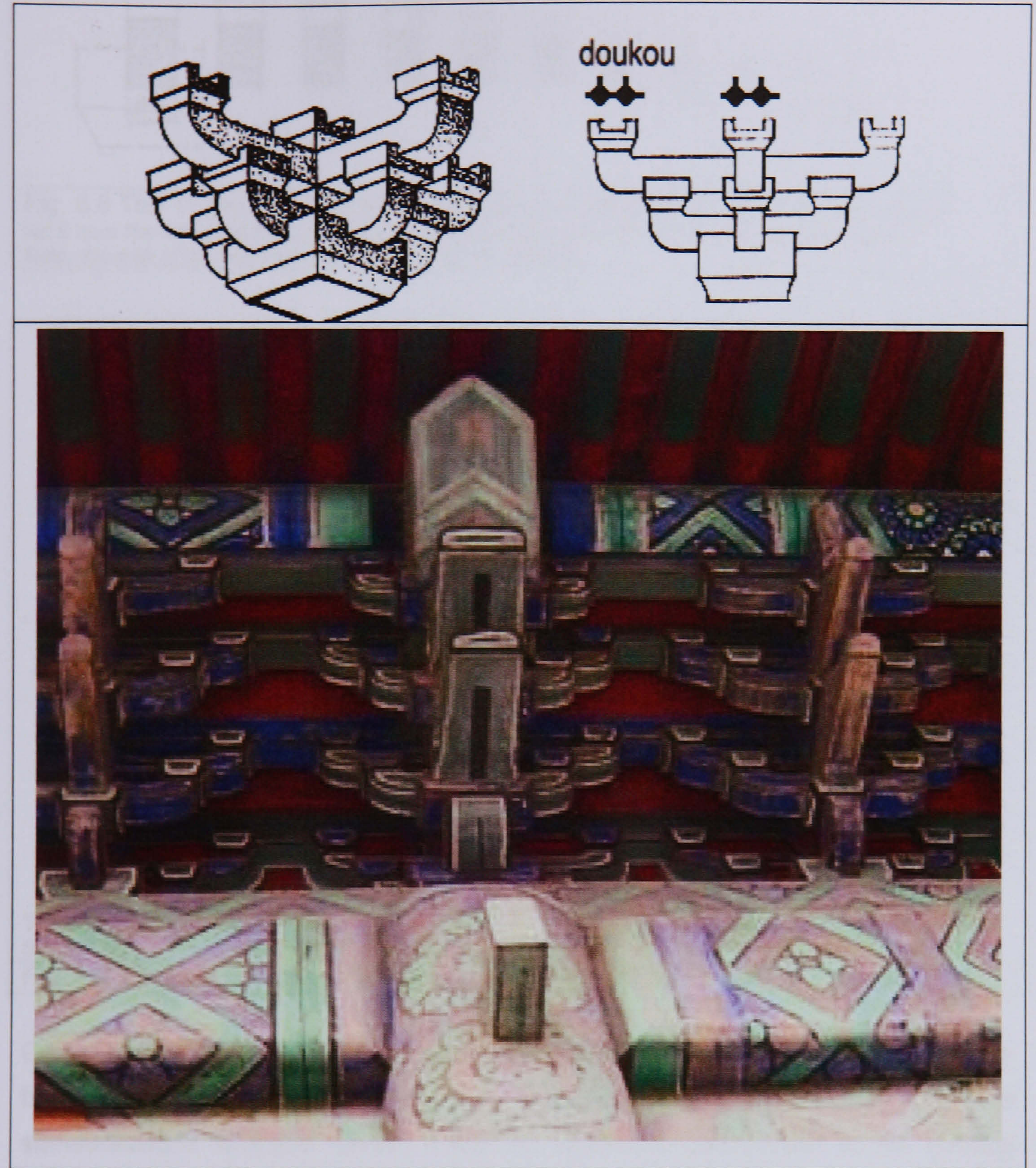


Fig. 8.7 The *DouGong* system, from the second main building of *Fuwangfu* Mansion

Examining a round column in an ordinary building such as number 71 of lane 8, the column's diameter is 23cm, and the height of the column is 230cm, the proportion ratio between the height and the diameter of the column is 10, which also matches the *Qing* regulations (Liang, 1984; Guo, 1999). Furthermore all the buildings' elements follow this basic module which is the diameter of the column. .

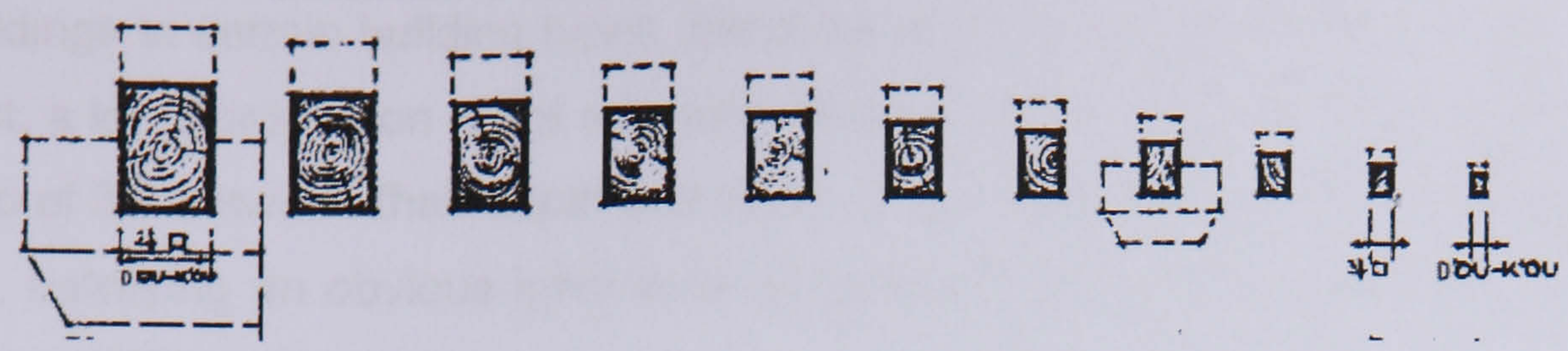
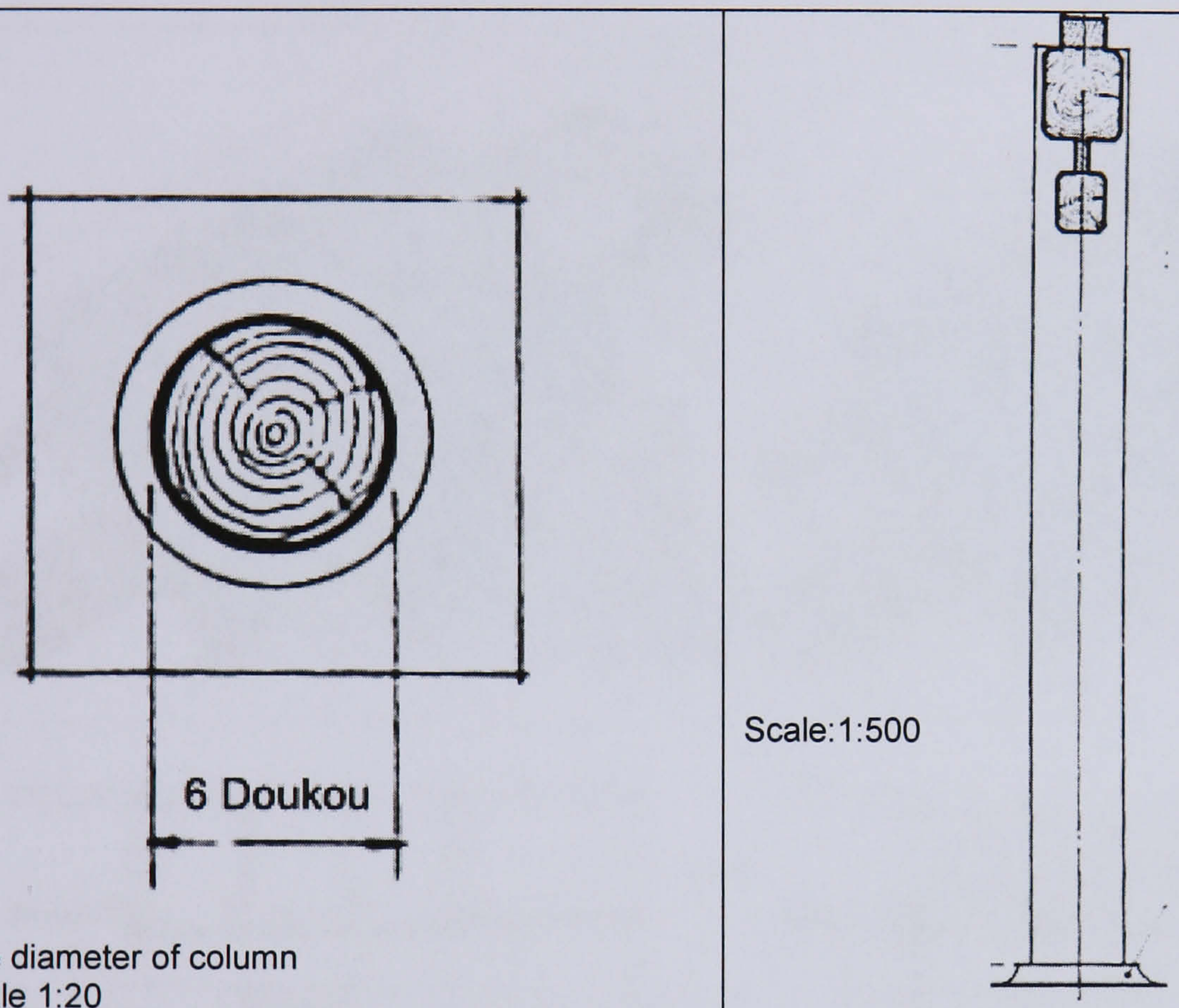


Fig. 8.8 The 11 grade of '*cai*' with one *doukou* in width and *two doukou* in depth,
No 8 from the left is the basic '*cai*' (with dash line at top) and '*doukou*' for *fuwangfu* mansion
Note: the size of *doukou* may vary from 3.3 cm to 19.8 cm



The diameter of column
Scale 1:20

Fig. 8.9 The column (based on the second main building of fuwangfu mansion)

Generally, 'the idea of standardization and prefabrication of materials had already been practiced in China from time immemorial' (Xu, 1964:217), and this standardization structure system made the enormous construction of the building groups such as *FuwangFu* mansion building groups achievable in a very short period because the module system allows the prefabrication of the building elements. This modular system was also very economic in its consideration of different sizes of the timber materials according to the different sizes of the modules. Meanwhile, the standardization that is based on the fundamental modular system also allows for the economic repair of the buildings and gives tremendous potential for modifying a structure (Qiao, 2002). The standardization system also makes it easy to create a physical model to scale for the client before any construction takes place, and in the *Qing* dynasty it was referred to as '*tangyang*' (model). However, this modular system certainly decreases the richness of the neighbourhood, and limits the layout of the buildings to certain building types. Because of a lack of mechanical knowledge in the past, a lot of proportion is not scientific. 'Beams of the *Song* dynasty generally have a ratio of 3:2 between their depth and width. In the *Qing* rule the ratio changed to 5:4 or 6:5, betraying an obvious ignorance of mechanics and of the strength of materials' (Liang, 2001:116)

8.1.3 Space unit and the building structure

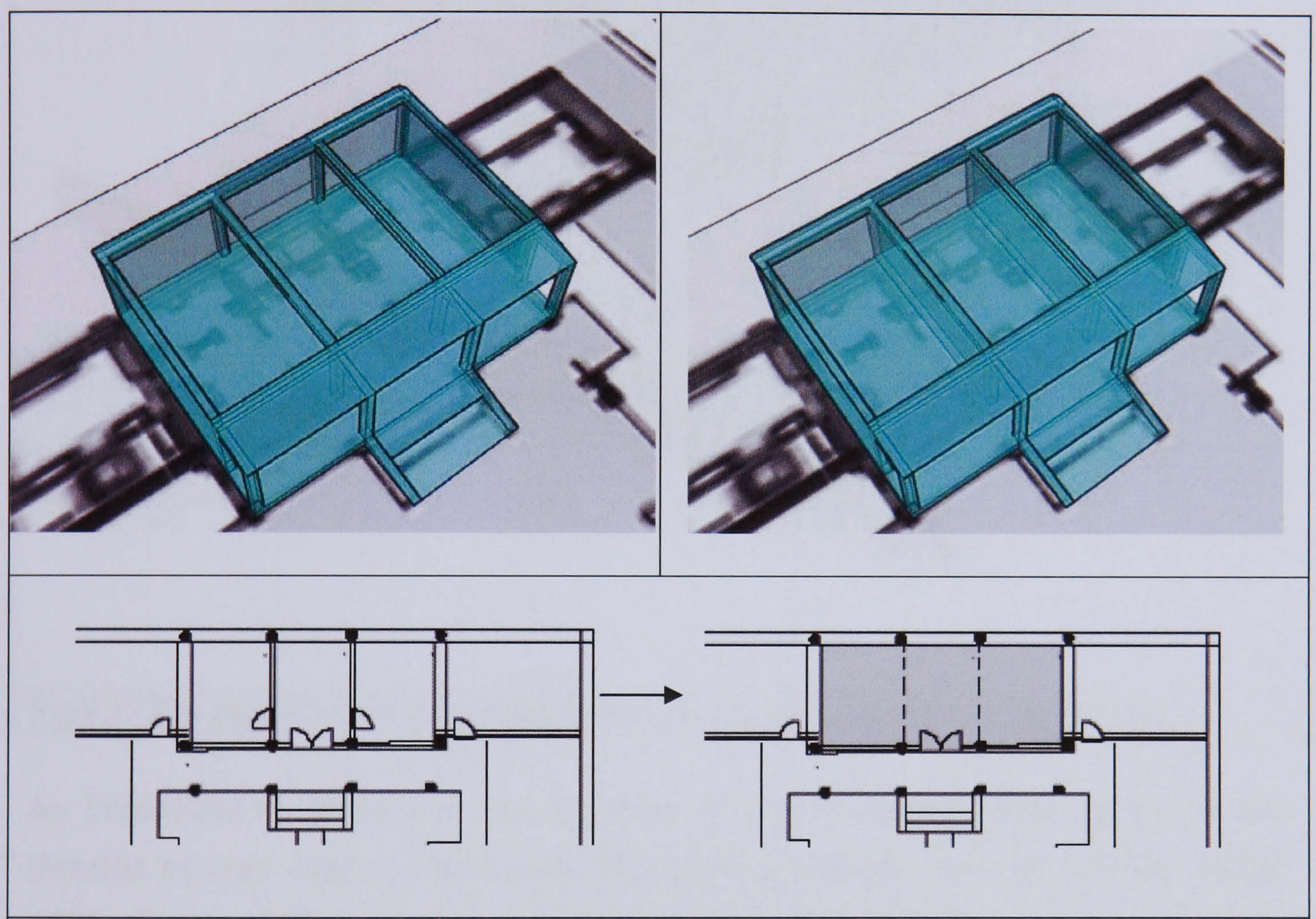


Fig.8. 10 The transformation from 3 bay space to open space

From the survey, we can see that the internal space of a building is generally open, divided by partition walls (Fig.8.10) supporting Bouvier's observations that 'the supporting members of a building are not walls but pillars' (Bouvier, 1972:88). Therefore, the wall or partition is not load bearing, and can be easily transformed, and this has also been proved by the main researchers in this field (Boyd, 1954; Liang 1984; Knapp, 1999, 2000; Jing, 1999). The result is great flexibility in making doors and windows and in selecting materials for the walls. The flexibility of the internal space also makes it convenient to transform the residence rooms into an open area for worship which the rich and nobles always did in ancient times (Fig.8.10). Such a structural system is a clear precursor to contemporary skyscraper construction, and is generally viewed as a modern innovation.

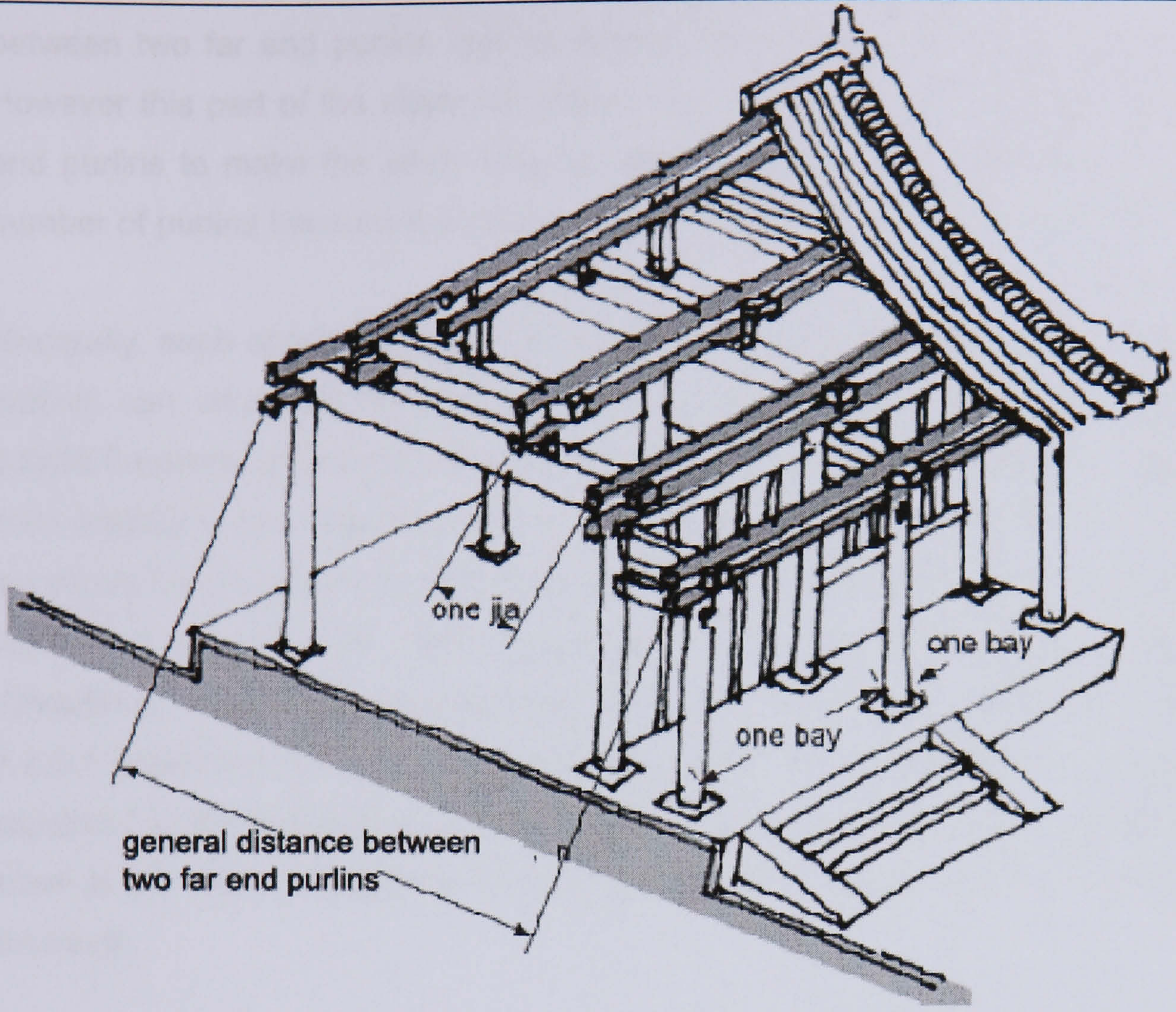


Fig.8.11 The space unit of the buildings from the survey area (from 1 bay to 5 bay)

As introduced in Chapter 4, the dimensions of a traditional Chinese building are dictated by *Jian* (bay) in width and *Jia* (distance between purlins) in depth (Boyd, 1962; Knapp, 1989). A *Jian* (bay) is the span between two lateral columns or pillars, and each *Jia* refers to the distance between one of the two stepped roof purlins (Fig.8.11), and the purlins needed to support the common rafters of a rising roof. Therefore, the slope and curvature of a roof ultimately depends upon the relative vertical placement of purlins. From the survey of the 12 courtyard buildings units, the dimension details of the main buildings located on the south north axis are shown in the following Table 8.1. From this data (Table 8.1), it is easy to identify the shape of the building and more importantly the dimension of the internal space unit which is one bay by the distance between two far end purlins (Fig.8.11). The dimension of each bay can vary from 2.7m of an ordinary building of No. 129 of lane 8, to 5.6m of the central bay of the main buildings of *FuwangFu* mansion, and the number can vary from 3, 5 to 7 as well, but the general distance of *jia* (Fig.8.11) is always the distance between two far end longitudinal columns which can vary from 5 meters of an ordinary building to 18.5 meters of *FuwangFu* mansion. The total distance between two far end purlins can be divided into different numbers of *jia* (Fig.8.11). However this part of the study will always use the general distance between two far end purlins to make the study easy to understand (it is very difficult to identify the number of purlins because the ceilings have blocked the view of the purlins).

Generally, each space unit (one bay multiplied by the distance between two far end purlins) can vary from the ordinary 2.7x5 square meters of No. 129 of lane 8 to 5.6x18.5 square meters of the main buildings of *FuwangFu* mansion, and also the front elevations can vary from 3 to 7 bays to the main buildings (Table 8.1). Together the proportion between the width and the depth of the whole building is appropriately kept as 1.6:1, and this figure basically follows the *Qing* structural regulations (Chapter 4). However, it does not mean that all buildings strictly follow this proportion. A 2.8:1 proportion for the first main building of No 111 of lane 8 is much larger than stipulated in the regulations, and the main reason is two 'er' (ear) buildings on both sides of the main buildings have been constructed together with the main building's structure.


Main building, no 71, lane 8

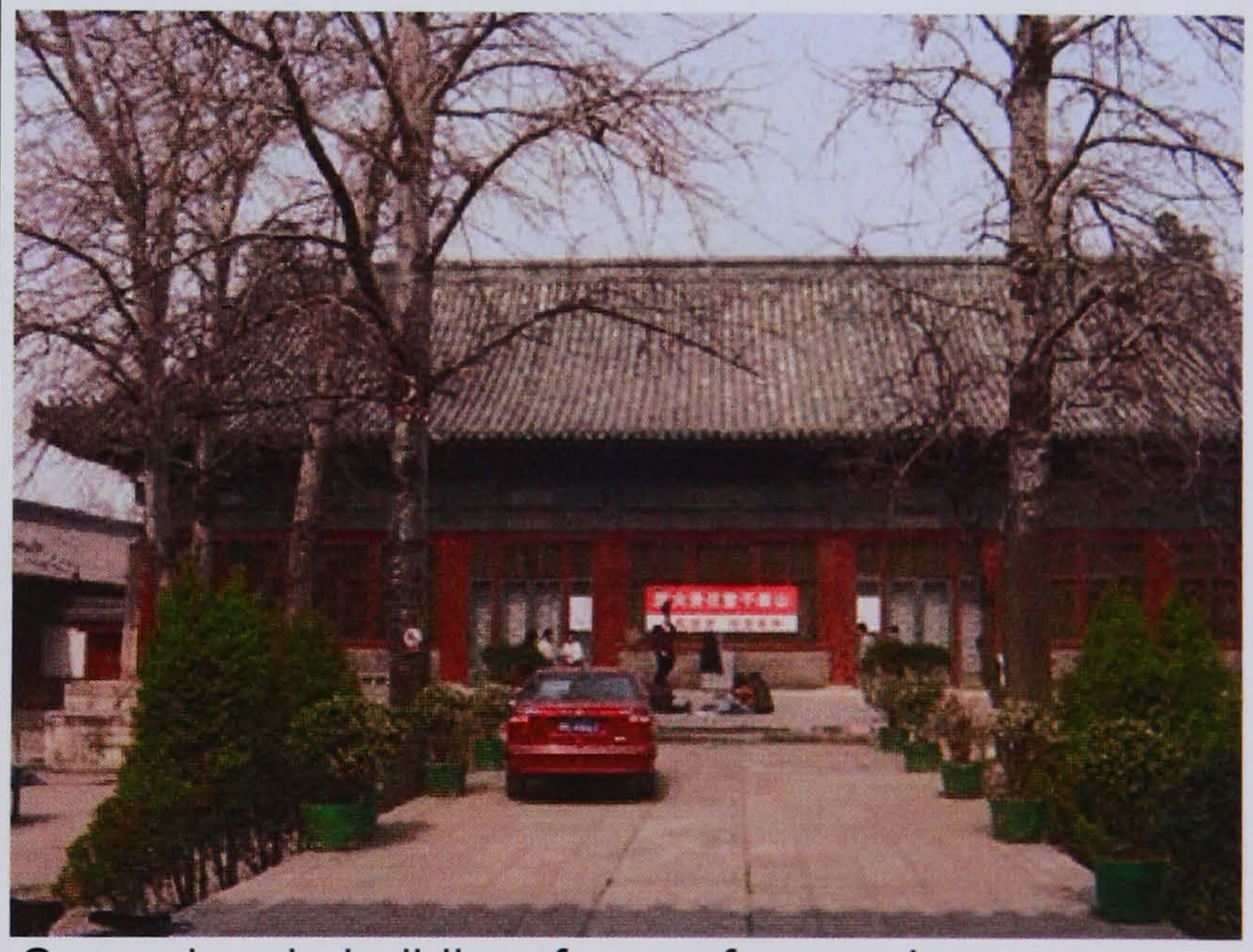

Second main building, fuwangfu mansion

Fig.8.12 Buildings scale and the social status

Buildings	No 68 Lane8	No 129 Lane 8	No 125 Lane 8	No 111 Lane 8	No 9 Lane 7-8	No 71 Lane 8	No 39 Lane8	No 51& 53, lane 6	No 28 Maze area	No 3 Lane 4	No 21 Lane 2	*Fuwangfu* Mansion
The distance of each *jian* (bay) (m) **X** the n o of bay	2.7x3	2.7x3	2.7x3	3.3x5	3x3	3.6x3	3x3	4x3	3.3x3	3.6x5	3.3x3	5.6x1+4x4 *
				3.3x3				3.3x3		4x3	3.3x3	5.6x1+4x6
				3.3x3				4.5x3				5.6x1+4x4
												5.6x1+4x6
												4x7
The general jia between two far end purlins	5	5	5	6.2	5.6	6.8	5.6	7.5	6.2	11.2	6.2	13.5
				6.2				6.2		7.5	6.2	17.5
				6.2				8.5				13.5
												18.5
												17.5

Table 8.1. The shape of the main buildings by *Jian*(bay) and *Jia* (purlin) space unit

Note1: all these buildings are the main buildings which are located at the central axis of the buildings groups, and for three courtyard unit, the order is from west to east direction.

2: * means one central bay plus a four sided bay for the main buildings of *fuwangfu* mansion


Fig.8. 13 The *er* 'ear' buildings (right side) and the main buildings (left side)

The space unit system (the distance between two longitudinal columns multiplied by the distance between two far end purlins) also works closely with the social and economic status of the house owners (Fig.8.12). It is easy to understand that the space unit of a main building can vary from 3.6m (one bay) multiply 6.8m (depth of the general *jia*) of No 71 of lane 8 to the 5.6m (one bay) multiply 18.5m (depth of general *jia*) of the *FuwangFu* mansion main buildings. The space unit can easily be extended without changing the main structure of the main buildings. For instance, '*er*' (ear) buildings can be easily built if the owner wants (Fig.8.13). This method of construction has allowed not only economical extension and reparation but also tremendous potential to modify a structure without touching the main structure of the buildings.

8.1.4 The roof types and the structural system

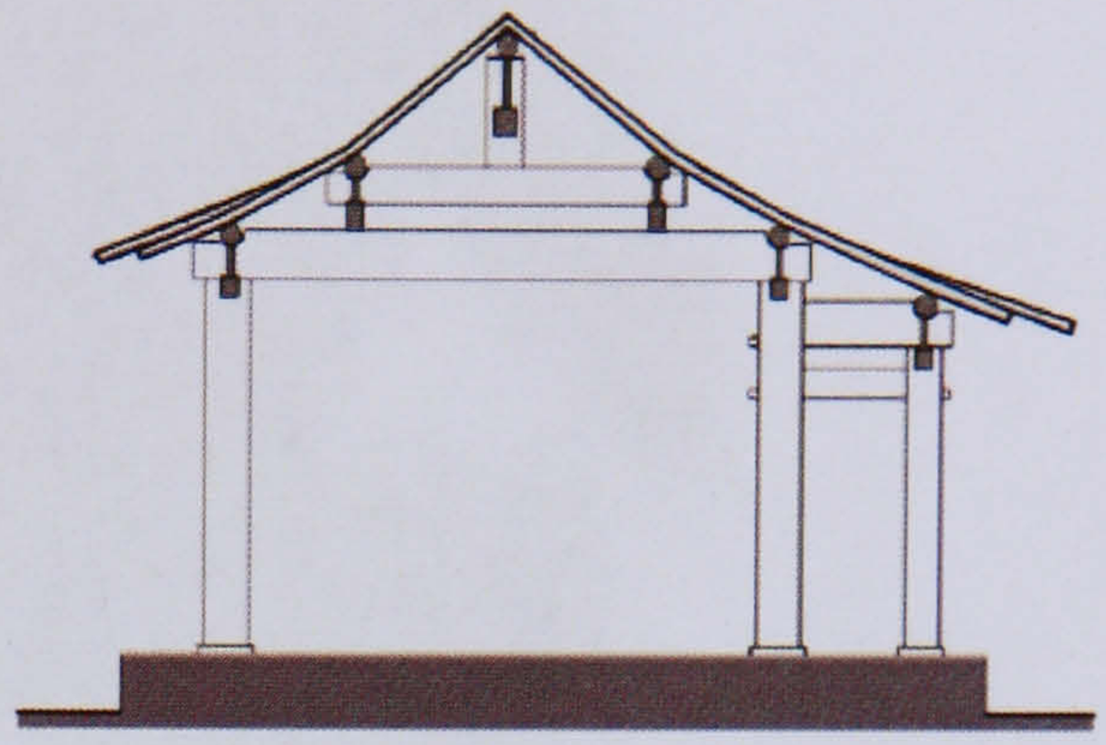
An outstanding feature of Chinese traditional architecture is the use of pitched roofs with overhanging eaves. After the studies on the Chinese modular system and the space unit, the physical characteristics and design techniques of the residential roof types need further analysis, although the social cultural aspects were introduced in Chapter 6. However, this part of the study mainly relies on secondary documentation and archive studies, because ceilings usually block direct access of the roof structure to most of the buildings and also many private rooms were not accessible.

As introduced in Chapter 6, the survey has found 5 types of residential roofs from 1st to 10th lane of *Dongsi* neighbourhood which are the flush gable (rolling and ordinary type) roof, overhanging gable (rolling and ordinary type) roof and hip and gable roof (Chapter 6). The majority of the buildings of the survey area are the flush gable roof with two main varieties which are the rolling flush gable roof type buildings and the ordinary flush gable roof type buildings (Fig.8.14). From the investigation, it is also easy to conclude that the overhang gable and flush gable roof are combined with one, two, three and five bay buildings, but mostly used with the three bay buildings. The hip and gable roof is only applied to mansion buildings with five or more bays.

At No 71 of lane 8, the roof type is an ordinary flush gable roof. For the details of the roof structure, two guazhu (squat queen post) are set symmetrically upon a beam and are used to lift one shorter beam, then two squat queen posts are located on the top of this shorter beam to lift another shorter beam again, with only one guazhu at the top. Purlins are located at the top and far end of each beam, and rafters are then laid on top of the purlins, sloping down from the ridge to the eaves, located at the top of the beam. The distance between the purlins is the same, as the height between two purlins varies according to the scale of the roof (see Chapter 4). For the structural fixing strategies, the beams (*liang*), connection beams (fang), and joints are important bonding structural elements while the columns (*zhu*) and purlins (*lin*) are the important supporting structure elements. Fang is the most important bonding structural element in the latitude direction which helps to connect all the columns together (Fig.8.15: 3), and the Fang are interlocked with the column at the top part of the column. The beams (*liang*) are then located at the top of the column and Fang complex (Fig.8.15: 5), the beams are fixed by the central connection beams (*zhengxinfang*, Fig.8.15:4), and the purlins (*lin*, Fig. 8.15:6) are then located at the top of the concaved beams, which all help to achieve a very stable timber structure. The rafters are finally located at the top of the purlins (*lin*), and the rafters are short, stretching down only from purlin to purlin. By manipulating the height and width of the purlins, a builder can produce a roof of whatever size and curvature required (Bouvier, 1972; Guo, 1999).

Flush gable roof : ordinary type

section



Flush gable roof: rolling type

section

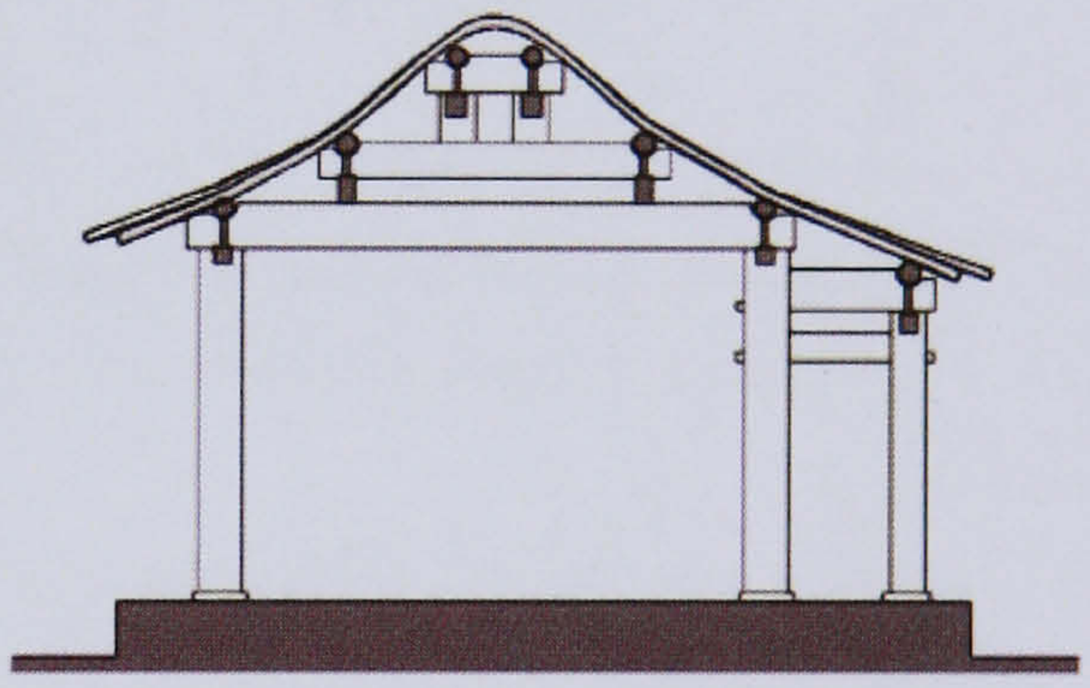
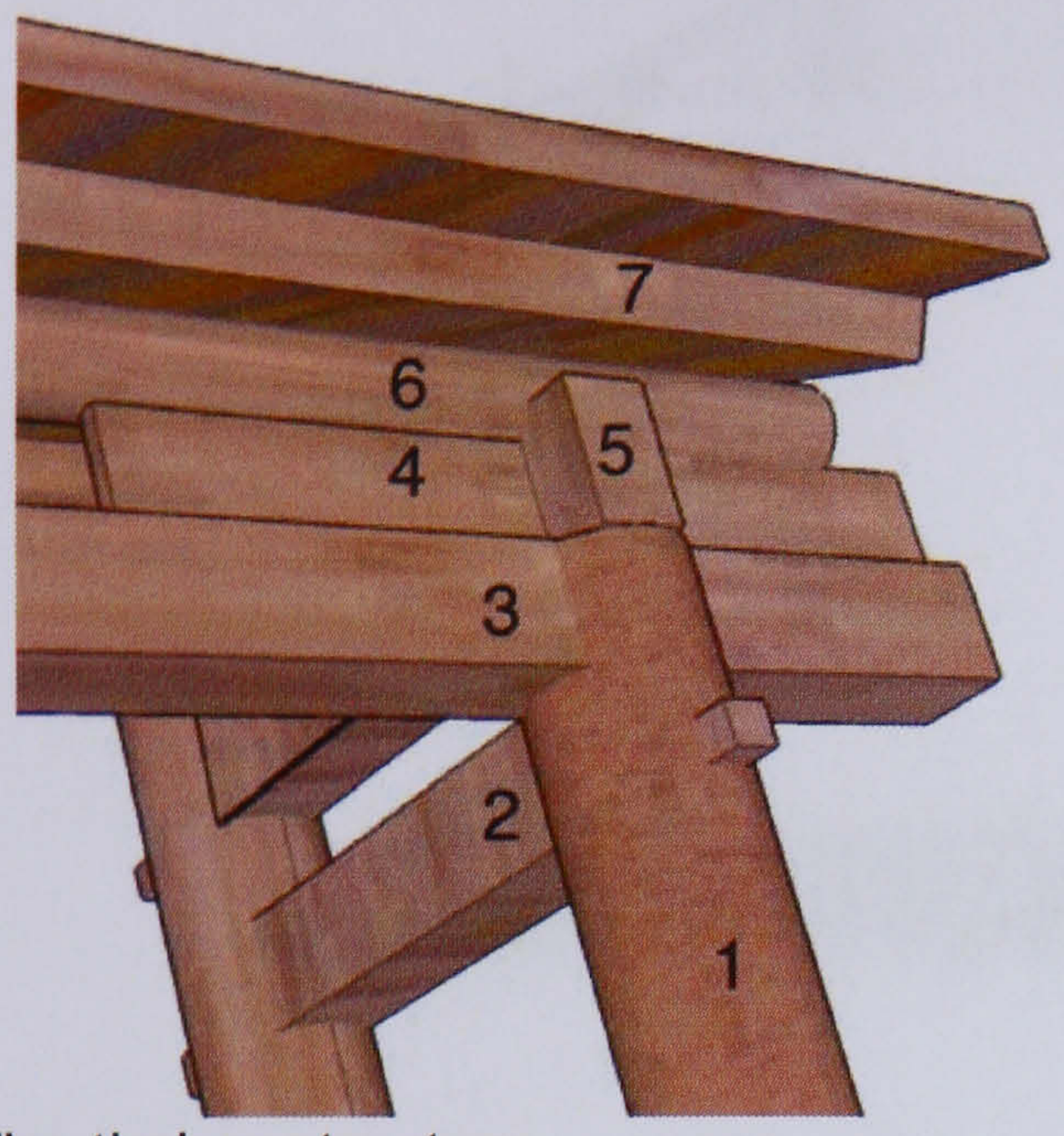
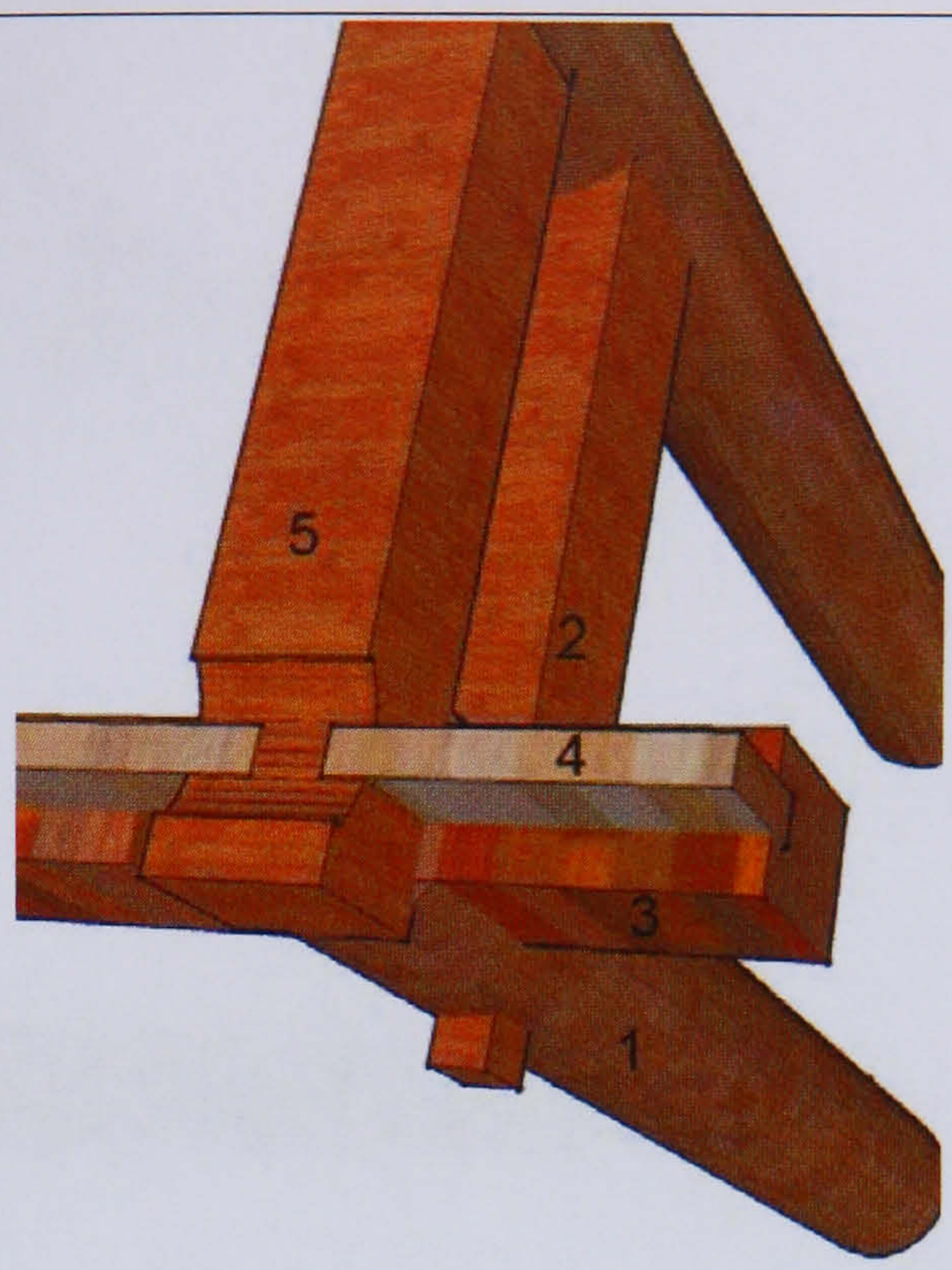


Fig. 8.14 The flush gable roof



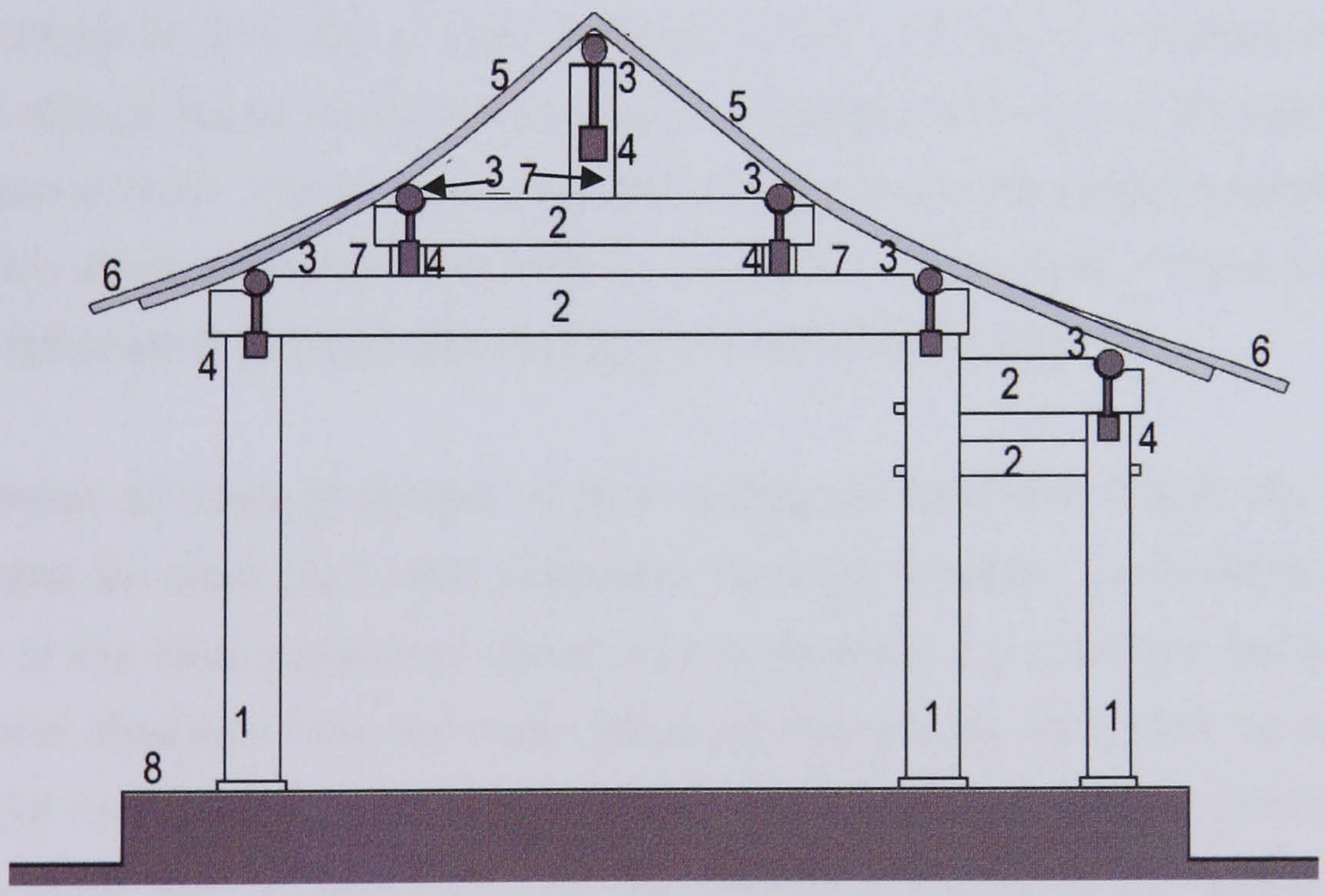
The timber structure



View from the top (without purlin)

1: *zhu* (column); 2&5:*liang* (beam);3: *fang* (connection beam); 4:*zhengxinfang* (central connection beam); 6:*lin* (purlin); 7: *chuan* (rafters)

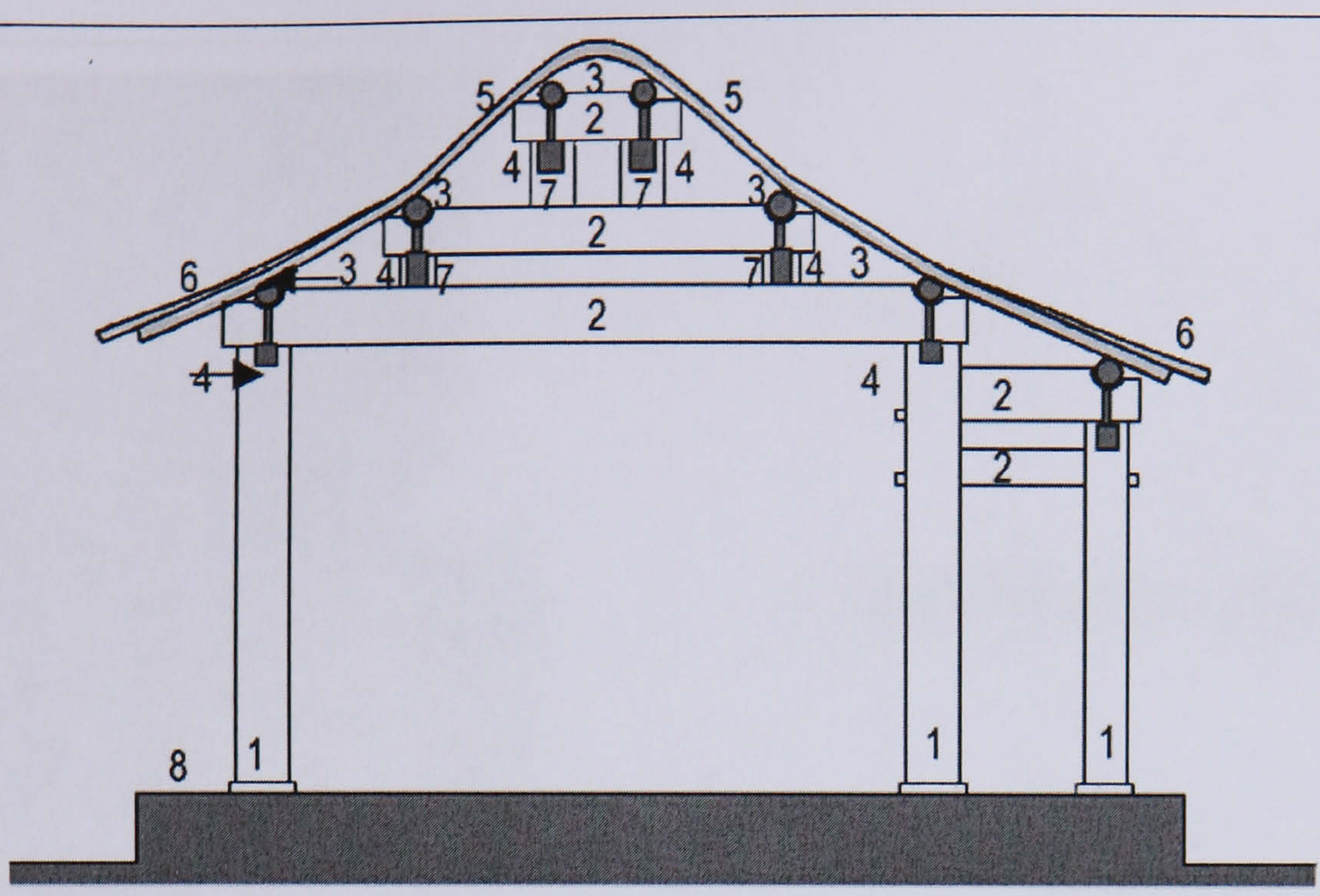
Fig. 8.15 The structure details based on No 71 of lane 8



1:zhu (column) 2: liang (beam) 3: lin (purlin) 4. fang (connection beam) 5: chuan (rafter) 6: feichuan (flying rafter) 7: guazhu (squat queen post) 8: jizuo (platform)

Section scale, 1:100

Fig.8. 16 The roof structure, No 71 of lane 8



1:zhu (column) 2: liang (beam) 3: lin (purlin) 4. fang conection beam) 5: chuan (rafter) 6: feichuan (flying rafter) 7: guazhu (squat queen post) 8: jizuo (platform)
Section scale, 1:100

Fig.8.17 The section of the main building, No 21, lane 2

Fig.8.17 shows a typical rolling flush gable roof structure, which is based on the survey of the main building of No 21 of lane 2. The construction techniques of this building's structure are very similar to those of No71 of lane 8. However the rolling roof types always have two squat queen posts located on the top of the shorter beam to lift the curved roof. The distance between two purlins is the same, except between the final two at the top where the width is normally 3 times that of the eave column diameter indicated in the regulations (Fig.8.17, see also Chapter 4).

The extension of eave projection is also worthy of comment (Fig.8.18). A timber structure and an open plan offer protection from the weather, particularly rain. The extension of the eave projection works for this purpose, for instance, the eaves can throw off the rainwater from the main structure that course down the tile troughs of the concave roof (Liang, 1984; Zhao, 2001). The function of raising the roof edges can also permit light to penetrate into the interior of the building despite the wide overhang. Therefore, the roof plays an important function in responding to the elements of the physical environment such as natural light, the rain, the ventilation and so on. These characteristics will be studied further in the following section (Chapter 8.2).

Eave with the veranda

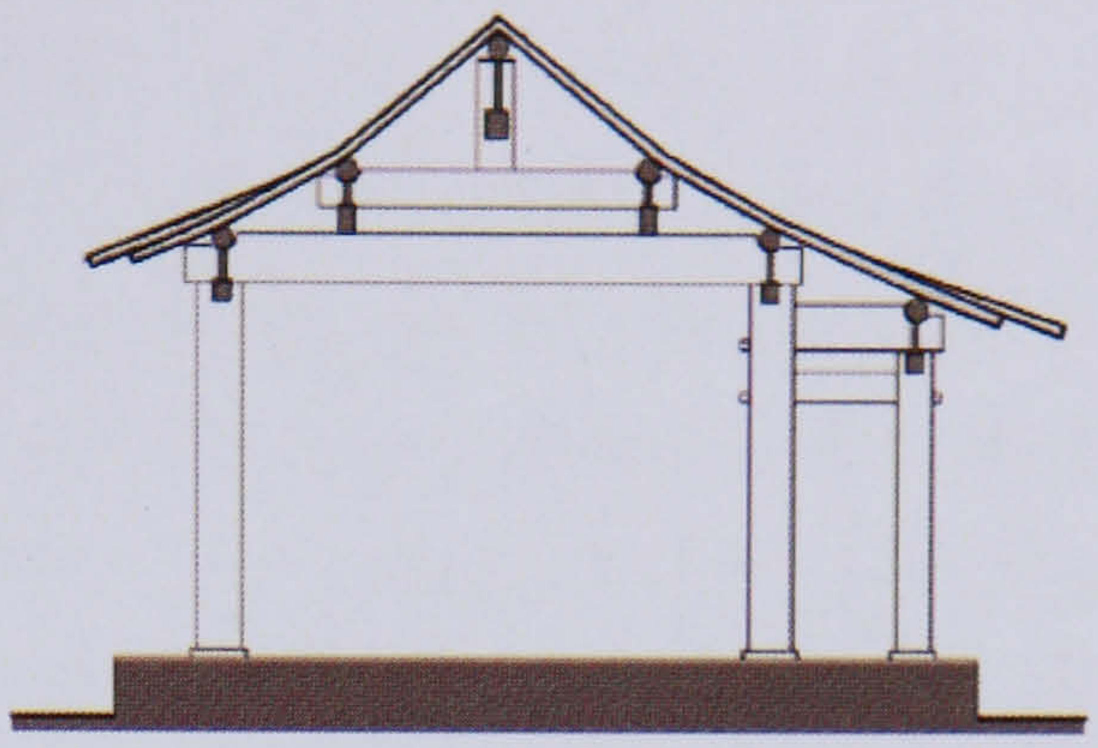


Fig.8.18 The eaves, no 71, lane 8

In summary, the flush gable roof with two varieties (ordinary and rolling types) is the main roof type from the investigation area. For the main building of *Fuwangfu* mansion the hip-and-flush roof is used. The planning of the purlins both in longitude and latitude direction make it easy to get the right size and proportion of the curved roof, and the techniques to use the shorter rafters to connect purlins can accommodate the desired curvature easily. The extension of eave projection can also provide good protection to the timber structure from the weather and also achieve a good quality of natural sunlight, ventilation and so on (this part of the study will be further analysed in the following section, see Chapter 8.2).

8.1.5 Building elements

Following the studies of the building structure, this part of the studies will mainly provide a brief introduction of the buildings wall, the openings and the dividing building elements that help to explain the buildings as a whole.

Buildings walls:

As the above studies noted, 'the house is separated from the outside world by walls' (Mitchell & Wu, 1998:59). The external enclosure walls are normally 3 meters high and always have decoration at the top and bottom. However we can see from the survey that the walls of the buildings on the south side of the buildings are normally reduced to 600mm, both for the ordinary building and also the main buildings of *Fuwangfu* mansion (Fig.8.19). This allows the maximum sunlight during the winter, and also allows the natural ventilation during the summer (for more details, see section studies). Here the buildings' plinth walls 'are set as the secondary features into the load bearing structure; they are simply infilling and contrast with the structural members' (Blaser, 1974:10). However, the west and east gable walls are completely solid, which helps to prevent the west and east from overheating during the summer, and the construction of both sides can be the cavity wall which is normally a 500mm thick wall (Blaser,1985). As previous studies indicated, the pillars and beams work together as the *TaiLiang* (beam-column) frame system to carry the load of the buildings, and the wall is completely free from the timber structure (Liang, 1984; Knapp, 2000; Lip, 1995). Furthermore, the wall is also climate responsive; the thickness and the materials can be easily changed according to the local climate (Jing, 1999; Fu, 2004). The timber also is the normal material used for the internal partition wall. Various types of partition wall can help to divide the internal open space into the smaller space unit, such as the living room, bedroom, study room and so on.


The ordinary plinth wall, no71, lane 8 main building


The terracotta plinth wall, the second main building of fuwangfu

Fig. 8.19 The building enclosure walls

Windows:

Windows are very important to help to achieve the comfortable physical living environment (see section studies). Furthermore, the windows 'are also decorative elements' and 'a traditional Chinese window consists of three parts, the window frame, the opening and the lattice work' (Lip, 1995:29). Traditionally, rice paper in winter and bamboo blinds in summer have been employed to cover the window.

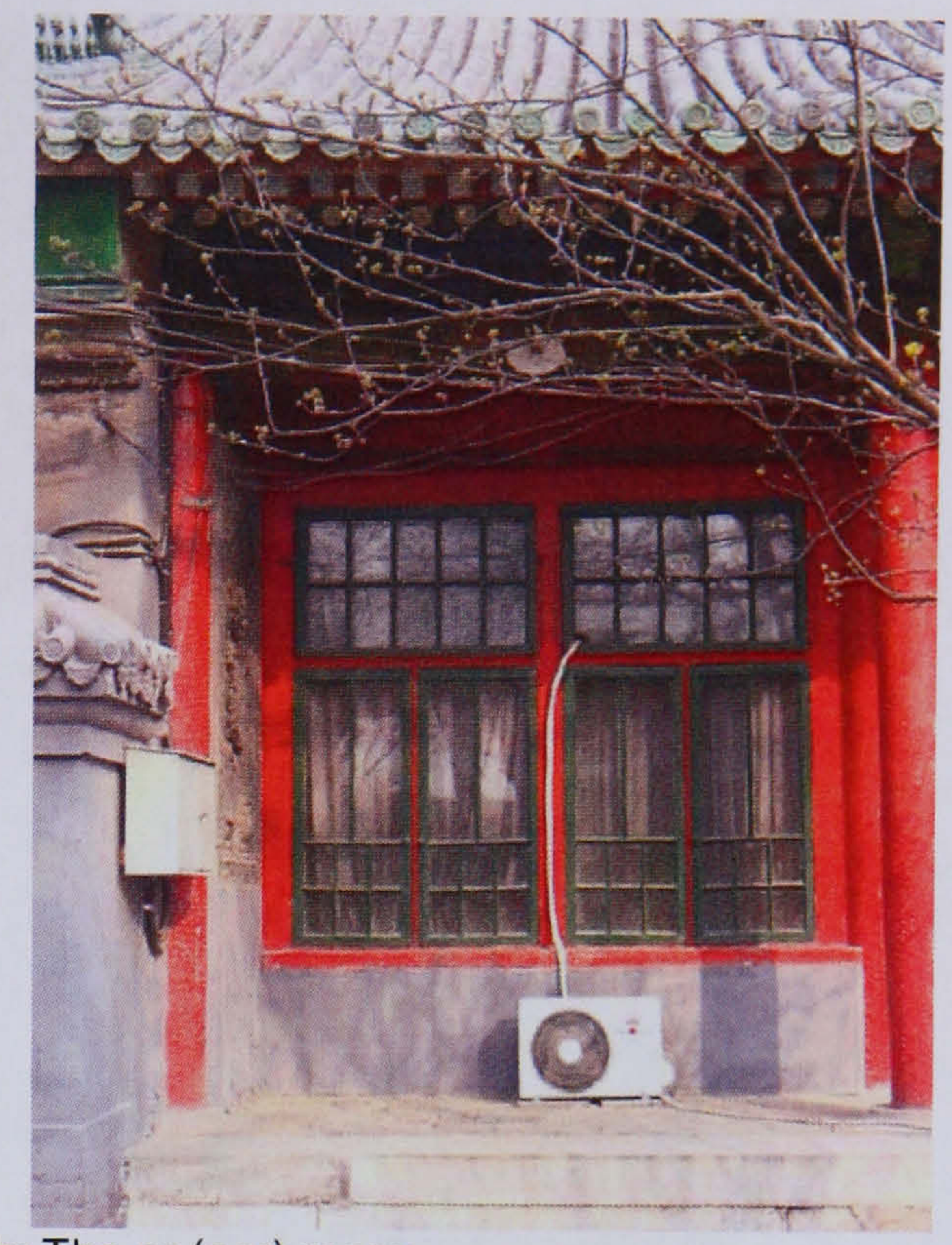
Tian (5): ...The window's materials are normally timber and rice paper, and the courtyard is normally covered by the brick and stone slab.
Zhu (6): The rice paper, the bamboo blind, the wooden sculpture and the way it opens and closes; I think you can learn a lot.
Liang (7): You know the window is covered by the rice paper, it has all kinds of styles which shows the traditional culture.

From the survey, we can see that the opening and window frame mainly are of two types. The first one is the window with the moveable casement (Fig.8.21: a, c)..This type of window can be completely opened and closed, the lattice work is used both for security reasons and also for decoration. The second type is the overhanging window (Fig. 8.20: a, c; Fig.8.21: b) which is the typical window type for the survey area. Traditionally, the overhang window is divided into two parts, the upper part of the window can be opened for ventilation, and the lower part is fixed. In winter the lower part is pasted with paper and in summer it is faced with gauze.

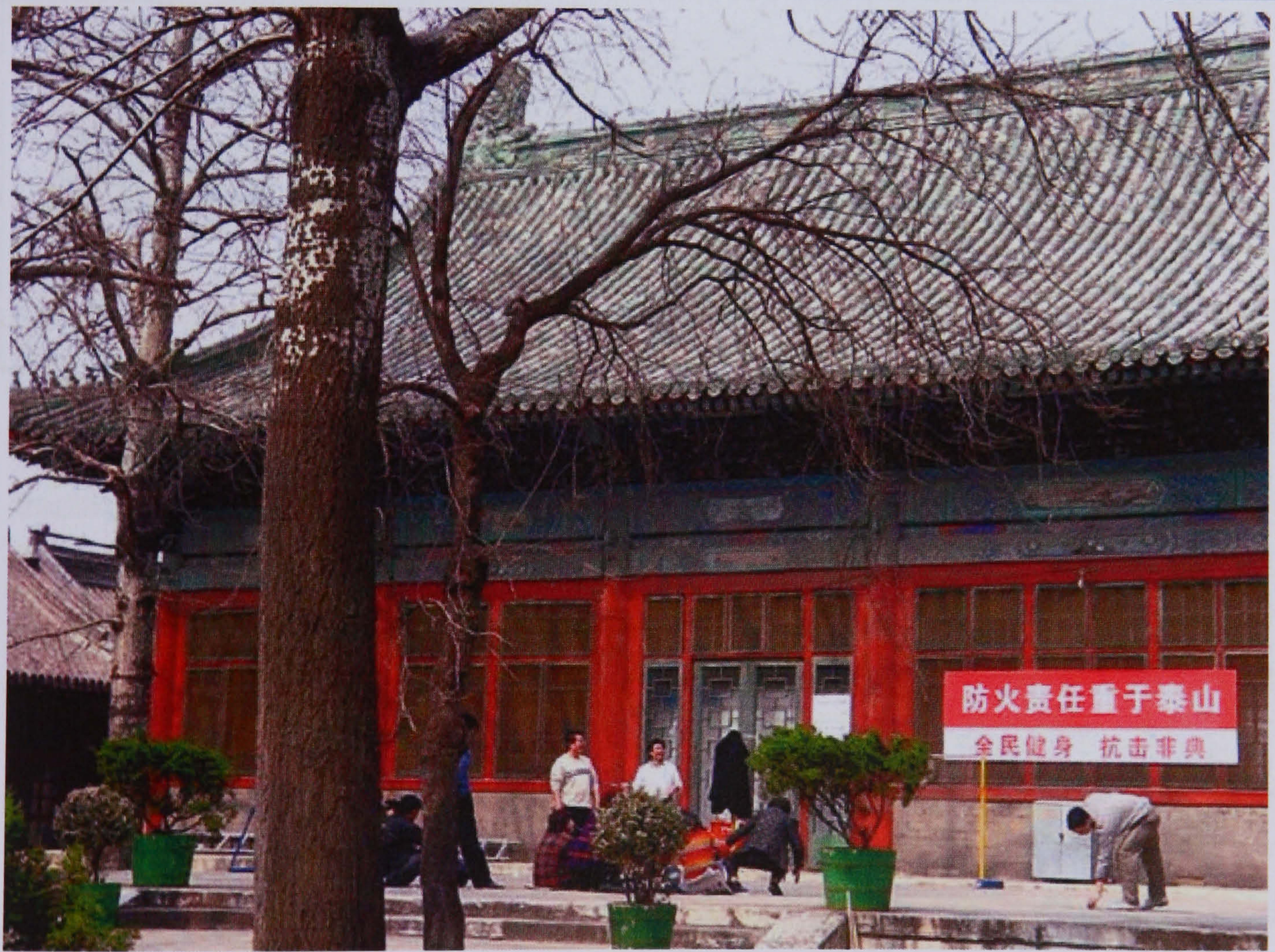
 a: No 71, lane 8: The overhang window	 b: The fixed windows of the front buildings, lane 8	 c: No 39, lane 8: The overhang window

Fig. 8.20 The windows of the ordinary buildings

a: The windows of the first main building:
The window with the moveable casement

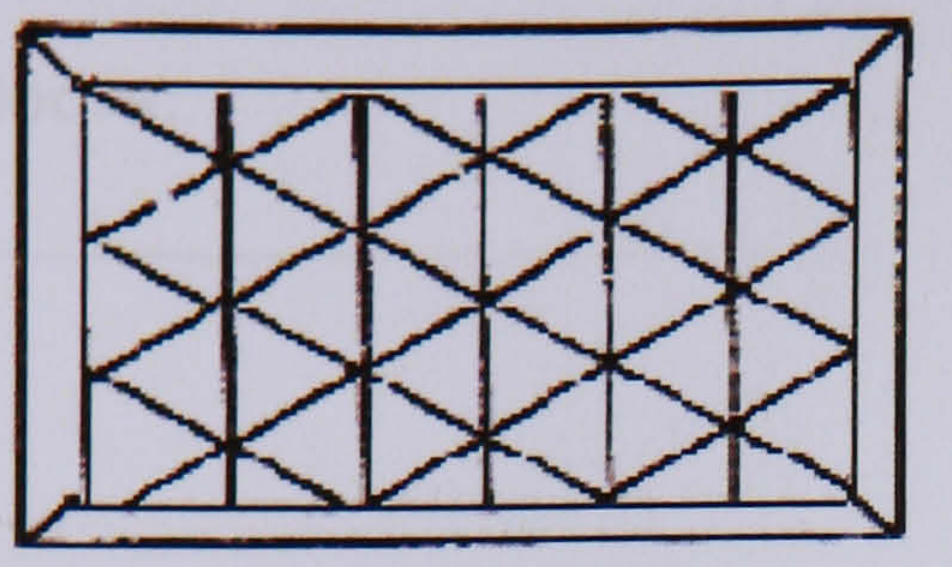


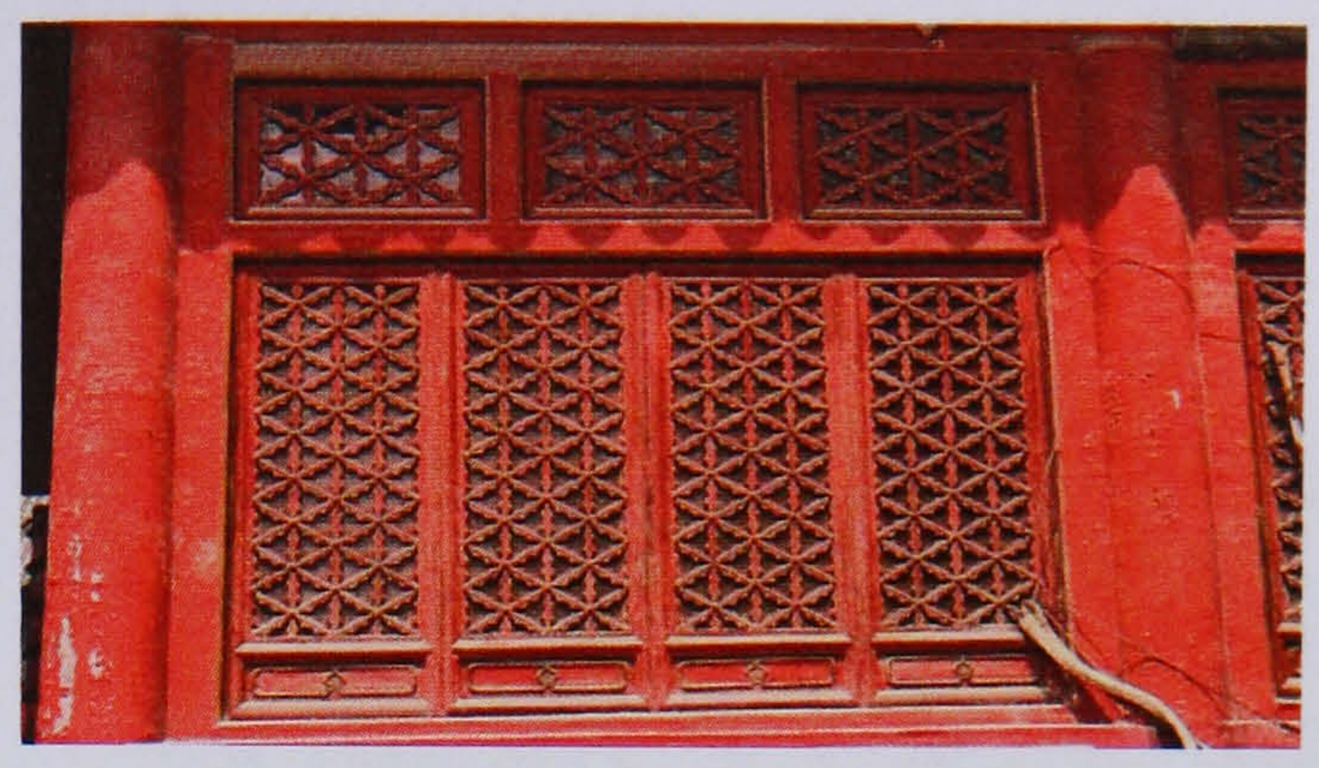
b: The er (ear) room:
The overhang window



c: The second main building: the windows with the moveable casement

Fig.8.21The windows of the *fuwangfu* mansion





Fuw
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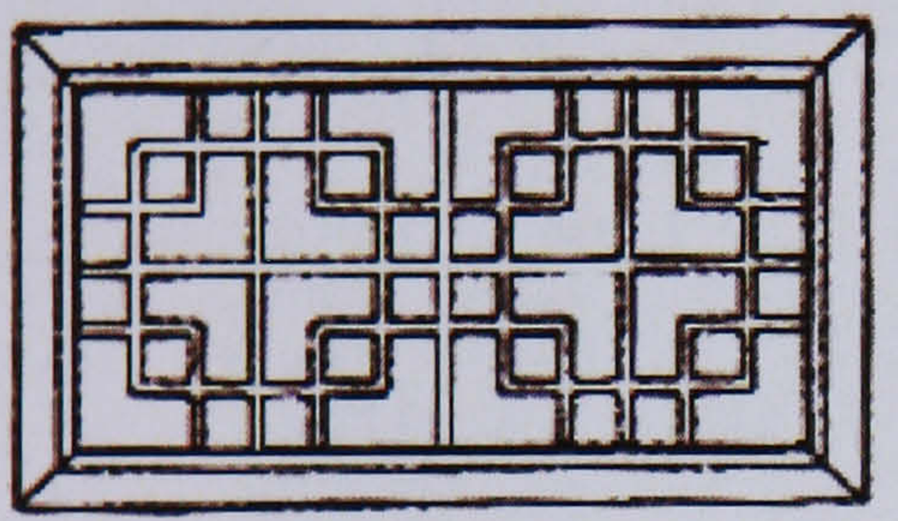
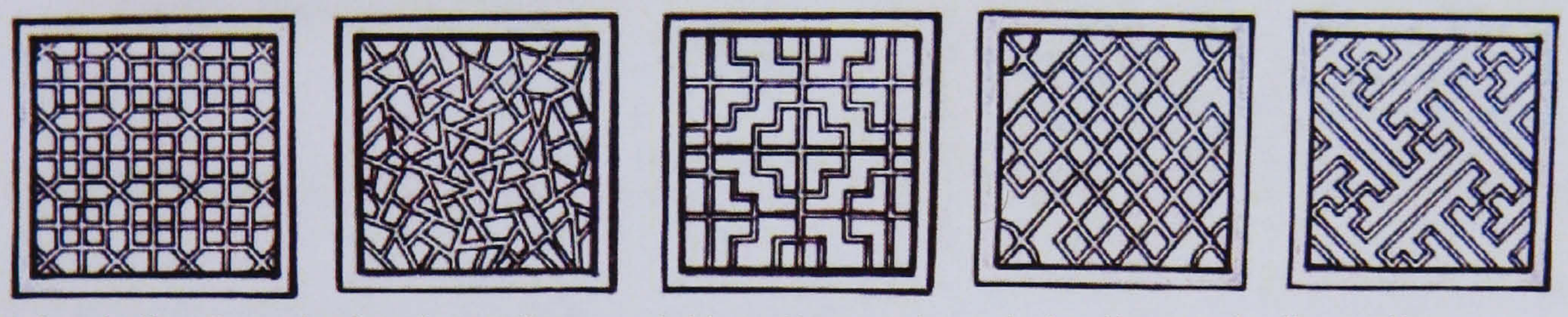
mansion: first main buildings



NO 39, LANE 8



tortoiseshell pattern broken ice pattern variable pattern elongated pattern slanting pattern
Cource: Lip, 1995:32

Fig. 8.22 The window grilles or lattice work

The lattices (Fig.8.22) and the paper-cuts create an important extra layer to a traditional Chinese building. 'Windows were of thick translucent paper; in spring they were rolled up and the rooms opened to the outside air' (Boyd, 1962:82), and the bamboo blind could be used to cover the window. When people look outside at the courtyard gardens through a window, the landscape and the sky should be separated by the window lattice or the paper-cut work, and therefore, 'the trees and stone sculptures are likewise incorporated into the internal space. The utmost freedom in the interior is related most directly to the outside world by a clear structural concept, and thereby exemplifies the connection between timeless classicism and timeless nature' (Blaser, 1979:11). The effect produced by the lattices and the paper-cut is to divide the outside view into many sections, lending to the imagination and achieving a rich effect of light and sight. Meanwhile, the lattice also gives people functional information about the window and a sense of separation, and creates an effect of light and shade of the filtered light in the room. The focus group materials also indicated the social culture values of the paper cut, which is symbolic of happiness, good fortune and so on.

Doors:

a: The entrance door to the first main building

b: The entrance door to the second main building

Fig.8.23 The entrance door of *fuwangfu* mansion

Entrance doors are mainly made of timber, and five door types have been found in the survey area for the ordinary buildings: the doors for the entrance gate and decorative gate, the connecting doorways between different courtyards, the front entrance door for the buildings, the back screen door for the main buildings, and the internal partition door. There are normally double doors (Fig.8.23: a, Fig.8.24) for the entrance gate and also the decorative entrance gate. The door for the entrance gate of the *Fuwangfu* main building is much larger than in ordinary buildings, and 63 metal doornails (which can only be used by the royal family) have been used uniquely for each door for decoration (Fig.8.23: a). For the front entrance door, double doors have been broadly used by most of the buildings. For buildings with a higher social status, two single panel doors (Fig.8.23: b) are normally located at both sides of the double doors. A windbreak door can be added at the front of the main entrance door. In summer the windbreak door is replaced by a bamboo curtain and in winter the windbreak door is replaced by a padded cotton curtain.

The entrance door to No 111, lane 8

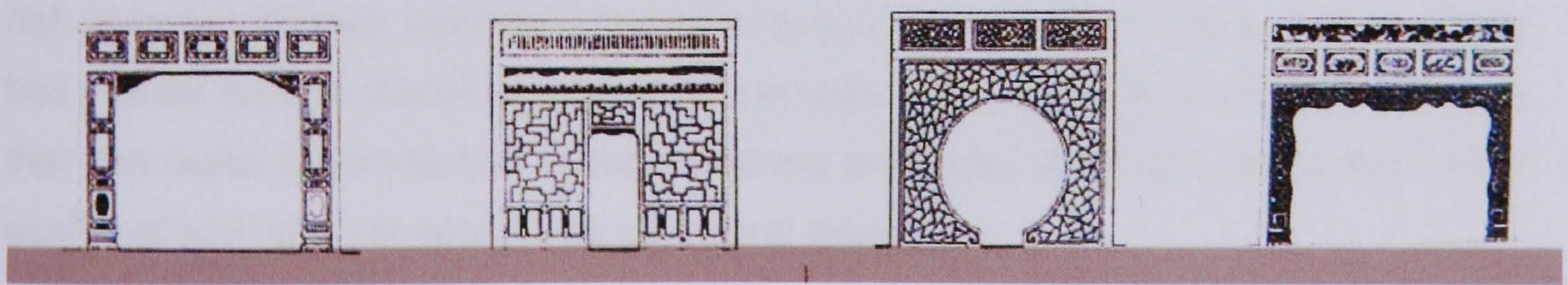
The decoration entrance door to No 71, lane 8

Fig. 8.24 The entrance door

a: The entrance door to the main building, no 51&53, lane 6

b: The back screen door to the main building, no 111, lane 8

Fig. 8.25 Entrance doors to the ordinary courtyard buildings



Source: Zhao, 2001:118

Fig.8.26 Interior doors

Linking doors between two courtyards are normally a doorway, and the doorway is shaped like a moon, a vase or a flower petal. No picture-frame is more attractive than one of these doorways through which a vista arrests the eye. The back screen doors are located at the central axis of the main buildings which can only be opened during an important family event (Fig.8.25: b). The internal partition doors are normally not opening doors but more likely a doorframe to work with the internal partition wall. The door patterns can vary from the geometric patterns to abstract forms, however, the partition door is rare in the investigation because of the heavy transformation and also the requirement for privacy (Fig.8.26).

8.1.6 Summary

The previous section study focused on the materials, modular system, space unit system and construction techniques of the timber structure. As the above studies suggested, the beam-column frame system is the main structural technique used to fix the building structure, the fundamental principle of the beam-column frame system can be concluded as follows: on the top of the platform, the varying size of the space unit is made up of four columns which can be named as one bay in width and general *jia* in depth. On the top of the columns are the purlins and beams and all these buildings elements form a three dimensional structural unit (Guo, 1999; Knapp, 2000) The bay can vary from 1, 2, 3, 5 to 7 in the survey area (three bay is the ordinary space unit). Then certain roof types (the flush gable roof for ordinary buildings and hip-and-gable roof for *Fuwangfu* mansion main buildings) will be located on top of this space unit with either a symmetrical or asymmetrical double sloping roof. Whatever structural frames are used, the structural elements are finally jointed by tenons and mortises (*LieJie* 1097, Bouvier, 1972; Lip 1999). The detail of this structure system is extremely complicated; all the buildings elements have their own literal name and the formula to calculate the dimensions from structural regulation design principles. Also, the building elements such as the walls, windows, and doors mainly use timber but with different patterns and construction techniques to provide a rich layer functionally, aesthetically and culturally. Nevertheless, this part of the study has mainly tried to identify the design principles and values of the timber structure that can make a contribution to contemporary architectural design, particularly in the aspect of architectural economics (structural design).

8.2 Section typology studies: response to climate

Many studies have concentrated on courtyards as climatically responsive urban forms. For instance, Fathy (1986) and Bahadori (1978) claim that the introverted character of the courtyard fulfilled several climate functions in hot arid regions, and Manty's (1988) analysis of vernacular architecture throughout Sweden, Norway and Switzerland praised the use of courtyards in their ability to create 'pockets of solar gain', thus balancing the harshness of cold northern climates. This part of the study mainly concerns the strategies employed in the Chinese courtyard buildings which help them respond to the continental climate of Beijing. From the previous study, we can see that the principles of *Yinyang* and change, the Five Elements of Daoism, the energy control strategies from *Fengshui* theory, and partly the plan and colour typology. These studies have all been shown generally to provide the basic courtyard design guidelines for the response to the local physical environment. These traditional design techniques/ values employed are rarely costly in terms of materials or energy and thus not only have economic potential, but their 'low tech' nature is directly within the realm of easy understanding by the local residents. However, there is nothing more important than a scientific understanding of a living space created by traditional design values. 'Dwellings are built to serve a variety of functions, but one of the most important is to create living conditions that are acceptable to their occupiers, particularly in relation to the prevailing climates' (Oliver, 2003:130).

Compared to the social-culture values of the courtyard buildings, the good quality of a physical living environment which responds to the local climate is nearly universally desired in human housing design and planning. The quality parameters of the physical living environment characteristics of the living space include the quality of natural light, natural ventilation, humidity, noise, privacy and security which are offered by the courtyard, yard and surrounding buildings. However, noise, privacy and security have all been discussed in the plan studies and this part of the study will mainly focus on the climate related parameters such as sunlight, ventilation and humidity. The courtyard, yard and building envelope interact with the external climate, creating a new interior microclimate zone, and the microclimate of each courtyard building group can be further divided into several different secondary microclimate zones as the result of the multi-courtyard buildings groups.

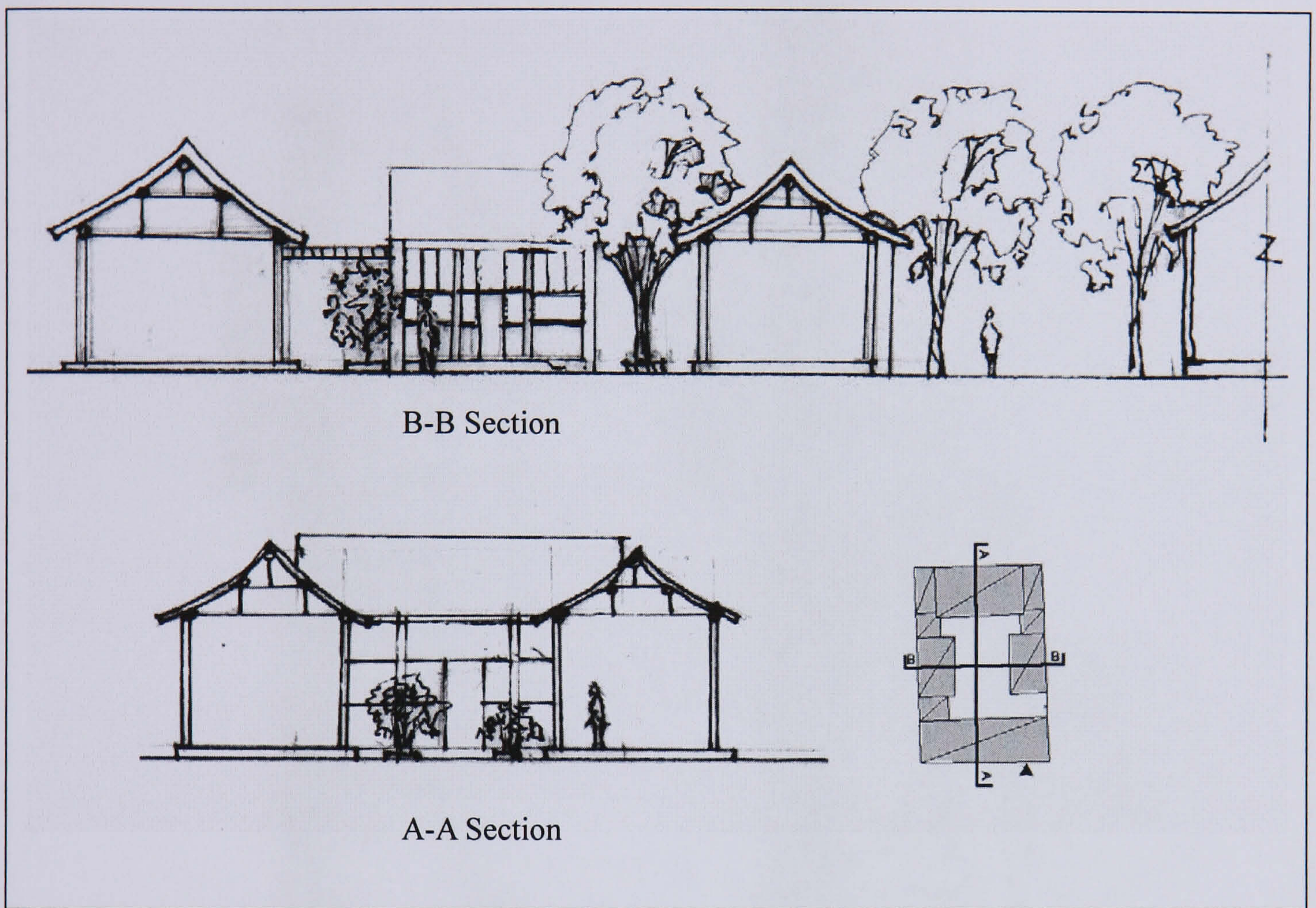


Fig.8.27 A standard section of type one (based on No 39, lane 8)
Scale 1:200

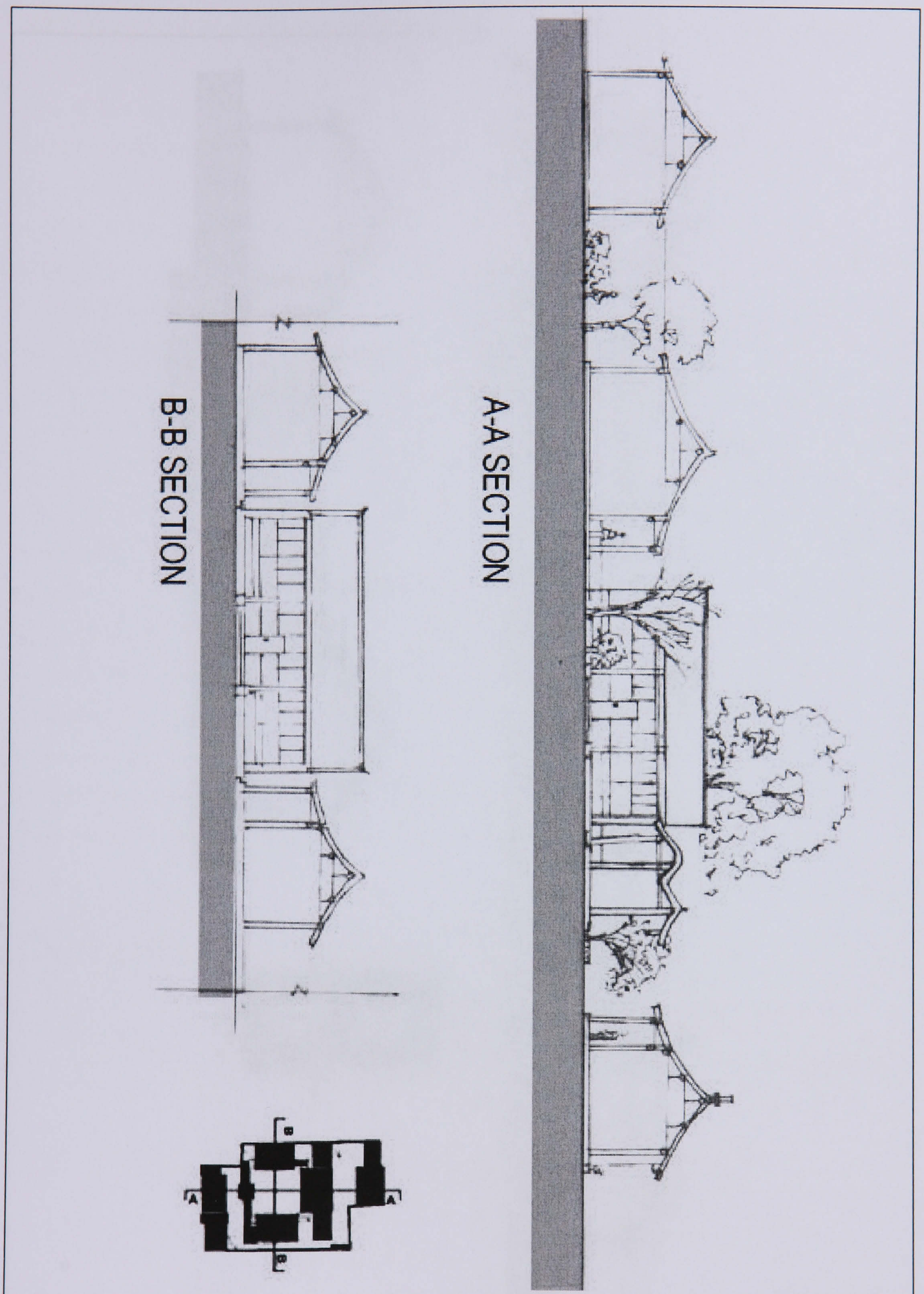


Fig.8.28 A standard section of type two, three and five (based on no 71, lane 8)
Scale 1:200
0m 3m 6m 9m
N

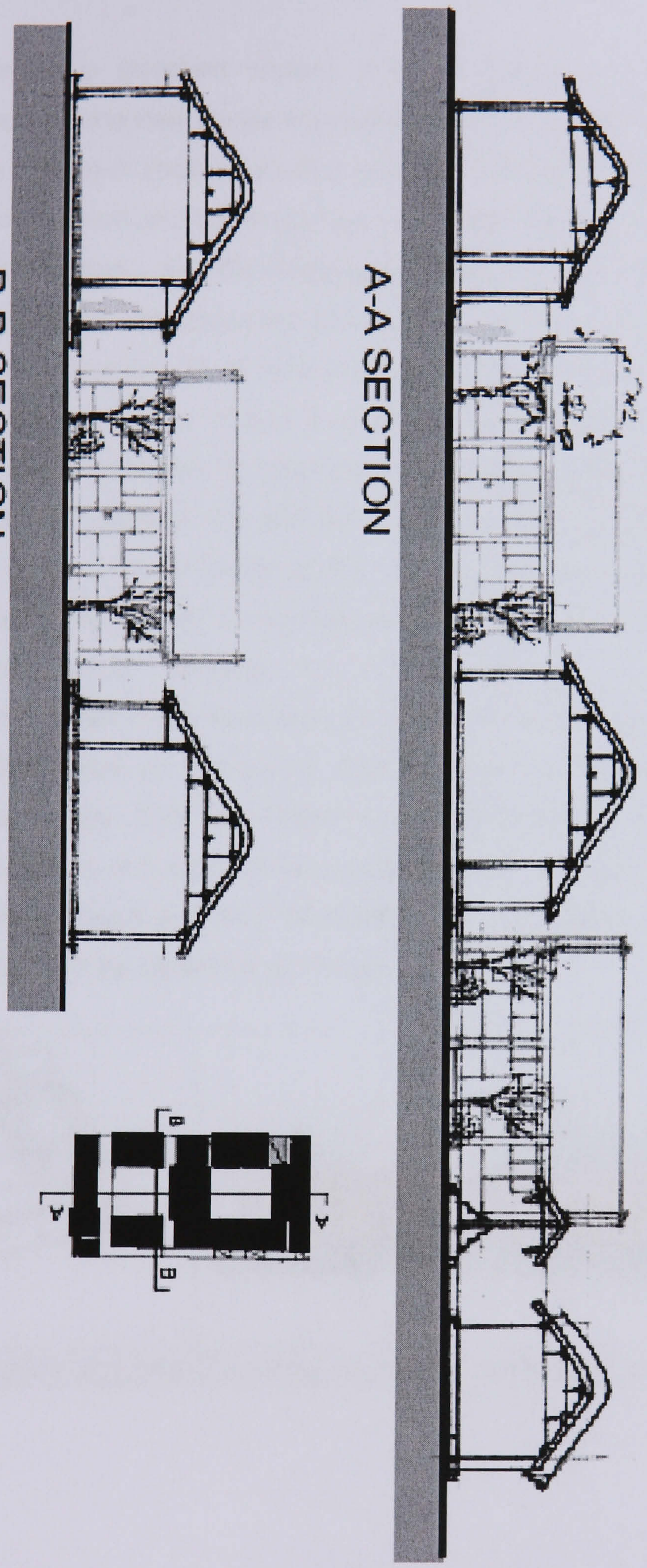


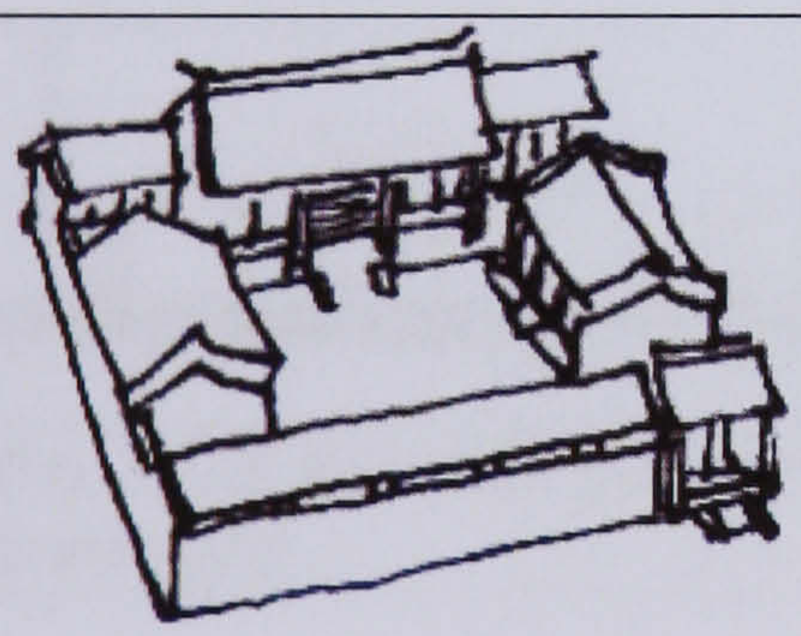
Fig.8.29 A standard section of type two, three and four (based on no 21, lane 2)
Scale 1:200

0m 3m 6m 9m

N

8.2.1 The classification of the microclimate

Fig. 8.27 illustrates a standard section drawing (number 39 of lane 8) which represents the south oriented single courtyard buildings (without additional yard) of the survey area. The A-A section drawing can be simply mirrored to make the new section of the single courtyard buildings face north (the entrance located at the north part of the building groups), and the B-B section is still the same. Fig.8.28 represents a section drawing of the one courtyard unit building that has the front and back yard buildings (based on number 71 of lane 8). Fig.8.29 illustrates a two courtyard unit based on courtyard number 21 of lane 2 which has a front yard, two courtyards and the buildings. From the analysis of these representative courtyard units and also the previous plan typology studies, one and two courtyard units are the basis for all three and more than three courtyard units in the latitude direction (except the *fuwangfu* mansion). Normally there is only one linking gate (moon gate) between two buildings groups in laterally, which indicates the buildings groups are nearly completely separate from each other in the latitudinal direction. Therefore, this part of the climate studies will mainly focus on the longitudinal courtyard and building and also the microclimate they create. After identifying the standard sections of the one and two courtyard unit buildings, according to the location of the courtyard, yard and buildings inside the buildings groups and also the relation with the *hutong* (lanes), 5 types of microclimate types can be classified as follows.



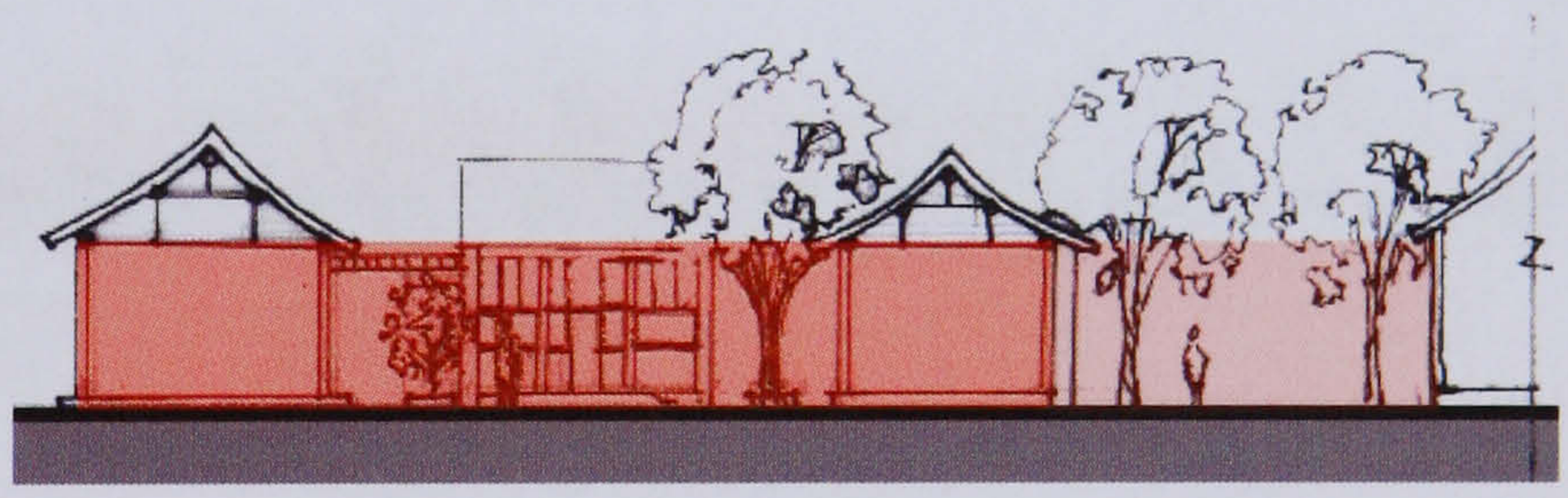
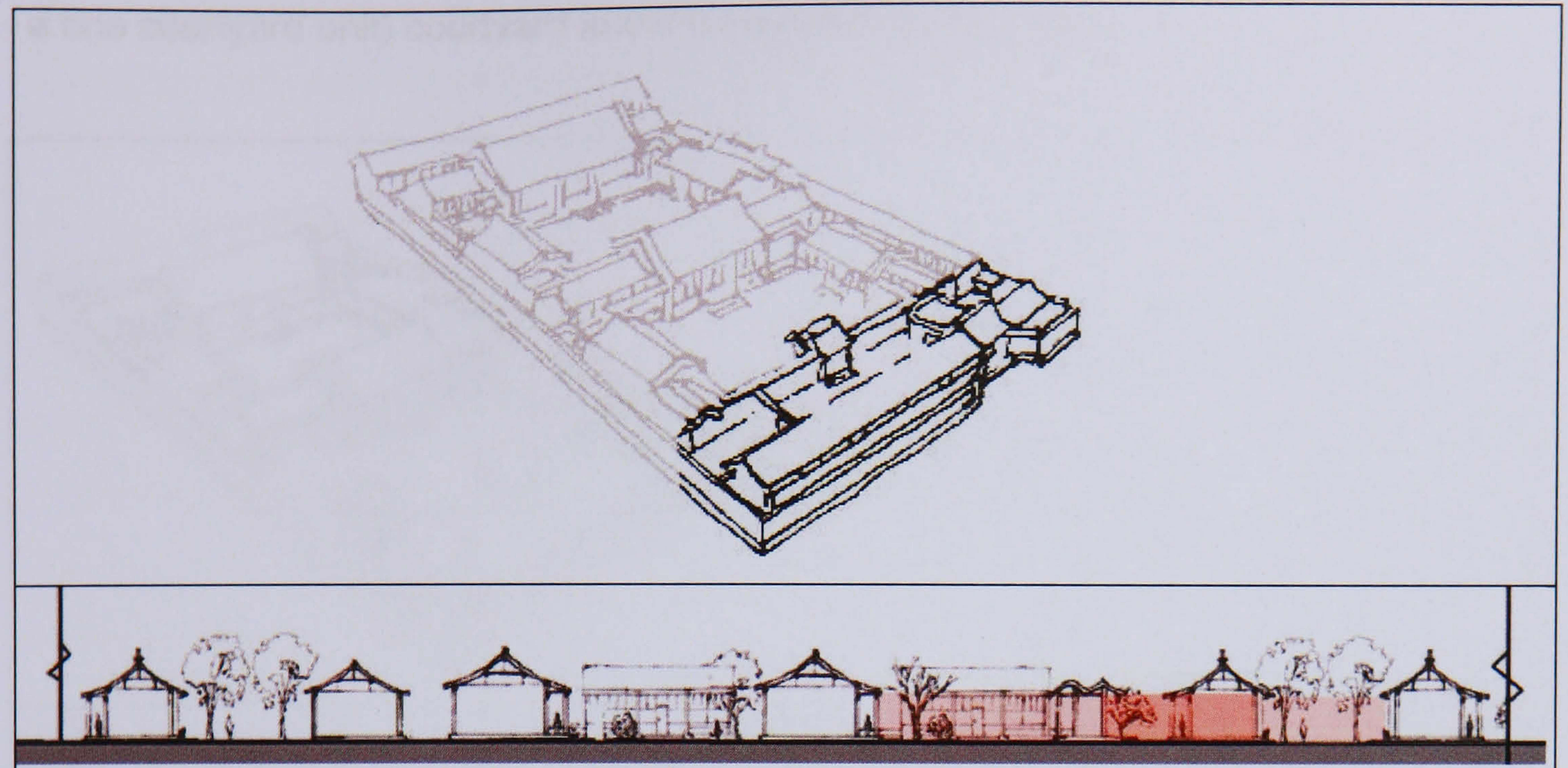


Fig.8.30 Microclimate type one (for single courtyard): at the back of *hutong*



These drawings are the ideal sketches for microclimate studies which include types 2,3,4, and 5

Fig. 8.31 Microclimate 2 (the front yard type): between courtyard and *hutong*

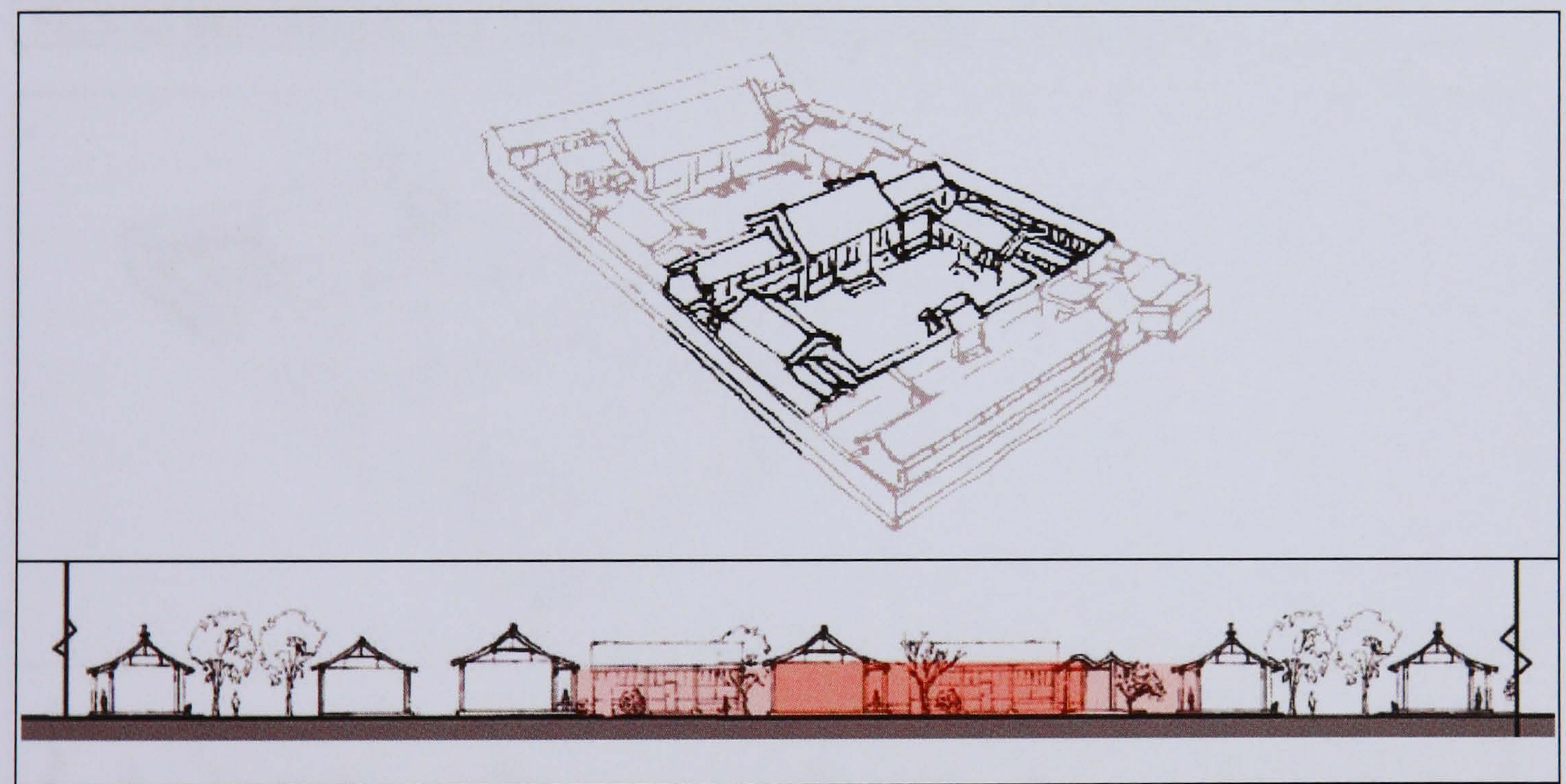


Fig. 8.32 Microclimate three (the first courytard type): between back courtyard and front yard

Microclimate type one is composed of the single courtyard, the buildings, and also has the influence of the front street (Fig.8.30). Microclimate type two is composed of the front yard and buildings, and has the influence of the courtyard and the front lane (Fig.8.31). Microclimate type three is composed of the first courtyard and the surrounding buildings, and has the influence of the front yard and the second courtyard (or maybe the back yard for one courtyard unit) (Fig.8.32). Microclimate type four includes the second courtyard and the buildings, and has the influence of the first courtyard and also of the possible back yard (Fig.8.33). The back yard and buildings comprise microclimate type five, with the influence of the second (or first for a one courtyard unit) courtyard and the back street (Fig.8.34).

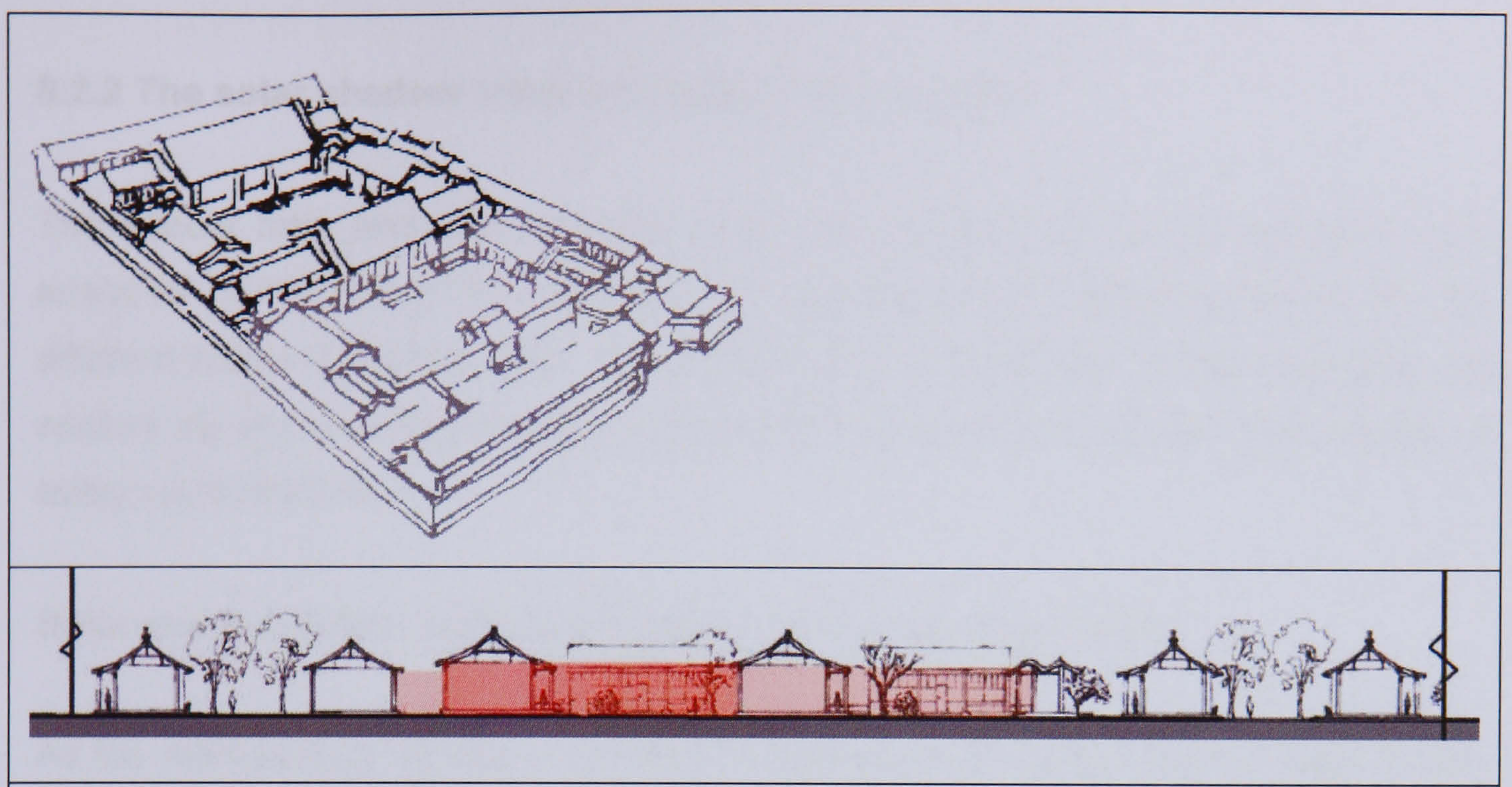


Fig.8.33 Microclimate four: between front courtyard and back yard

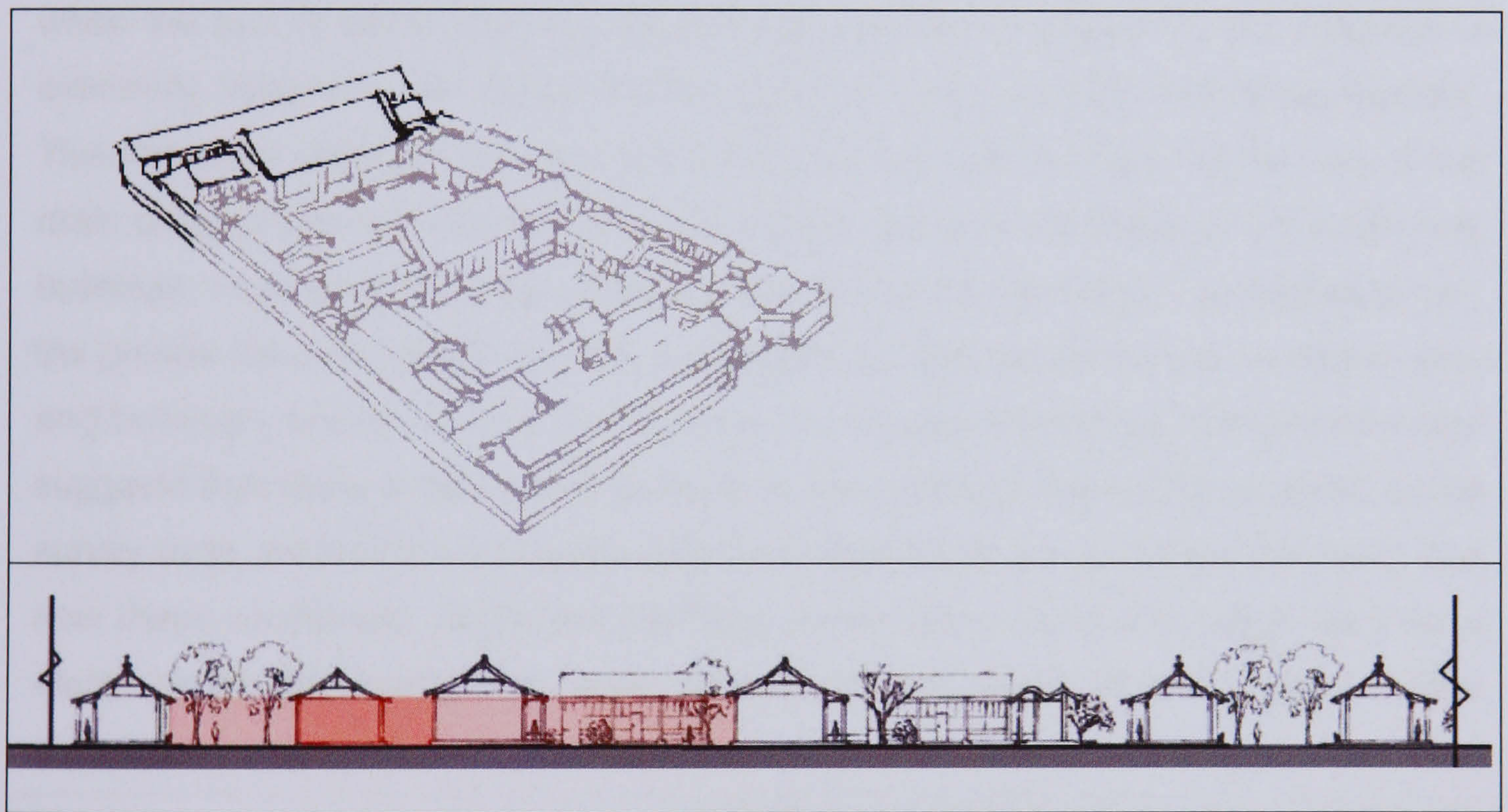


Fig. 8.34 Microclimate five: between front courtyard and *hutong*

However, before conducting the microclimate studies, the weather of Beijing should be examined. 'The Northern settlement region is an area characterized by continental climate with long, and relatively short severe winters but hot summers, during which only modest precipitation falls. Strong dry winds during winter and dust storms in spring pummel much of the region for more than six months of the year. Dwellings throughout the region reflect these harsh climatic realities and give evidence of significant environmental adaptation' (Knapp, 2000:167). The weather of Beijing is of the continental type, the midsummer sun angle is 76 degrees and midwinter 27 degrees at midday (Zhao, 2001:96), with cold and dry winters and hot summers owing to warm and humid monsoon winds from the southeast.

8.2.2 The solar shadow index and aspect ratio studies

The aspect ratio and solar shadow index (see Chapter 3) will be examined and analyzed (Table 8.2, 8.3) to indicate the basic physical characteristics of the five different types of microclimate. The microclimate of each unit is not separated; the section studies will regard each microclimate type as part of the microclimate of every courtyard unit.

Solar shadow index: south wall height/north-south floor width

As the methodology studies in Chapter 3 suggested, the solar shadow index mainly examines the quality of winter sunlight to the courtyard, yard and building. In winter when the sun is low in the sky, the ability to get direct sunlight to the buildings is extremely important, but during the hot summer, direct sunlight should be avoided. Therefore, the balance between the winter and summer sunlight will be one of the main shaping forces to the size of the courtyard, yard and the height of the south side buildings. In general, the solar shadow index deals with the winter sun exposure, i.e., the greater the solar shadow index, the deeper the well formed by the courtyard, yard and buildings, and less winter sun reaches the courtyard buildings. Meanwhile it also suggests that there is less direct sunlight to the buildings during the summer. In the survey area, most of the courtyard units have more than one courtyard and yard, and how these courtyards, yards and buildings which vary in size and height work as a whole to create comfortable living spaces for the house owners needs further analysis.

		South wall height	North-south floor width of the courtyard or yard[1]	Solar shadow index
Microclimate 1	One courtyard unit	3.3	6 to 13.5	0.55 to 0.24
Microclimate 2	One courtyard unit	3.3	3.3 to 3.9	1 to 0.85
	Two courtyard unit	3.9	3.3 to 4.6	1.18 to 0.85
Microclimate 3	One courtyard unit	3	9.5 to 13	0.32 to 0.23
	Two courtyard unit	3	8 to 11	0.38 to 0.27
Microclimate 4	Two courtyard unit	3.9	12 to15	0.33 to 0.26
Microclimate 5	One courtyard unit	3.3	4.6 to 6.6	0.72 to 0.5

Table 8. 2 The aspect ratio of different types of micro-climate unit

[1] The physical measurement indicated the minimum and maximum figure of different types of the courtyards, yards and the buildings from the case study.

As the above figures indicate, the solar shadow index figures of microclimate 1, 3 and 4 are the smallest figures (from 0.24 to 0.55) in the table, which indicates the good quality of solar gain and direct sunlight in the courtyard during the winter and also the main buildings (Table 8.2). As the Chapter 7 studies indicated, these courtyards and the main buildings are the place for the oldest generation of the family, and the good quality of winter sunlight in the courtyard and main building match their social status. The focus groups also indicated a similar situation:

Wang (1): My dwelling faces south, the ventilation and light is much better than in others, particularly before these new buildings were built, the natural light can access the far inside of the room, and during the summer just arrives at the outside of the wall, it is a very acute design. I think we can learn more from that. The window is very big, so the ventilation is also very good.
Zhu (6): That veranda room is the greatest room of this dwelling...
Liang (7): This dwelling is "winter warm and summer cool", but just for the rooms with a south orientation.
Rong (7): The natural light is particularly good in the winter, it reaches the far corner of the room

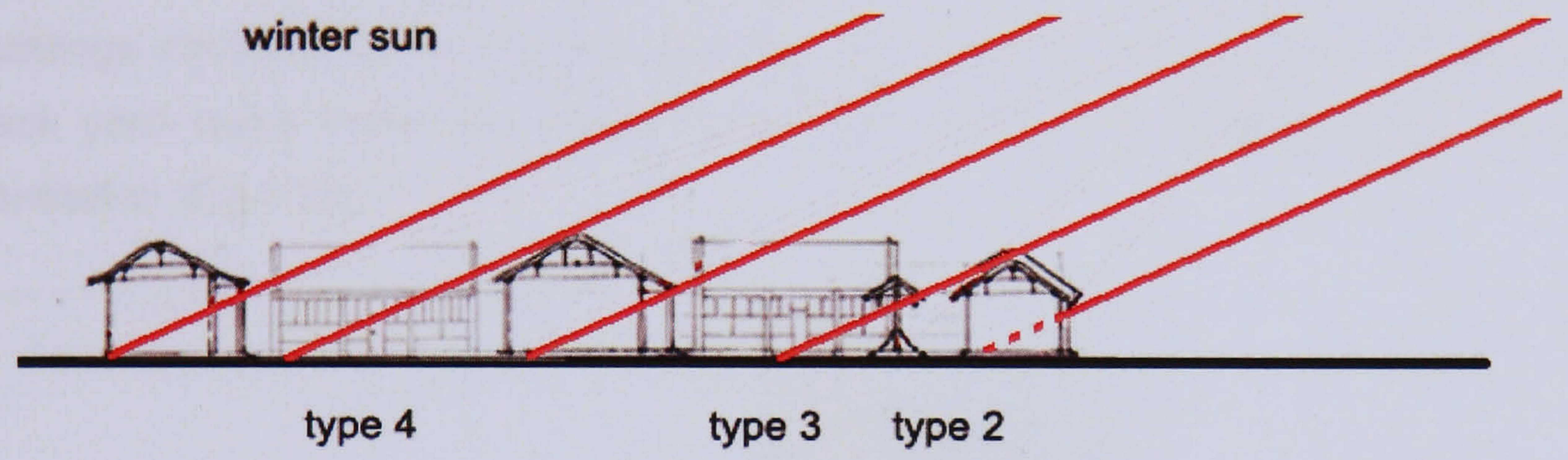
Microclimate 2, which represents the front yard and buildings, has the largest figure in the table, which indicates that the front yard is the deepest well in the courtyard buildings groups. It also indicates that the front yard can not get too much direct sunlight and solar gain in the winter. As we can see from the front plan studies, the front buildings were mainly used by the visitors and the servants, and the quality of the winter sunlight on the front buildings also indicates that the front yard has a lower social status than the buildings in the courtyard.

Microclimate 5 represents the microclimate of the back yard and buildings, the solar shadow index figure is in the middle of the table (0.5 to 0.72), and this figure indicates that the back yard and buildings can receive a better quality of sunlight and solar gain than the front yard but less sunlight and solar gain than the courtyard and buildings. As the Chapter 7 plan studies suggested, the family members can (the youngest female) live in the back yard and buildings. This arrangement also matches the winter sunlight quality of the back yard. The focus group inside the back yard of No 129 of lane 8 indicated there is not enough sunlight inside the back yard and buildings during the winter.

Zhang (2): Not a very strong natural light here, you know here is the backyard, maybe this is the reason. Particularly, during the winter, there is almost no natural light at all.
Wang (2): She is right, the natural light is not enough, you see, I have put all my flowers at the higher level to let them get the natural light.

If we compare these solar shadow index figures of the different types of microclimate, microclimate 2 (if the front buildings have the opening) can only receive approximately 1/3 of the sunlight of microclimate type 1, 3 and 4 which the courtyard and the main buildings have, and microclimate 5 (the back yard and buildings) can only receive 1/2 of the courtyard and buildings (Table 8.2).

The section drawing shows that the winter sunlight can reach the main courtyard and the internal parts of the buildings for microclimates 1, 3 and 4 (Fig.8.35: type 3, 4), and there is basically no direct sunlight to microclimate 2 which is composed of the front yard and buildings. However, the high-level windows (if the front buildings have them) can provide the winter sunlight to the front buildings (Fig.8.35: type 2).



The winter sunlight

Fig. 8. 35 The winter sun to different types of courtyard, yard and the buildings
No 21 of lane 2

Aspect ratio: area of courtyard floor/ square and average height of surrounding walls

If the most important consideration is the courtyard's effectiveness as a conduit of nature, then the aspect ratio that indicates the degree of openness to the sky is paramount. The greater the aspect ratio, the more exposed is the courtyard to the sky. This exposure allows heating by the sun by day, cooling by radiation to the cold sky by night, and also the entry of the natural sunlight and wind.

		Courtyard, yard floor area	Average height of the surrounding wall (buildings)	Aspect ratio
Type 1	One courtyard unit	90 to137	3.3	8.3 to12.5
Type 2	One courtyard unit	48 to 88	3.1	4.9 to 9.1
	Two courtyard unit	66 to170	3.3	6.1 to15.6
Type 3	One courtyard unit	110 to 150	3.2	10.7 to14.5
	Two courtyard unit	110 to 140	3.2	10.7 to13.7
Type 4	Two courtyard unit	128 to 201	3.9	8.4 to 13.2
Type 5	One courtyard unit	63 to120	3.1	6.5 to12.5

Table 8.3 The aspect ratio of different types of micro-climate unit
Note: the physical measurement indicated the minimum and maximum figure of different types of the courtyards, yards and the buildings from the case study

From these aspect ratio figures, the openness of microclimate type 1, type 3, and 4 where the main courtyard and buildings are located is relatively larger than the aspect ratio that the yards and the surrounding buildings created. This larger openness allows more sunlight and ventilation to penetrate into the courtyard and the buildings. The openness of microclimate types 2 and 5 where the front, back yard located is generally smaller than the main courtyard, which suggests that front and back yards are relatively cooler in the summer, and the cool air of the front and back yard will enter into the main buildings following the evaporation of warmer air inside the main courtyard (because of more solar gain than the front and back yard). Together, these buildings and courtyard and yards work together to make the main buildings comfortable. During the summer, the trees inside the front yard and the back yard make these two areas cooler and will help to accelerate the natural ventilation (Fig.8.36).

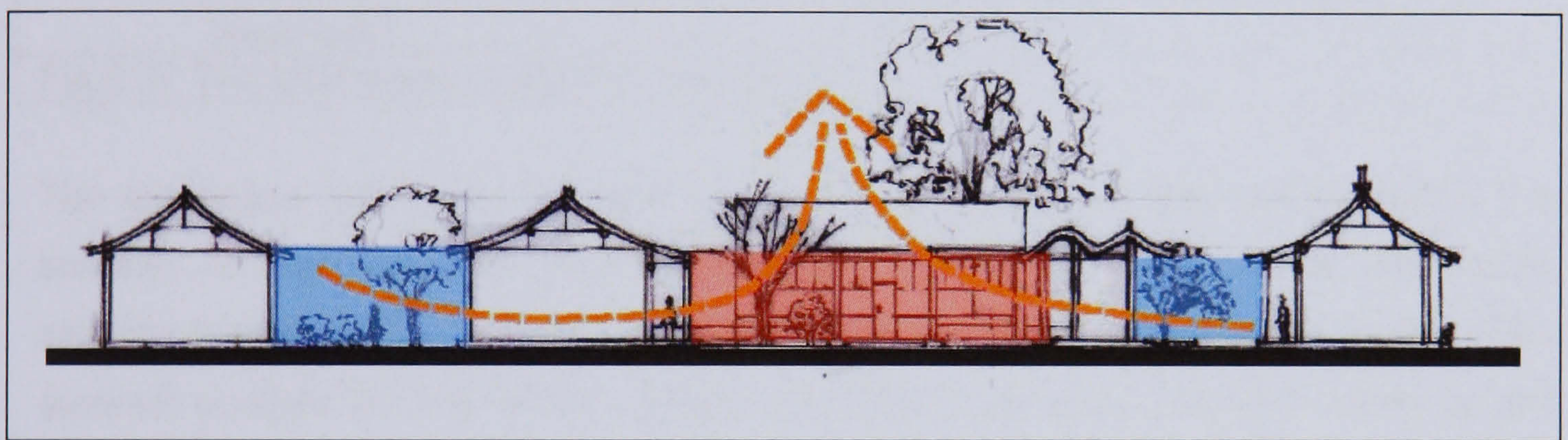


Fig. 8.36 The natural ventilation of the courtyard buildings group (no 71, lane 8)

8.2.3 Response to climate: the climate control strategies

The above solar shadow index and aspect ratio studies have indicated that the main courtyards and buildings which microclimates 1, 3 and 4 represented have good quality natural sunlight in winter, and also better natural ventilation than the front and back yard buildings in summer. Meanwhile, the courtyard gains more sunlight in summer, and is also influenced by the cold wind from the north in winter. How do the courtyards and the buildings respond to these negative effects of the climate? The following research will study the strategies on how the courtyard building responds to the local environment.

8.2.3.1 Strategies for the natural sunlight:

The orientation factor:

From the section studies, the majority of the courtyard buildings groups are organized on the south-north axis; most of the main buildings face south except for a small number of single courtyards which face north. The west and east facing wing buildings, particularly the west wing building, could overheat during the summer. The south facing front buildings can also get natural sunlight if there are windows at the south elevation.

The landscape factor:

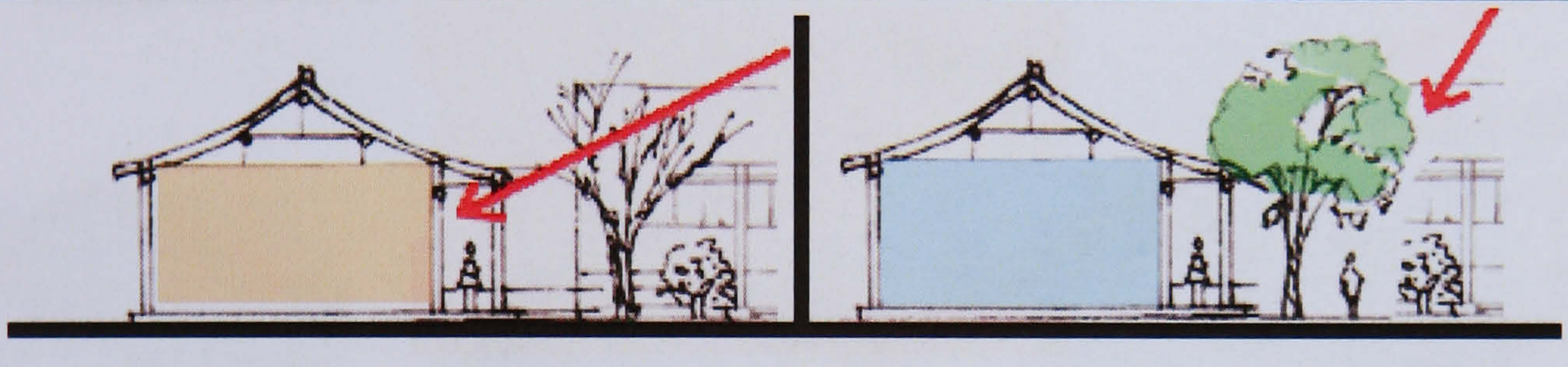


Fig.8.37 The landscape inside the courtyard

The landscape plays an important role in acting as the sunlight barrier during the summer to decrease the direct sunlight to the main buildings and also more importantly, the wing buildings. The trees inside the courtyard help to filter the summer sunlight but will let the sunlight reach the buildings during the winter period (Fig.8.37).

Wang (1): You see, there is a big tree in the middle of the courtyard, at least more than hundred years old, it is very cool during the summer, it covers this entire courtyard.
Wang (3): Mrs. Li is right, this courtyard is without any particular landscape today except that tree. That tree does work during the summer, we feel much cooler under the tree and we can have a chat under the tree.
Zhao (4): The trees on the lanes and the courtyards are very helpful during the summer; the shadow makes these places not very hot.

The water feature inside the courtyard, such as the jar and the pool for the goldfish not only gives aesthetic pleasure to the residents but also helps to collect the rain water and helps to cool the area during the summer.

Wang (2): Normally, there is the pond in the central courtyard, for us…
Liang (7): We always got the fresh air in the past because of the courtyard, and we have a huge jar in the middle of the courtyard. We can feel the cool air blow through the rooms.
Liang (7): The most important thing is that jar, we raise the gold fish there, and also the rain water flows into this jar, so we can feel this is a small world for ourselves.

The soft (landscape) paving of the courtyard helps to decrease the reflection of the sunlight on the opening of the buildings during the summer period (Watson, D & Kenneth Labs, 1983). The trees inside the courtyard help to buffer the east and west sunlight on the wing buildings. The landscape barrier and the verandah all work together to produce a better, more comfortable microenvironment for the residents.

The building envelope factor:

In contrast with an ordinary flat roof, the pitched roof (with the same height) will allow more sunlight to penetrate into the courtyard and buildings which is especially useful for the lower winter sun (Fig.8.38).

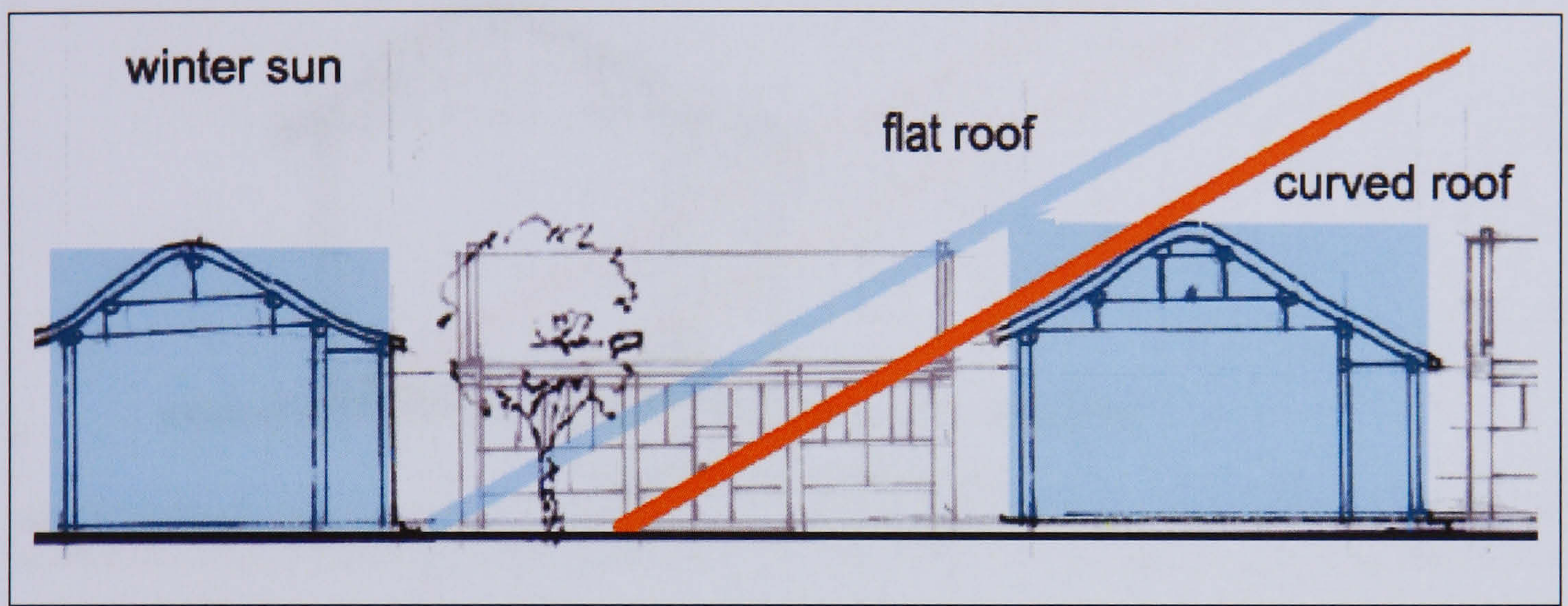


Fig. 8.38 The curved roof and the block building with the same height
Red: the curved roof blue: the flat roof with the same height

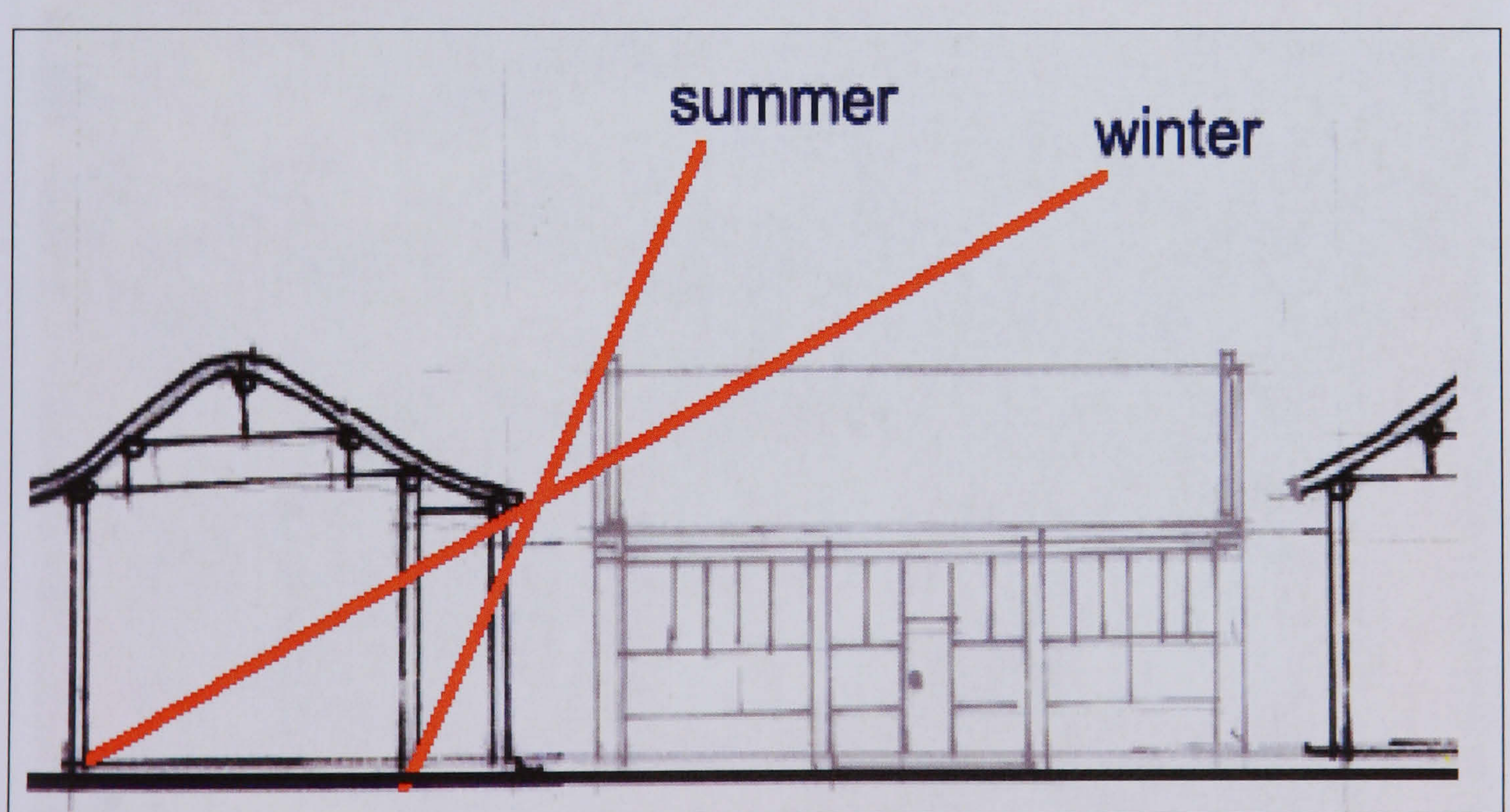


Fig. 8.39 The curved roof and the control of the sunlight

The curved eaves play an important role in controlling the sunlight. They allow the sunlight only to reach the external enclosure wall during the summer and reach deeply into the main building during the winter. The pitched eaves also help to shade all the buildings from the hot sunlight cast directly during the summer (Fig.8.39).

Tian (5): The corridor with the curved eaves has a strong influence on the natural light, you see, the corridor has connected the whole dwelling together, and it plays an important role in the light and ventilation. The width of the corridor is around 2 meters, so it is cool when the summer comes, and it is very warm in winter. The sunlight can reach to the far back of the rooms. The ventilation is also very good for this dwelling, particular for the south facing rooms; these rooms also have huge front and back windows, so the ventilation is very good. However, the east and west facing rooms are not in a very good situation, whatever the natural light and ventilation.

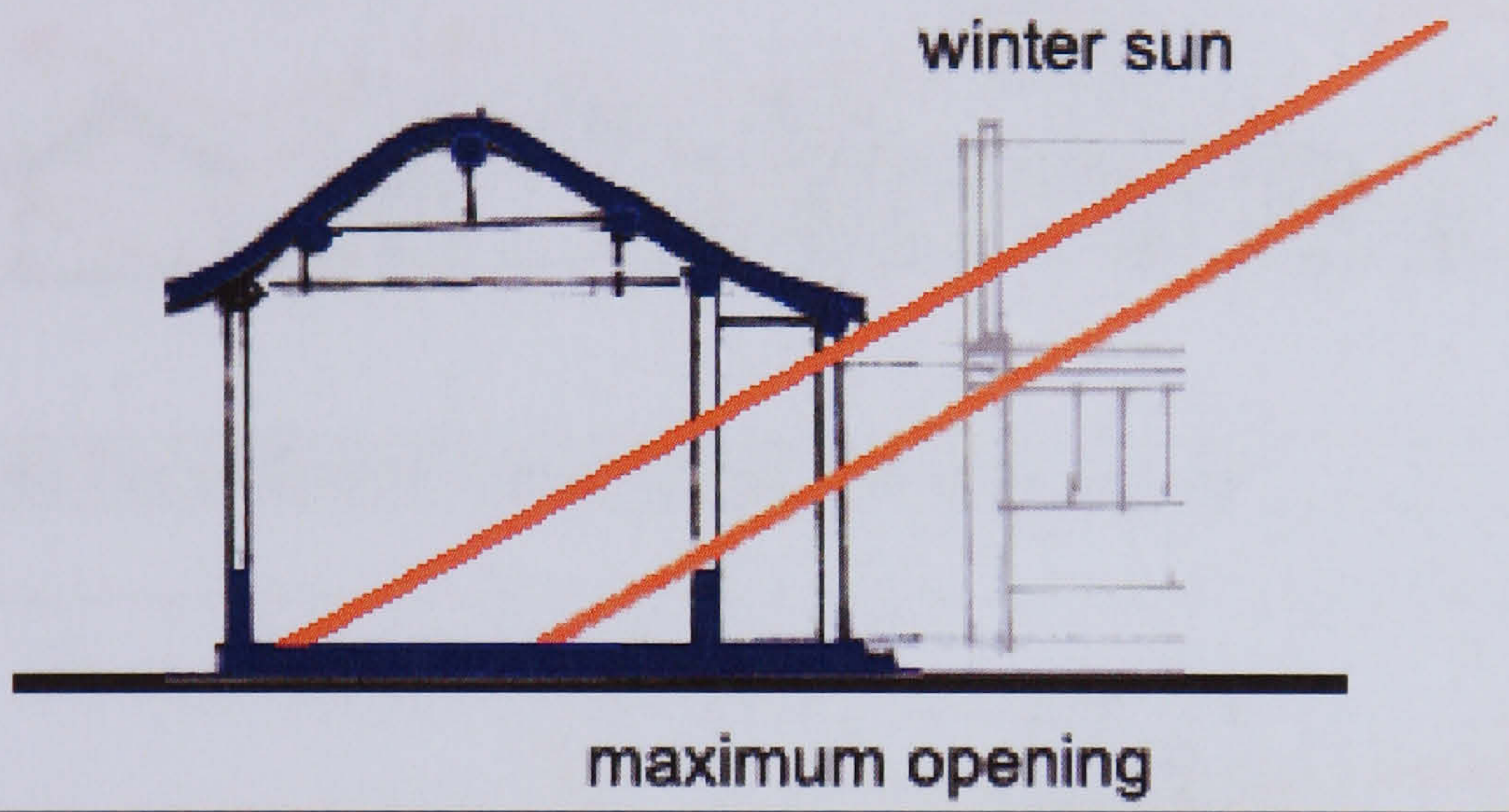


Fig.8.40 The maximum opening of the main buildings

Fig.8.41 The curtains and potted plants (East wing building, no 71, lane 8)

8.2.3.2 Strategies for natural ventilation:

The studies on natural ventilation, just like natural sunlight, should include two sectors: creation of the welcome natural ventilation from prevailing summer breezes and protection for the buildings from the prevailing cold north wind during the winter.

The orientation factor:

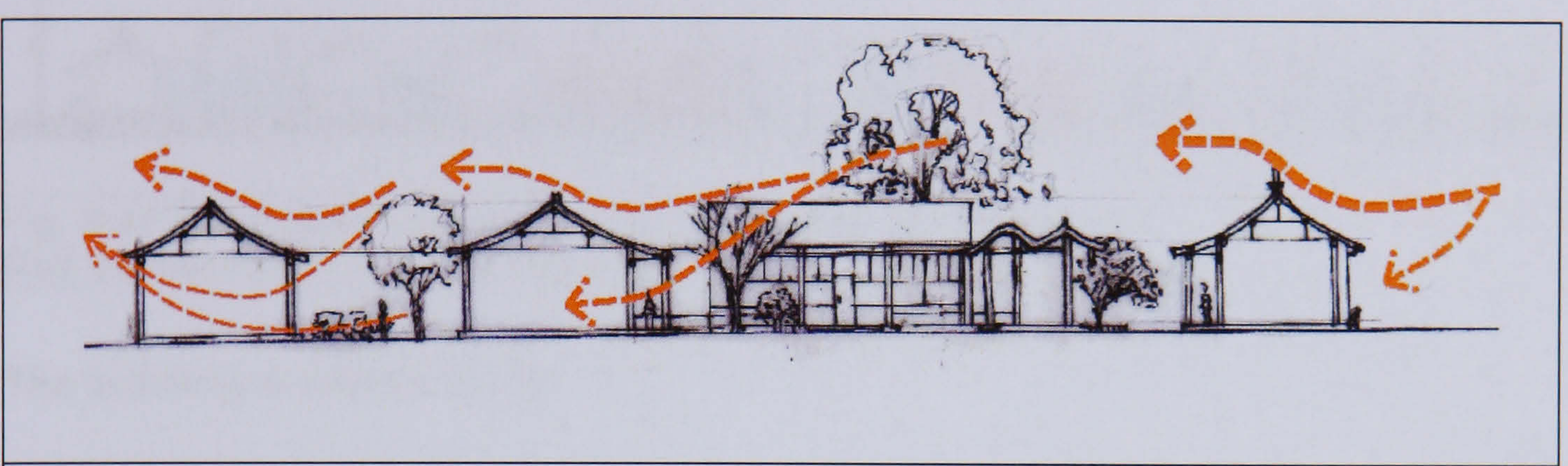


Fig.8.42 The ventilation from the south during the summer

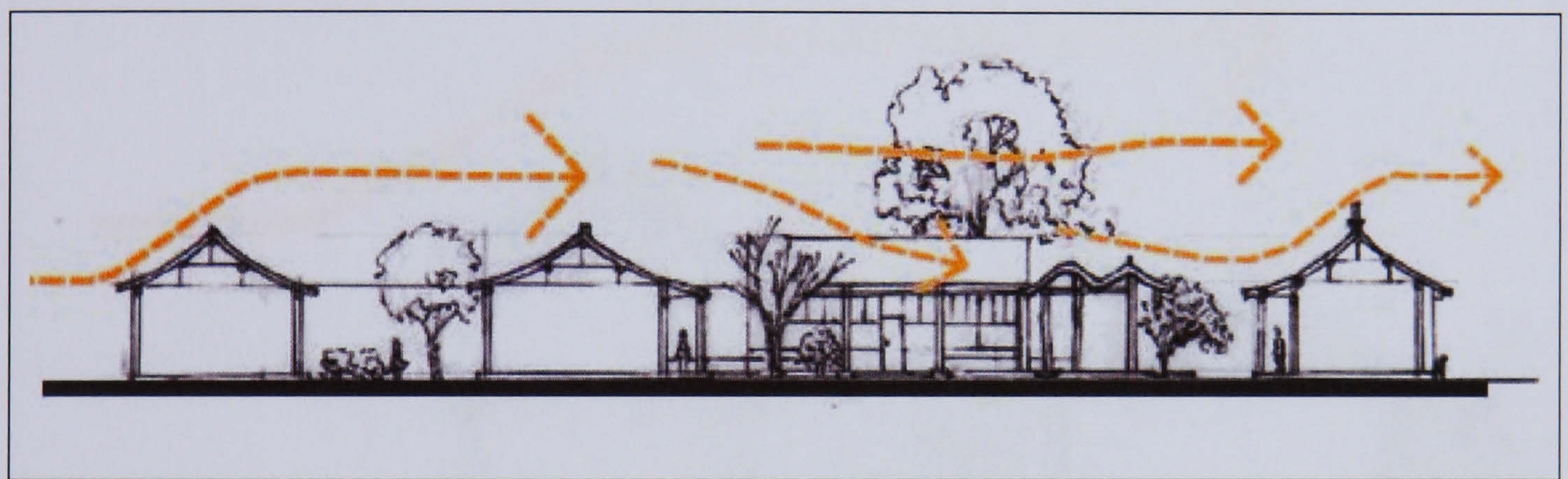


Fig. 8.43 The cold wind from the north during the winter

The south facing main buildings certainly help to get nice natural ventilation during the summer from the prevailing south cooler breezes (Fig.8.42). The completed closed north elevation of the back buildings will help to shade the buildings from the cold north wind during the winter (Fig. 8.43). The front buildings can still achieve relatively good quality natural ventilation during the summer because of the opening in the wall, and the building is also completely open to the front yard which helps to create good quality natural ventilation.

The sunlight factor:

There is more solar gain to the larger courtyard than the front and back yards during the summer. The heated air inside the larger courtyard will rise and therefore create convection between the warm air of the courtyard and the cooler air of the yards, which helps to create natural ventilation between the courtyard and yard. The cooler air could therefore be brought into the buildings. The air flow into the smaller yards and buildings is likely to be drawn through the windows of the front and back buildings which open to the cooler street, shaded by the trees during the summer (Fig.8.44).

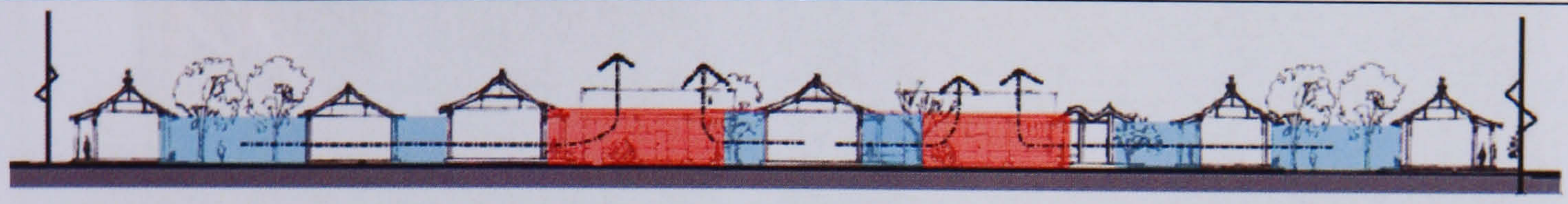


Fig. 8.44 The natural ventilation which is created by the sunlight
Red: the warmer air; blue: the cooler air

The building envelope factor:

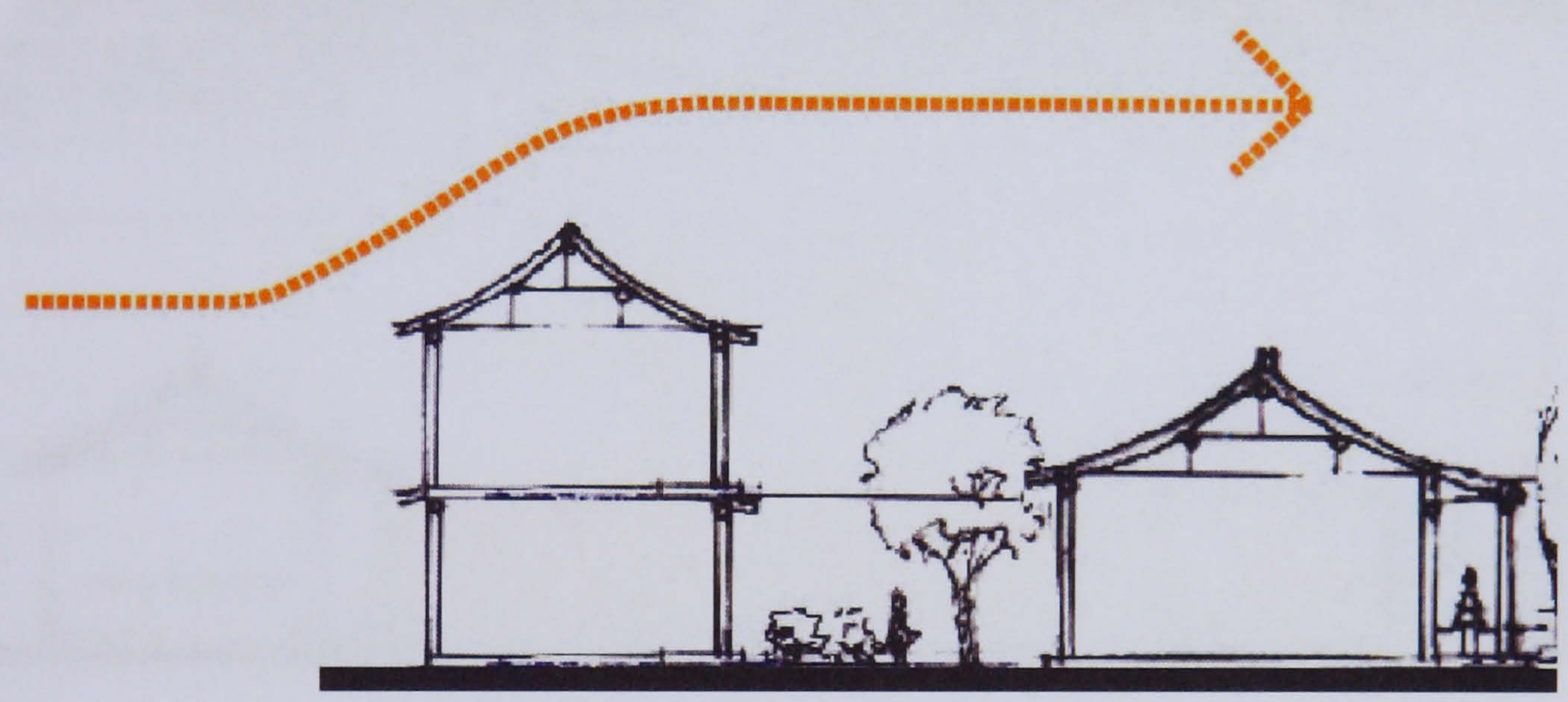
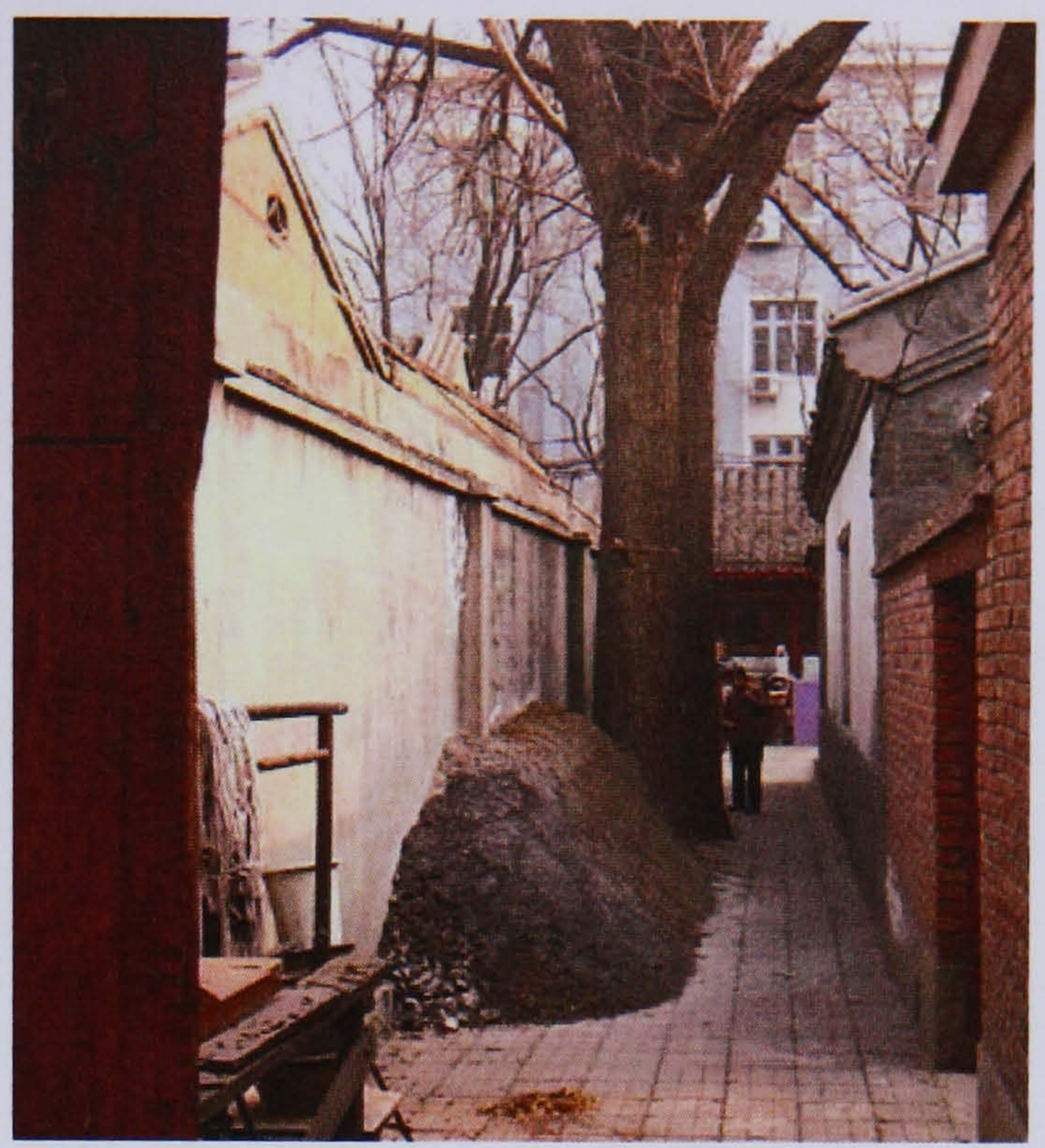


Fig. 8.45 The two storey back buildings of *Fuwang fu* mansion

The enclosed courtyard buildings compound protects the main buildings from harsh weather such as dust in spring. The minimum opening buildings that are located at the back of the buildings help to shield the building groups from the cold north wind in winter. In the larger courtyard unit, such as *fuwangfu* mansion, there are two storey buildings at the back to help to protect the main building from the cold winter wind (Fig.8.45). Insulating the buildings from the outside cold weather and minimizing ventilation is another main strategy for the cold winter. The timber, the cavity wall and double layer tiles also help to decrease the conductive heat flow. Hanging thick curtains outside the entrance door is also an important strategy used to isolate the internal space in winter.

Wing buildings, Fuwangfu mansion



East wing building, no 71 of lane 8

Fig. 8.46 Rear aisle

Fig.8.47 The aisle for ventilation (no71, lane8)

Furthermore, the aisle located in the east part of the building groups which are used as the link route for the east wing building of No 71 of lane 8 (also the east wing buildings of No 21 of lane 2) helps to create natural ventilation during the summer period to help the wing building get a relatively good quality of natural ventilation (Fig.8.46: right & Fig.8.47). The *Fuwangfu* mansion also has a similar arrangement; the aisle at the rear of the wing building helps to get good quality natural ventilation for the wing buildings (Fig.8.46: left & Fig. 8. 48). The internal open space of the buildings which is only separated by the partitions facilitates natural ventilation on a micro scale.

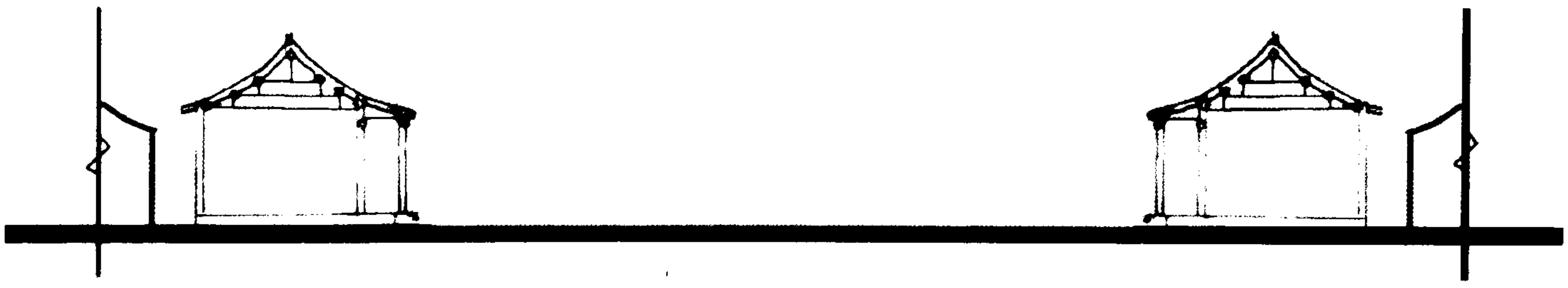


Fig. 8.48 The section drawings through the wing buildings of fuwangfu mansion (through the third courtyard)
Scale:1:500 0m 10m 20m 30m

Rong (7): Ventilation is also very good, you know inside these three rooms there is only a very simple partition during the summer; it is very good for the ventilation, and also because of the front and back windows, very good.

8.2.3.3 Strategies for the right humidity:

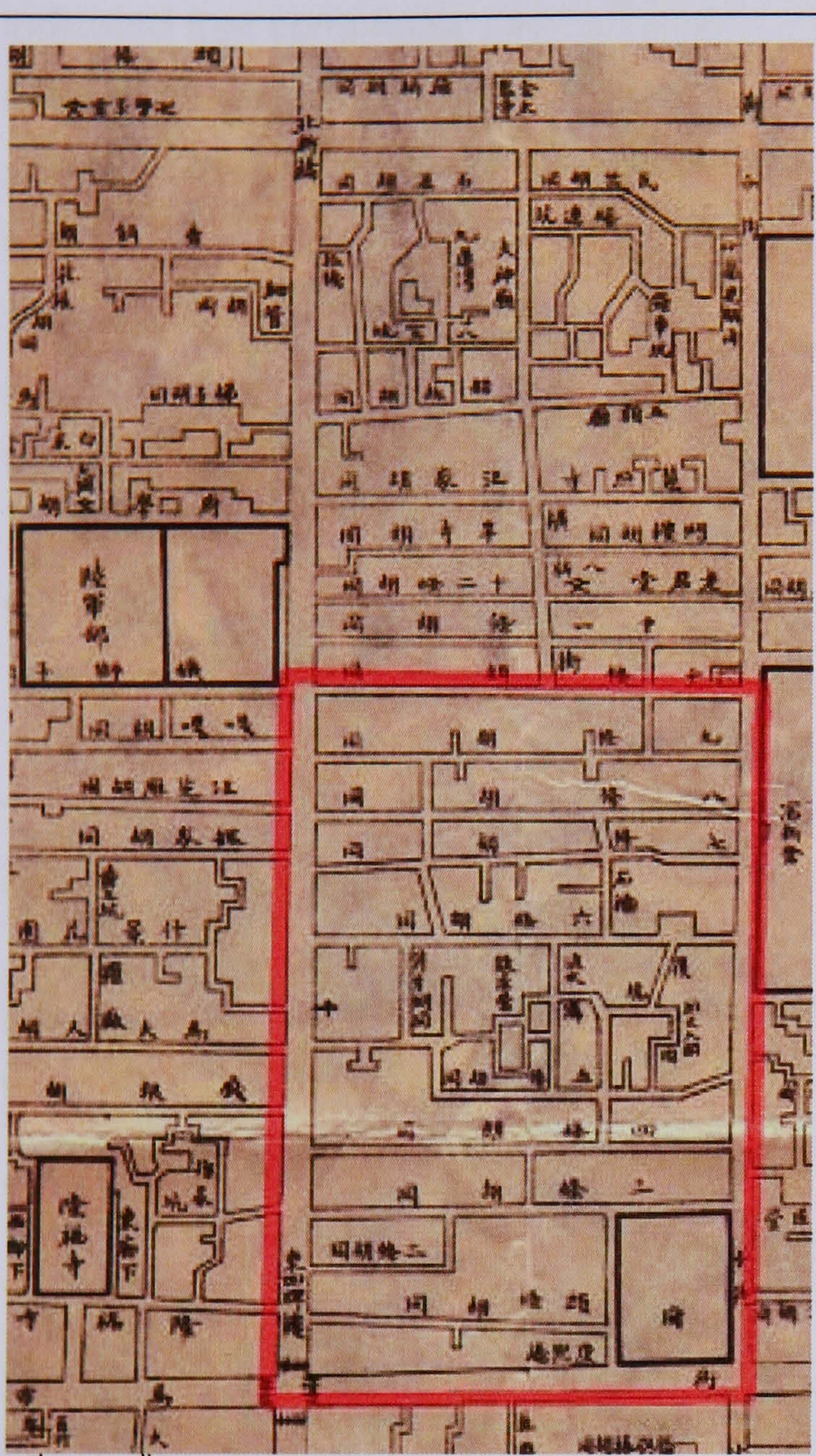
As we know the brick material of the buildings can easily absorb water during the summer; decreasing the humidity is also very important in order to get a comfort living place. Therefore, the cavity wall that is filled with limestone also helps to absorb moisture, and then the moisture can be released to the opening courtyards and yards during the sunny day. Natural ventilation is the best strategy to get rid of the moisture after a rainy day during the summer. As the above studies suggest, the buildings have good natural ventilation that helps moisture evaporate during the summer. The winters are dry and cold due to the continental weather in Beijing. Meanwhile, the evaporative cooling strategies work very well in the courtyards by accepting a higher humidity in exchange for a lower air temperature. The goldfish jar and also the pool also help this. The courtyard floor is also a promising surface for evaporative cooling because it is a natural collection place (the unglazed brick padding materials) for the rainwater.

8.2.4 Conclusion

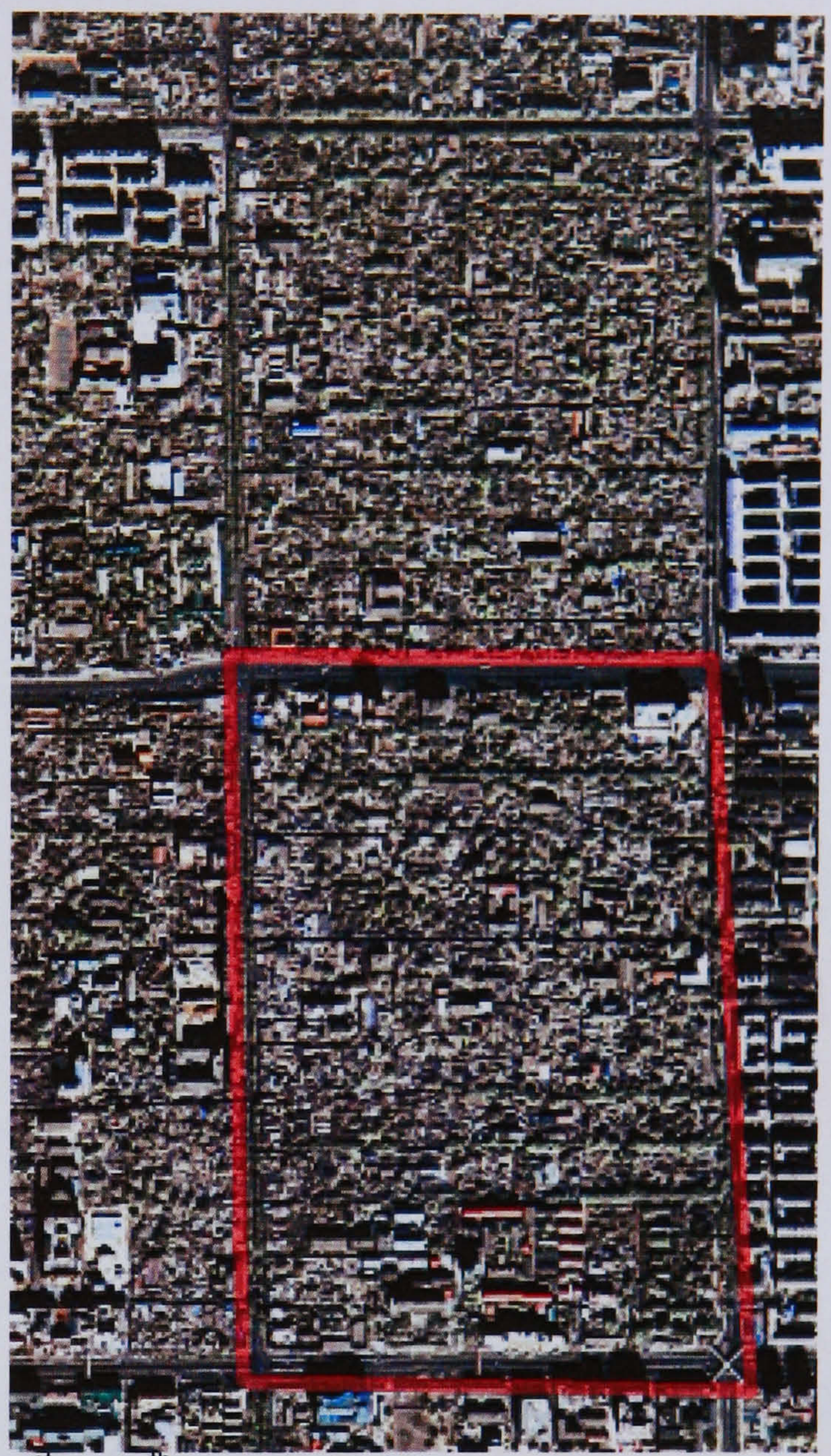
The multi-courtyard groups create a complex passive climatic regulating system in which all the processes are natural, without any mechanical devices. The courtyard, yard and buildings represent an attempt to bring the forces of nature under partial control. Courtyards and yards can intensify some aspects of the climate, such as daylight, and dilute others, such as the wind. Furthermore, the building envelope is a device through which light, ventilation, heat, and humidity are exchanged between the interior and exterior environments. Furthermore, five types of microclimate unit/section have been identified based on the location of the courtyard, yard and the surrounding buildings. The basic physical characteristics such as the solar shadow index for the winter sunlight, and the aspect ratio for the openness to the external environment have been briefly examined and discussed for the design values, in order to achieve a comfortable living environment.

During the winter this design utilizes direct sunlight and solar gain, avoids the cold wind from the north and insulates the buildings from the cold weather. Promoting the evaporative cooling in the summer and using the cavity wall with the limestone filling are the main strategies used to cope with the problem of humidity. Therefore, rather than simply housing an autonomous mechanical system like contemporary modern buildings, the traditional building and the courtyard themselves can act as the stimulating system which responds to the climate and creates a comfortable microclimate for the residents. Furthermore, as the above studies indicated, the comfort level of the place also matches the social behaviour inside the courtyard buildings.

Chapter 9: Urban courtyard buildings living environment transformation studies, 1st through 10th lane, *Dongsi* neighbourhood: 1900's – 2000's



1st to 10th lanes in 1900's
Source: Qing authorities, 1908

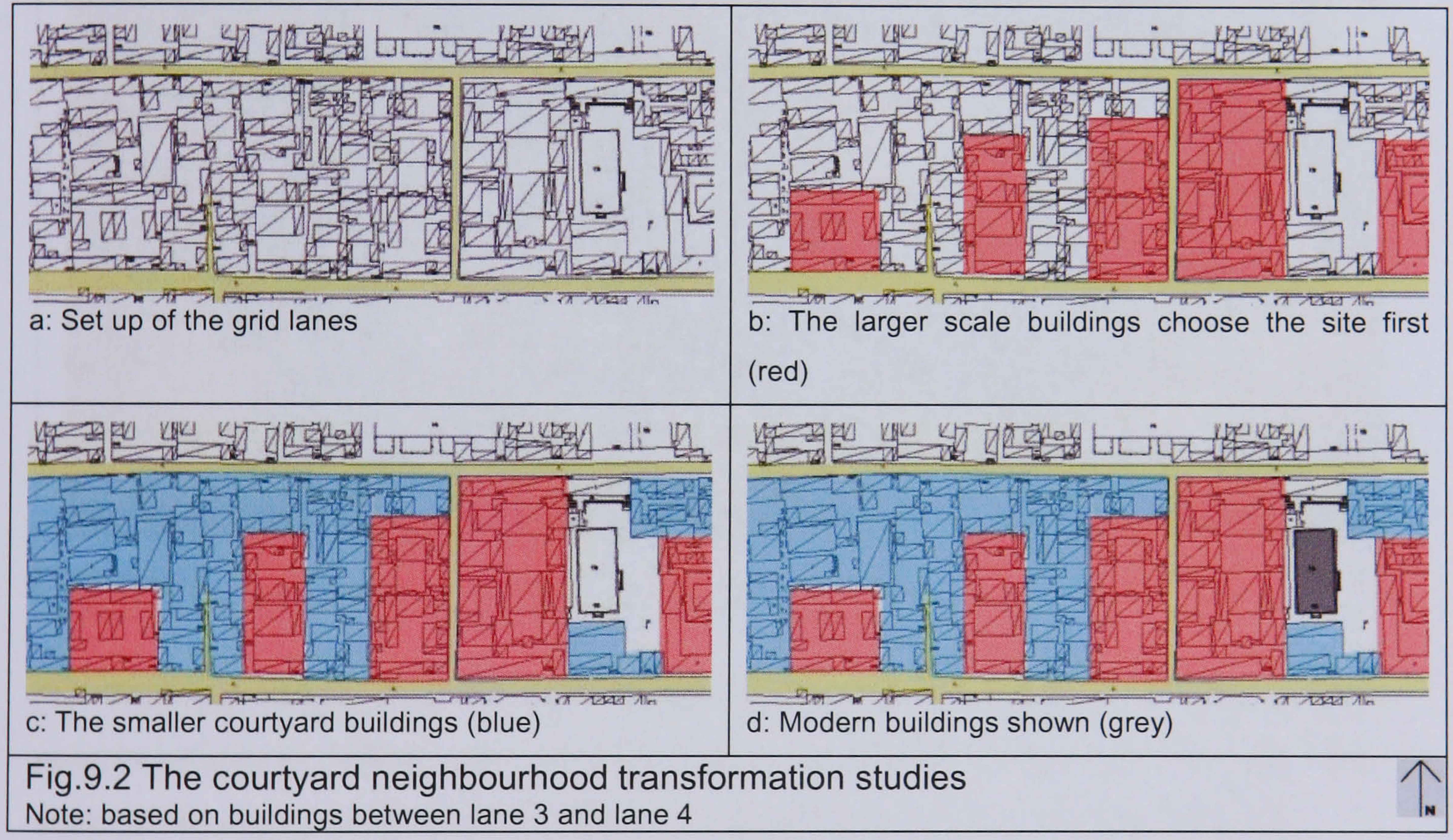


1st to 10th lanes in 2000's
Source: Google Earth, 2003

Fiig.9.1 1st to 10th lane, *Dongsi* neighbourhood
Note: red represents site boundary

As the Chapter five place studies indicated, the relatively stable boundary of Dongsi neighbourhood has allowed the accumulation of the social cultural, physical and economic contexts since the first to fourth lanes were first constructed in the 1420's (Chapter 5). The 1st through 10th lanes have been developed and transformed continuously over the last six hundred years. 'Less than half a century ago, China's cities were walled settlements based on millennia - old architectural and urban design traditions' (Gaubatz, 1999:`495). However, in the last past five decades, *Dongsi* archway and Taoist temples have been demolished; lanes such as 10th lane have been broadened to allow public transport (Fig.9.1); large courtyard building groups such as *FuwangFu* (mansion) have been subdivided, and smaller courtyard buildings have been transformed from the private courtyard dwellings into communal living compounds. Meanwhile, the new building types and extensions have also been built inside the neighbourhood and so on. The building types studies in Chapter 6 indicated that completely new buildings from different cultures have emerged into the neighbourhood since 1900's, therefore, these transformation studies will use this period as the starting point for a historical transformation study of the neighbourhood, which will explain the transformation process. The primary shaping forces from 1900's also help explain the current living environment and suggest the possible future. Following this historical study, are the neighbourhood and courtyard buildings transformation studies.

9.1 Historical studies of the transformation process and primary shaping forces: 1900's-2000's



a: Set up of the grid lanes

b: The larger scale buildings choose the site first (red)

c: The smaller courtyard buildings (blue)

d: Modern buildings shown (grey)

Fig.9.2 The courtyard neighbourhood transformation studies
Note: based on buildings between lane 3 and lane 4

As previous studies indicated, the hierarchal grid lanes were set up first (Fig.9.2: a). In the *Dongsi* neighbourhood, the rich and noble further had the privilege of building their dwellings (Fig.9.2: b). The remaining plots from the standard 8 mu (5336 square meters) were used by the ordinary residents to build the smaller scale courtyard buildings (Fig.9.2: c). Much later, completely new building types emerged into the neighbourhood, which can be traced back to the 1900's (Fig.9.2: d). Obviously, the urban environment of the 1st through 10th lanes is not completely static and has experienced hundreds of years' transformation, and 'when we see the site over time, we can study the changes that occur. This will reveal the powers that act on the site and the ways in which they relate to one another' (Habraken, 1983:14). The focus group materials from the local residents can also help to disclose the shaping forces from the real life context of *Dongsi* neighbourhood which could be traced back to 1900's through memory and records:

Fig.9.3 The new buildings from different cultures in lane 8

(1) The completely new building types from different cultures arrived in the neighbourhood in 1900's when Western culture was firstly brought into the city. The scale of the buildings is similar to that of the existing courtyard buildings (Fig.9.3).

(2) There was important social cultural transformation during the period of war with Japan (between 1930's and 1940's). No 111 of lane 8 was occupied by the Japanese army during this period, and *Songli* dwelling (Nos 63 & 65 of lane 6) were also used by a traitor (Zhang yanqing) during the war with Japan (1937-1945). However, there has been no fundamental change to the layout of the courtyard buildings or the physical morphology of the neighbourhood.

(3) Courtyard buildings started to be demolished on both sides of the main street

from 1950's, which was a response to the transport issues of the time in the old city of Beijing. Meanwhile, landmark buildings such as *Dongsi* archways and the city entrance gates were demolished for the same reason during this period.

Liu (1): ...and the Dongsi Pailou also was destroyed in 1950's, because of the transport problem.

'Since the new regime came to power 50 years ago (1949), large changes have been made in the unique approach to living which grew up over several thousand years in China and whose quality is still manifest in essence in Peking. A new way of life has been superimposed on the old logic of Chinese living, and new values have been mixed in with the traditional ones' (Cameron & Brake, 1965:4). One of the important influencing policies during this period is the 'Maoist city' defined by Gaubatz: 'One of the primary goals of Chinese urban planning after 1949 was to create a new, decentralised and self-sufficient urban form. Cities were to become production centres...places of employment were encouraged to become self-sufficient communities within the city, providing not only work and housing, but also health care, food distribution and other basic social services' (1999:1497). The 'Maoist city' with its emphasis on working and living together has had a strong influence on the neighbourhood; many new uses such as the health care, education, light industry and workshops were brought into the neighbourhood which was mainly based on demolishing poor quality courtyard buildings or transforming residential courtyard buildings to fit the new uses. During this period, the most dominant characteristic of the housing policy was to provide dwellings to the working class who lived in the sub-standard urban slums (see also Chapter one). Therefore, the private courtyard dwellings were transformed into either the smaller courtyard buildings or the communal living compounds to meet the objectives of the socialist government, and this transformation worked well to meet the housing demand (basic living standard). During this process, landscape gardens were demolished for many reasons, e.g., the construction of bomb shelters was the main reason in number 21 of lane 2.

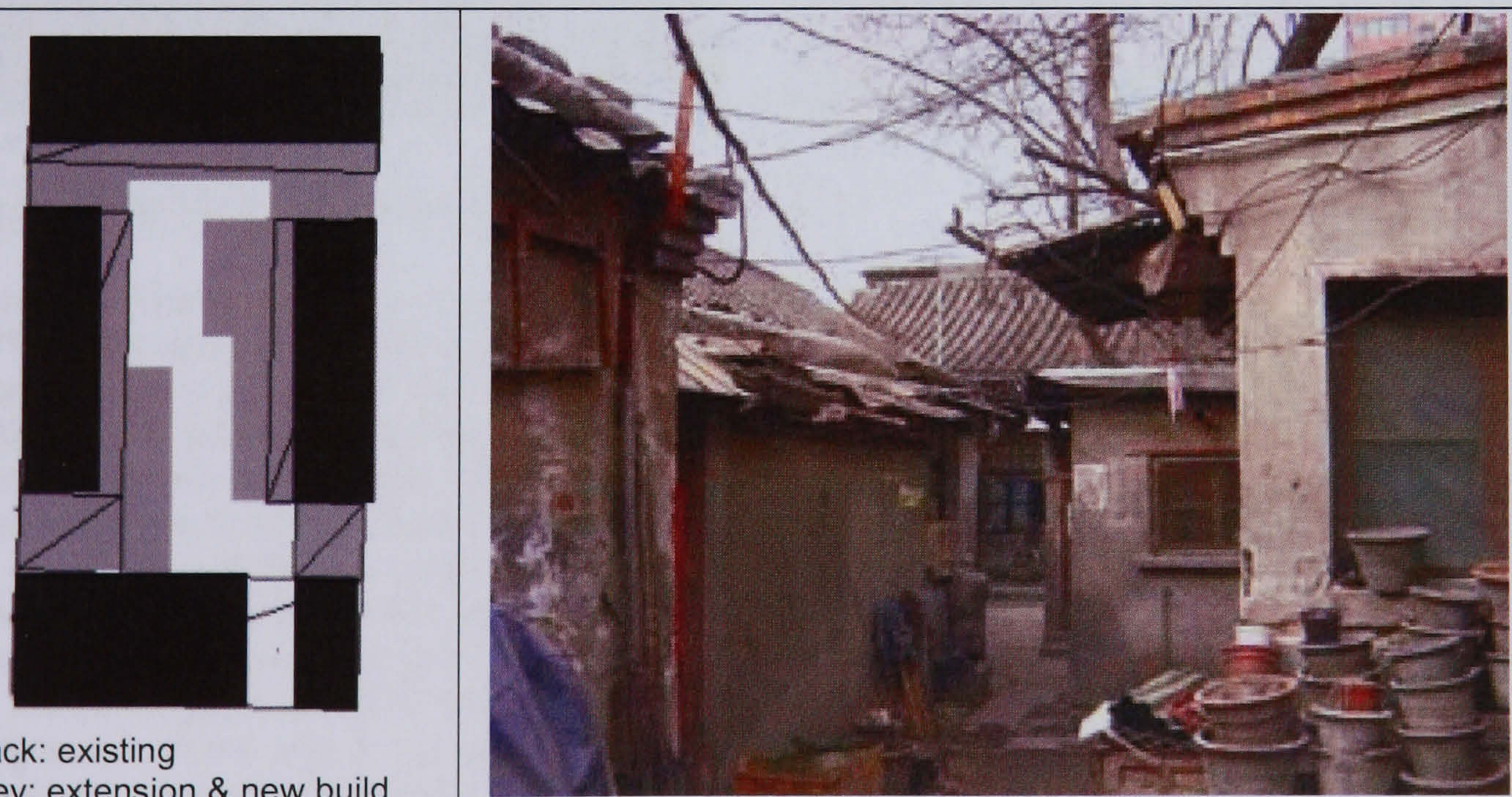
Liang (7): This courtyard belongs to us, we moved here in 1954. It has three main rooms facing south, and then two secondary rooms (ear room). There was a corridor which connected this whole courtyard together. The courtyard was destroyed because they had to dig for the bomb shelter in 1950's.
Rong (7): The landscape was demolished at that time.

(4) The 1960's Chinese Cultural Revolution made the situation much worse. *Fengshui* features such as the buildings' decorations were broadly regarded as superstitious and were generally obliterated.

Zhu (6)…Originally, there were four courtyards here, and the first one was demolished during the cultural revolution, and there are also a lot of detailed changes…

(5) The new construction and extension inside the courtyard mainly started during the 1976 earthquake. During the earthquake period, the temporary buildings were built inside the courtyard and yard, and most of the temporary buildings were kept and transformed into the service buildings such as kitchen, toilet, store room and so forth after the earthquake. However, 'the residential quarters are poorly maintained, overcrowded, and lack amenities. The courtyard houses, which once had been the sanctuary of family life, had been deformed into unsightly shelters shared by several households. Some even crumbled, while others were replaced by apartment blocks' (Wu, 1999: xviii).

Wang (3): Most of the new buildings are kitchens, they were already there before I moved into this courtyard, Mr. Guo should know much more than us.
Guo (3): I moved in 1957, the courtyard was in a very good condition at that time, the corridor, *ChuiHuaMen*(decoration gate), the landscape in the courtyard all is kept as before. Everything has been changed since the 1976 earthquake, we all build the tent in the courtyard to have a safer place, since then, new buildings have been build and used privately.
Yang (4): Most of these new building were built after 1976 earthquake, all the people built their own tent and then transferred into the small buildings. When their children grew up, they moved into these small buildings.
Yang (4): There is not too much change at all, just more and more buildings have been built in the courtyard.
Wang (4): Most of these buildings are kitchens and store rooms; some of them have people living there.



Black: existing
Grey: extension & new build

A view of the internal courtyard

Fig.9.4 A heavily transformed courtyard building located at lane 8
Note: from the IPPR survey, 31.9% of the courtyard buildings are in the same condition

(6) The 1990's government refund policy (the new building and extension floor area is counted as the valued floor area if the resident moves out of the courtyard

buildings to the suburbs of Beijing) encouraged more extension and construction work inside the neighbourhood (Fig.9.4).

Li (3): There is a policy that this new build area could be calculated into the floor area. Government will refund this area as well as the formal floor area if we move out, so people started to build these kinds of buildings quickly.
Wang (4): There is a policy from the government since 1980's, the government will pay this new build area as well as the formal building area if they want the residents to move out, so lots of people have started to build their own buildings like this (Fig.9.4).

(7) During 1990's, lane 10 was widened from an ordinary *hutong* of 9 meters to 45 meters of traffic road in response to the urban traffic problem, but the transformation work destroyed the existing urban patterns and also the traditional urban courtyard buildings. Meanwhile, the tube station construction work on the west end of 1st and 10th lanes has greatly transformed the urban morphology of the neighbourhood (Fig. 9.5).

a: Lane 10 b: West end of lane 1

Fig.9.5 The transformation of the periphery area

Wang (1): There were two important transitions to these buildings as far as I know. One was 1976 earthquake, it destroyed a lot of buildings, and most of the new buildings are built in the courtyard from that time. The other was 1997, when this 10th lane was broadened into the traffic line. A lot of old buildings were also demolished and they also started to build some buildings in the same style, actually, it is not the same one, you see, that one, is not the courtyard style (from the north), that style is from south China (Fig.9.5: a).
Liu (1): That is right, you see (at the front of 10th lane) the tube station (Fig.9.5: b) is under construction in that area, this whole area has been completely changed...
Wang (1): That courtyard dwelling which is located on the left side of the new tube station is the *Meilanfang*(the greatest Beijing opera actor). It also has been demolished, there is just a pavilion left, there was a big garden there before at the site of the tube station. When I was young, we always went there to play.
Liu (1): That pavilion has more than hundred years' history, still in a very good condition, the materials are very good.
Wang (1): You see, this lane (10th lane) changes a lot, the original lane is one meter lower (than the courtyard), and now is much higher. It is even higher than the ground floor of inside the courtyard ground.

All the transformation work should be very carefully carried out with attention paid to the local urban patterns, traditional courtyard buildings, and also should be more sensitive to the local landmarks, gardens, urban nodes, social culture foci, spatial transition points which were identified in Chapters 6 and 7.

(8) After 3rd to 8th lanes were classified as one of the 25 conservation areas of Beijing in 2002, residents chose to move out of the crowded traditional neighbourhood with financial encouragement from the government.

Tian (4): There are also some courtyards with fewer and fewer people; some of the courtyards just have three or four people living there.

Put the fractures and pieces of the courtyard buildings transformation studies of the 1st to 10th lanes of Dongsi neighbourhood together, and we see that the transformation shaping forces on the courtyard living environment include the emergence of a different culture (mainly Western culture in 1900's), the government policies (providing housing to workers and also the 'Maoist city' strategy which emphasised working and living together in 1950's, the Cultural Revolution in 1960's, the refund policy in 1990's, the conservation policy in 2000's), the natural disaster (the earthquake in 1976), the emergence of new uses (modern industry, education, health care) and so on. The identification of the shaping forces can help achieve a better understanding of the following urban and courtyard living environment transformation studies.

9. 2 The urban neighbourhood transformation studies

Currently, the urban structure of the1st to 10th lanes neighbourhood still remains as originally constructed, which includes the hierarchical urban grid street and the series of urban pocket courtyard buildings (Chapter 6). However, the transformation is not just the physical transformation, and between the physical environment and empirically observable human behaviour, there exists a social system and a set of cultural norms (Gan, 1968). Therefore, these neighbourhood transformation studies include the place and also morphology studies which followed the previous urban studies in Chapter 5 and 6.

9.2.1 Place studies

a:Rebuilt buildings and archways

b:Archways facing the neighbourhood

Fig.9.6 Longfusi temple

As Chapter 7 urban studies suggested, there were four social culture focal types that emerged inside the neighbourhood, which included the *Dongsi* archways, temple and temple fairs, *hutong* and also the courtyard entrance gates. However, the *Dongsi* archways were completely demolished in 1950's and the *Daciyan Fugong* Taoist temple was also demolished during the Chinese Cultural Revolution in 1960's. Most of the site has been occupied by the nearby office buildings; only ruins have been left. All the major Taoist statues were also moved out of the temple or demolished in 1960's. The refurbishment works to *Daciyan Fugong* Taoist temple were started in 2003, and the temple has been reopened to the public. However, the influence of the current temple is rather indeterminate to the visitors and even to the neighbourhood, since there is no direct link to the main road (concession space). No religious activities are held inside the temple, no temple fairs have been held, there is no public gathering place and so on. *Longfu Si* temple which was located just outside the neighbourhood, was partly demolished in a fire in 1901, the relic was still used as the most famous religious and commercial gathering place in Beijing before it was transformed into a purely commercial market in 1950. The new multi-storey buildings and the archways were rebuilt in 1990, and used as a modern shopping centre (Fig.9.6). However, in contrast with the original temple and temple fairs which provided important religious, social, cultural and commercial activities to the neighbourhood and even the whole city, the new scheme is not very successful in all these sectors, because the newly constructed buildings, like many other similar schemes only borrowed the traditional buildings elements (see Chapter 2 literature review), but lacking a good understanding of the social, cultural and economic values of the temple and temple fairs. So the new shopping space failed to attract shoppers.

a:Playing cards

b:Gate community

c:Sports facility

Fig.9.7 The street community of lane 8

The transformation of the *hutong* is also significant. More communities have been created inside the *hutong* because of the opening of the front elevations (Fig.9.7), the transformation of the private courtyard to communal living compounds, the emergence of the new uses and so on. The entrance gate is still an important social focus for the neighbourhood, which provides an important identity to the private courtyard dwellings or the compounds (Fig.9.7: b). The social contexts of the entrance gates may have vanished, but they are still the ideal place for local residents to gather, relax, chat, and also for visitors to stop and explore the history of the courtyard buildings and so on. However, the increasing use of cars has a negative influence on the communities at *hutong*.

Taken as a whole, this part of the place studies has generally examined the new modern uses, obsolete traditional uses, social cultural contexts and also their influence on the courtyard living environment. The disappearance of the urban social, culture and economic generators that helped to achieve the coherence of the urban space and the transformation of the private courtyard to the communal living compound are the main characteristics of this transformation of urban space.

9.2.2 The morphology transformation studies

The historical and place studies of *Dongsi* neighbourhood have helped to identify the primary shaping forces and the transformation stages, and also the major social cultural changes. This part of the study will go further to focus on the morphological changes of the neighbourhood which include plots, building types, uses, streets, and spatial hierarchy.

9.2.2.1 The plot patterns

Following the emergence of the new building types, new uses, the demolition of old buildings and also the sub-division of the large courtyard buildings, the plot sizes have been changed and largely contrast with the traditional plot size which was based on the 8 *mu* (1mu=666.7 m^2) for a standard family courtyard (see also Chapter 9.3). However, as the previous studies suggested, the urban structure is still kept as before, which means the distance between two lanes is still kept as the original, and the plot size transformation is mainly limited between lanes. However, the plot size of the modern buildings which are located on the periphery of the neighbourhood is not clearly regulated, but the new office buildings have been limited to the lane 1 and lane 10 area, and to the west and east end of the neighbourhood.

9.2.2.2 The uses

Currently, one story courtyard houses and modern multi-stories flats (60.25% ground floor area, 3rd to 8th lanes) are the dominant uses in the neighbourhood. From the survey, we can see that the uses include the museum, office, education, hotel, commerce, recreation, light industry, workshop, and multi-use.

NO	Uses	Ground floor area (ha)	Percentage (%)
1	Residential (normal)	28.8973	59.2
2	Residential (special)	0.5109	1.05
3	Education	2.0907	4.28
	Toilet	0.1843	0.38
4	Office	3.0163	6.18
5	Commerce	0.546	1.12
	Hotel	0.7544	1.55
6	Recreation	0.2381	0.49
7	Sport	0	
8	Health care	0.1883	0.39
9	Religious	0	
10	Museum	6.0399	12.38
11	Industry	0.33	0.68
12	Store	0.0274	0.06
13	Public parking	0	
14	Water	0	
15	Multi-use	0.9472	1.94

Table 9.1 The uses survey of 3rd to 8th lanes, *Dongsi* neighbourhood[1],
Sources: Based on the survey from IPPR international design in 2003

[1] The preliminary surveys from IPPR mainly focus on the 3rd to 8th lane (most of the courtyard buildings at 1st, 2nd, 9th and 10th lane have simply been demolished and transformed into modern architecture), *Dongsi*, this area is one of 25 conservation areas in Beijing.

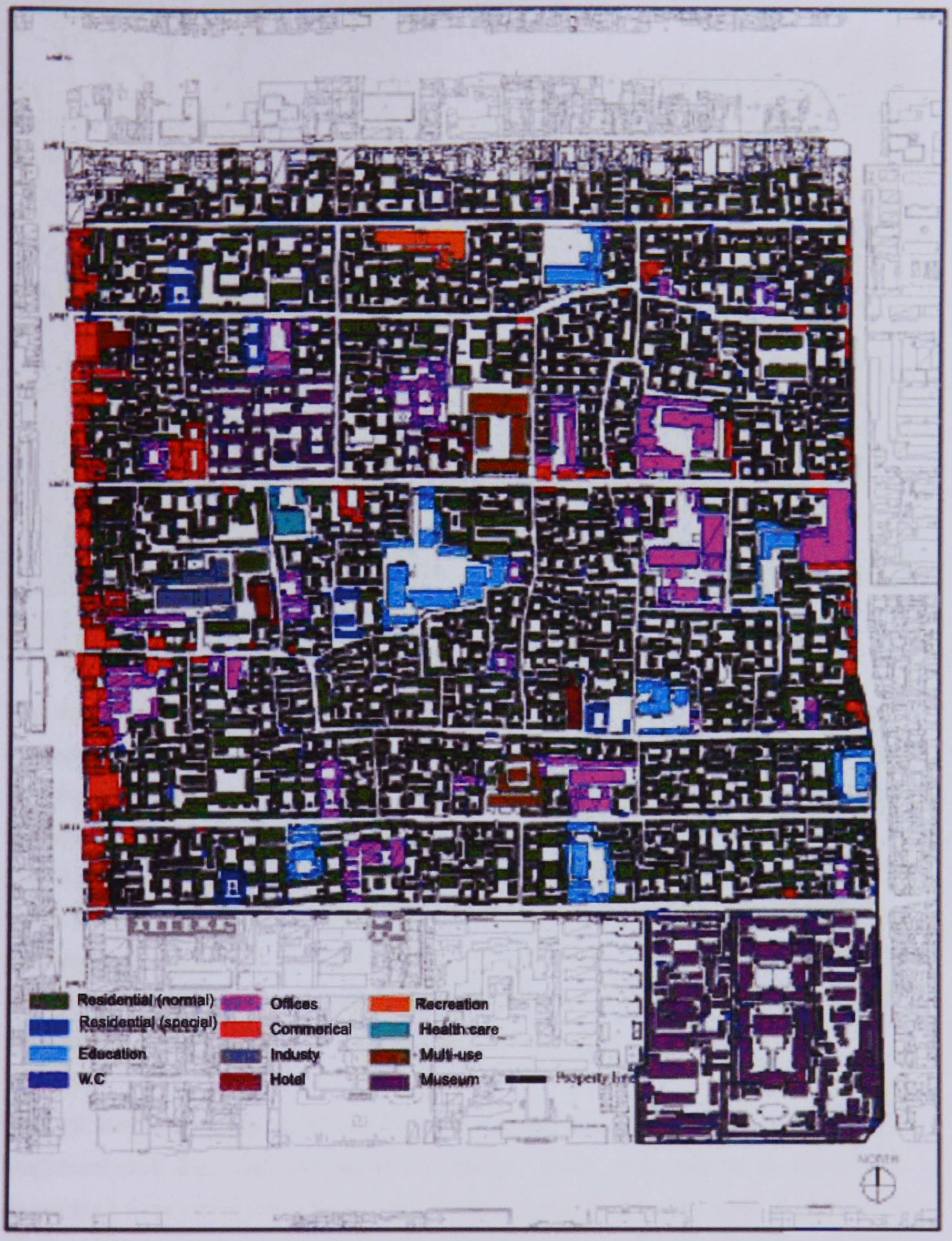


Figure 9.8 Uses, based on the IPPR survey from 3rd to 8th lanes, Dongsi, 2003
Scale 1:5000

A: Dongsi Beijie

B: Local shops at lane 8

Fig.9.9 The local shops

The survey reveals that only 1.05% of the ground coverage area is of good quality courtyard buildings which are still used by one family and are closed to the public. This figure shows that the neighbourhood is still a mixed community which includes the rich and poor, ordinary and noble (Fig.9.8), but the roof types and the entrance gate types have lost the social status indication uses. The living museum (12.38%) which transformed from the good quality of the courtyard buildings (still used as dwellings but open to the public) occupied the second place on the table, such as the *Fuwang Fu* (Mansion), *Songli* (noble) dwelling, *Saqianli* (painter) dwelling, Yeshengtao (writer) dwelling and so on (Fig.9.8, Table 9.1).

Most of the commercial buildings (Fig.9.9: A) are located at the periphery of the neighbourhood and can be easily accessed, which has helped to achieve a convenient living environment, and the inner hutong shops also help to achieve a good standard of living (Fig.9.9: B). Meanwhile, lane three -'morning market'- provides a place for convenient shopping and also social gathering (Fig.9.10). Therefore, the *hutong* not only functions as the pedestrian road but also hosts social activities and commercial uses as well.

Fig. 9.10 The three morning market lane

The light industry, workshop, education, hotel, restaurant, office, retail, commercial, entertainment, middle school, college, primary schools and nursery schools and so on inside the neighbourhood have brought new building types such as the modern multi-storey buildings (see the following section 9.2.2.3).

9.2.2.3 The buildings types

The previous studies have indicated that one Western style dwelling was developed at lane 8 in the nineteenth century (Fig.9.11: a). The height and scale of this building are similar to those of the nearby courtyard buildings, which have helped to enrich the diversity of the neighbourhood. There are also some new poor quality low rise modern buildings along the lanes (Fig.9.11: b). These buildings are basically built without any attention to design, and are mainly commercial buildings. The quality of these buildings needs to be improved although they have helped to create a mixed-use and convenient neighbourhood. The birth of the high-rise apartment and office buildings have deeply disturbed the traditional courtyard building living environment regarding the buildings' shape, scale, proportion, ornament, colour and material characteristics (Fig.9.11:c). The architects of some of the high-rise buildings of the neighbourhood have tried to work in harmony with the local environment (Fig.9.11: d), but high-rise buildings normally have a negative effect on the microclimate of the nearby courtyard buildings, particularly if they are located in the southern part of the groups (the direction where the mild sun and wind come from).

a: Western style low-rise building

b: Low rise poor quality commercial modern buildings

c: High-rise modern buildings

d: Old and new

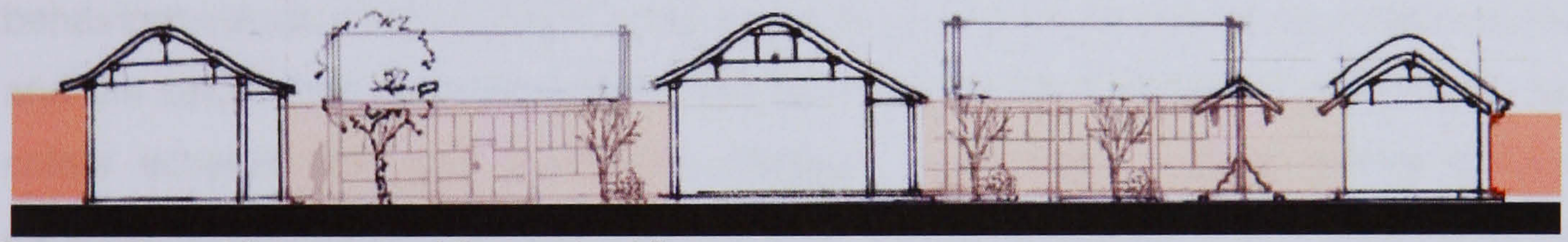
Fig.9.11 The transformation of the buildings

9.2.2.4 The streets

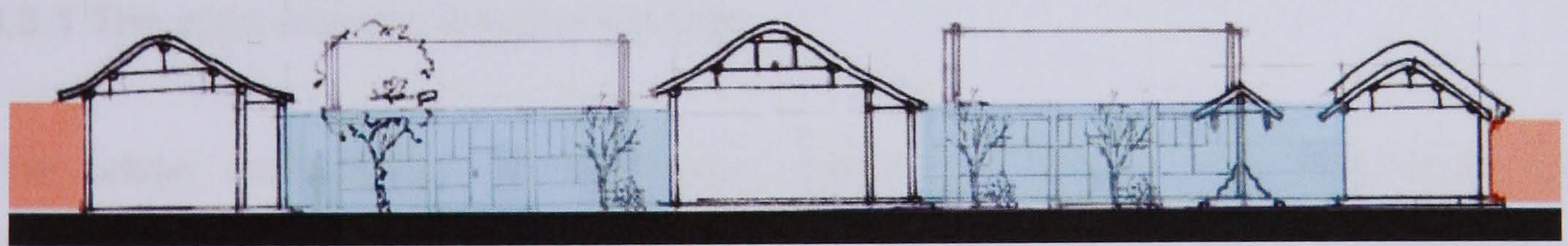
As the previous studies indicated, modern transport issues have imposed a huge pressure on the transformation of the streets, and the widening work on 10th lane which transformed the ordinary *Hutong* into the main traffic road in Beijing in 1990s was one of the impacts of the modern transport system. Following the boost of the Chinese economy, more cars have flooded into the neighbourhood, and more traffic problems have been generated, therefore, 'one of the most fundamental outcomes of the restructuring of cities is its impact on transport' (Gaubatz, 1999:1507). The other important impact on the neighbourhood is the street parking, which has had a negative influence on the street communities. However, the corner shops, offices, retail buildings, restaurants, hotels and so on all help to counteract this negative effect.

9.2.2.5 The spatial hierarchy

As Chapter 8 studies suggested, the spatial transition of the traditional urban space normally starts from the city gate/archways to the public roads, from public roads to *hutong* and then to the private courtyard buildings. Currently, the spatial hierarchy of the transformed urban space basically starts from the traffic roads to the *hutong*, from *hutong* to each courtyard building group, and if the courtyard buildings have been transformed into the communal living compounds, the courtyard/ yard provides an extra spatial transition before arriving at the private home. Therefore, the archways/city gate, the concession/front yard of the temple transition points have diminished, but the courtyard/yard may create a semi-public communal space in the historical urban space (Fig. 9.12).



Current: the public space and the semi-public space



Traditional: the public space and the private space

Fig. 9.12 The spatial transformation, no 21, lane 2
Note: red: public space; pink: semi public space; cyan: private space

9.2.2.6 Summary

This neighbourhood transformation study has classified the transformation stages and also primary shaping forces from 1900's to 2000's through the historical and place studies. The morphology studies furthermore helped to identify the physical changes of the neighbourhood. The plot studies indicated the subdivision of the large plot process, the uses studies suggested a transformation from the residential to a mix-uses living quarter. Building studies indicate that new building types such as the buildings from different cultures and modern buildings have been brought into the neighbourhood while the traditional building types such as the archways and temple buildings have been demolished. The function of the streets and lanes has also been transformed to fit the demands from the modern transport system. The spatial hierarchy of the neighbourhood has also been transformed; the semi-public inner courtyard/yard communal space may be created while the archways and public yards have vanished. Generally, because of the emergence of the modern buildings types, modern traffic and the disappearance of the archways and also the temple, the place has become more isolated from the outside neighbourhood environment both physically and social culturally. The urban fabric has also been strongly shaped by the emergence of modern buildings and also the modern traffic.

9. 3 Courtyard buildings transformation

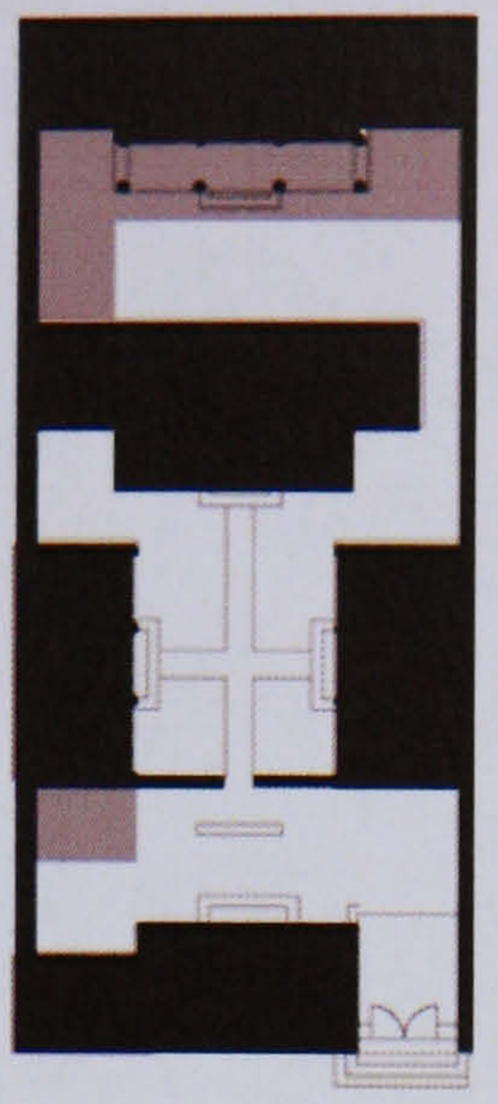
Following the traditional courtyard typologies studies in Chapter 7 and 8, the courtyard buildings transformation studies will include the plan studies with the social behaviour values, the structural studies with the architectural design economic values, and the section on typology with the physical environment values. Furthermore, the colour scheme that was studied in Chapter 7 has nearly lost its whole cultural meaning in the current neighbourhood and on the buildings. This colour scheme should be restored to the neighbourhood for the conservation work.

9.3.1 The plan transformation studies

The urban morphology transformation studies of *Dongsi* neighbourhood have suggested that more families and the new uses such as the parking, health care, education, office, hotels, light industry and also high rise residential uses have been brought into the neighbourhood, and these new uses have transformed not just the morphology of the neighbourhood, but also the social behaviour of the residents. Therefore, this part of the studies will focus on the plan with the social behaviour transformations.

Wang (4): The courtyard has changed a lot; some of the big courtyard has been divided into several separate courtyards with different entrances.

a: The extension of the verandah at the back yard



b: Plans
black: existing
grey: new build

c: The new building in the front yard

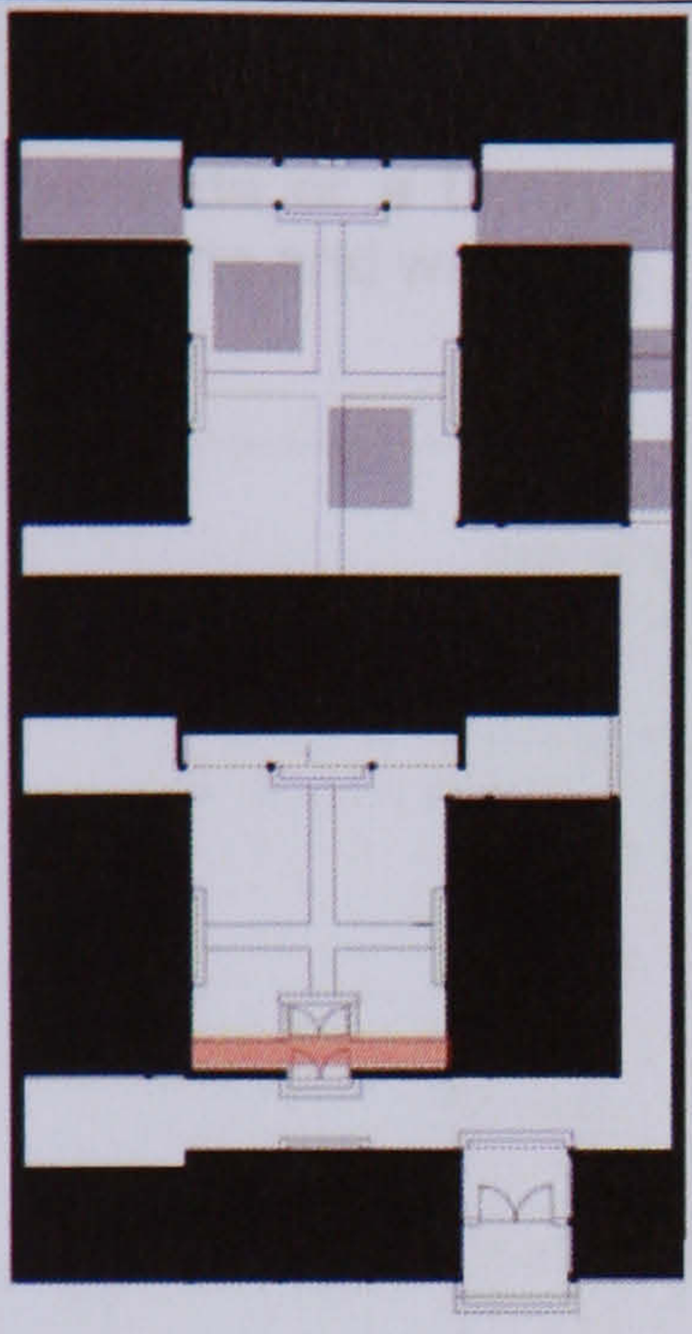
Fig.9.13 The extension of No 129, lane 8

One courtyard unit: No 129 of lane 8 has been transformed into a four family living compound. The front yard and buildings are for two families, the inner courtyard for one family, and the back yard for one family (Fig.9.13).

Zhang (2): Here are four families; we all work for the airlines. This courtyard has not changed a lot as not many people live here, particularly the central courtyard, just one family lives there, it's still in a good condition.
Wang (2): We have combined the living room and the corridor to make the room a little bit bigger, and we have built a new kitchen on the right side of the yard.
Zhang (2): The ceiling of this house has been changed, the wooden ceiling was destroyed during the nineteen seventies earthquake, and we changed it into the concrete ceiling.
W (2): They are people with higher social status, they even have their own garage, and they have transformed one room at the front of the courtyard into a garage (Fig.9.13).

Two courtyard units: No 21 of lane 2 courtyard buildings group has been divided into three parts; the front yard and buildings, the first courtyard and buildings and the back courtyard and buildings. Furthermore, in each part of the yard, courtyard and the buildings, there is the possibility for more than one family to live the same unit. From the survey, we can see that there are two families for the front yard and building, one family for the first courtyard and buildings, three families to the second courtyard and the buildings (Fig.9.14).

Rong (7): Our dwelling is of three bay main rooms with the secondary two rooms which face south and we have transformed some part of the corridor into our kitchen. The main rooms have not been changed (Fig.9.14).
Zhang (7): This courtyard dwelling has three courtyards, the first one is very small, the second one belongs to a family who came back from Taiwan, and this courtyard belongs to us. We have not changed much about it, it's still in a good condition. I think if we really want to protect the courtyard, the best approach is to return it to the original owner or buy it from the government, otherwise, it is very difficult to protect it.
Liang (7): I think the main change to this courtyard dwelling is that the dwellings have been divided into three parts, the front courtyard dwelling, the central courtyard dwelling and this one.(the back courtyard) (Fig.9.14).



a: The plan, black: existing
grey: extension & new build
red: demolish

b The new buildings inside the second courtyard

c The extension of the verandah

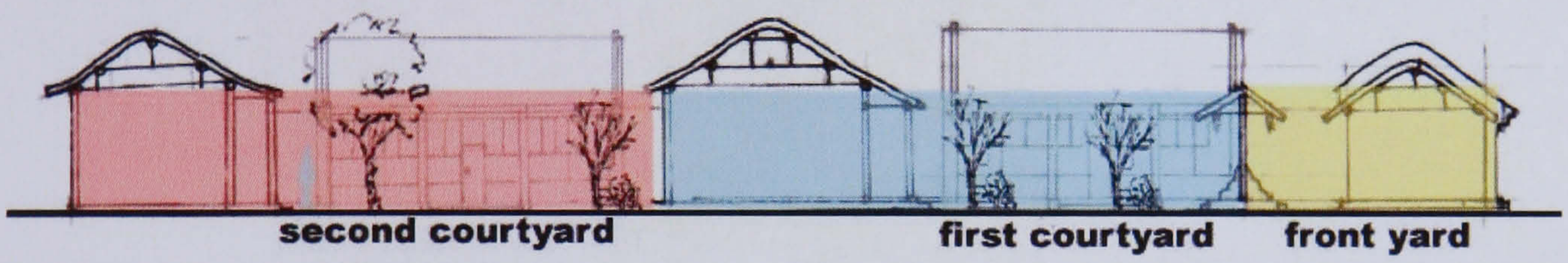
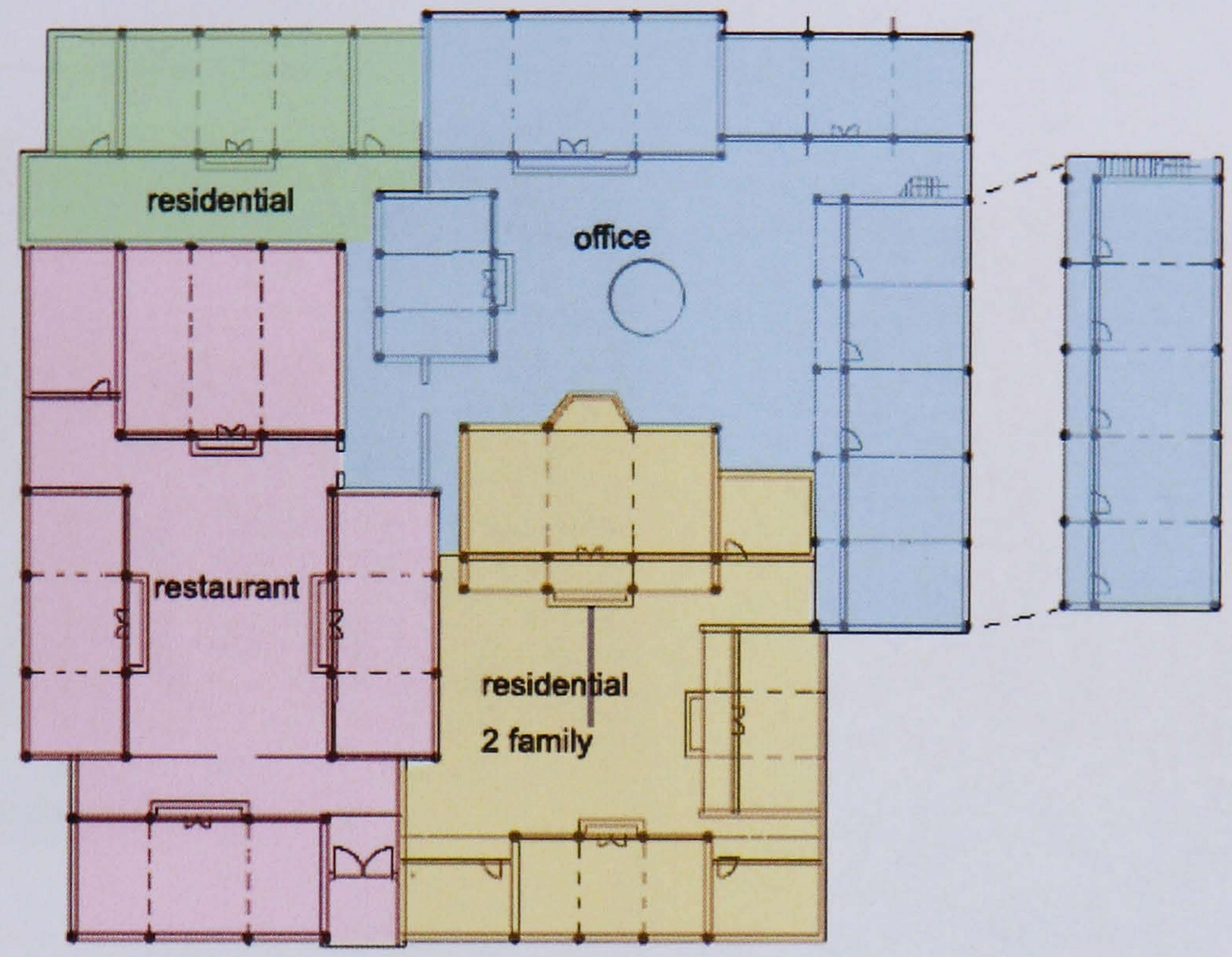


Fig.9.14 The extension of the courtyard buildings (no 21, lane2)

Three courtyard unit: Nos 51 & 53 of lane 6 courtyard buildings group has been divided into four parts. The left part of the buildings group has been transformed into a restaurant (Fig.9.15: a) and the left back yard and buildings have provided the accommodation for the restaurant staff. The right back courtyard has been transformed into a landscape studio office (Fig.9.15: b). The front right buildings and courtyard are still kept as a residential dwelling but have been transformed for two families (Fig.9.15: c). Regarding the details of the buildings transformation, the front elevation of the restaurant buildings has been opened up to lane 6 with large windows, and the new elevation is completely different from the original closed front building (Fig.9.15: d). However, this transformation has not touched the structure of the front buildings, all the transformation work is based on transforming the front non-loading enclosure wall into the larger windows.

Tian (5): This dwelling is kept very well, particular the front and central courtyard, no new building has been built. However, toilet and shower room have been added, this is quite different from the ordinary courtyard dwellings. One new building has been built inside the backyard, however, it's still in a good condition. Oh, the windows have been changed; the old windows have all kinds of style, normally they are made of wood and rice paper, very traditional. You see, it has been upgraded with glass now.

Zhu (6): ... Originally, there were four courtyards here, the first one was demolished (during the cultural revolution), and there are also a lot of details transformations, however, there are no new buildings in the courtyard, this is quite different from other courtyards. You see, every main room has a private toilet, and also the corridor has been transformed into an enclosed veranda or a family library, it is a nice place to be here, it is a place for eating, reading, chatting and watching TV, and the right hand room is for the servant to live.




a: Restaurant


b: Office


c: Dwellings

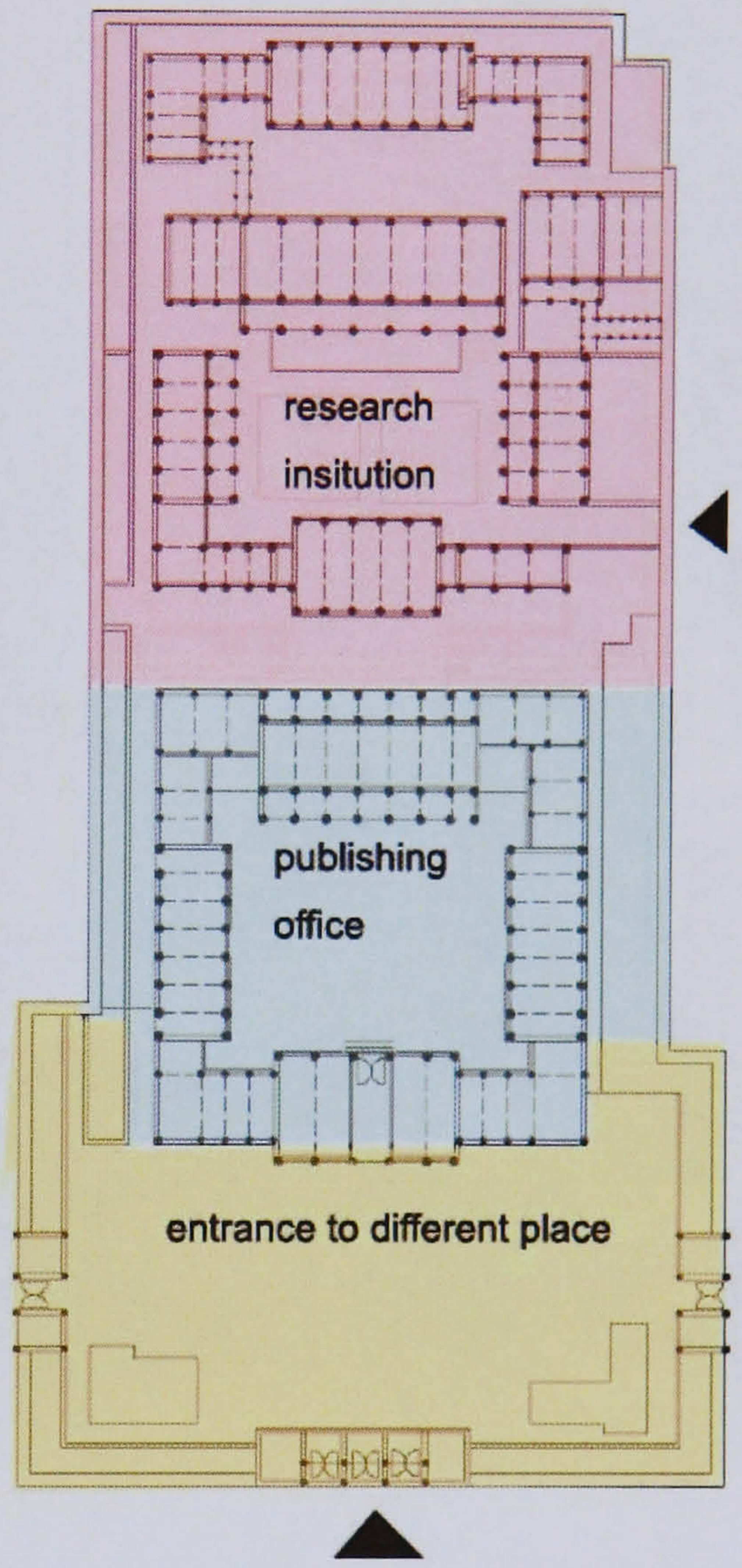

d: Entrance

Fig.9.15 The transformation of nos 51 & 53, lane 6

***Fuwangfu* mansion:** Currently, the central formal buildings group has been divided into three parts, the transport transaction part inside the first yard, the publishing house in the second courtyard, and the research institution inside the third, fourth and fifth courtyard buildings unit (Fig.9.16).

a: The new entrance which is located in the eastern part of the buildings group

b: The main entrance which is located in the south central part of the buildings group



c: The *fuwangfu* mansion plans, the blue colour represents the publishing house, brown represents the institution

Fig.9.16 The transformation of *fuwangfu* mansion

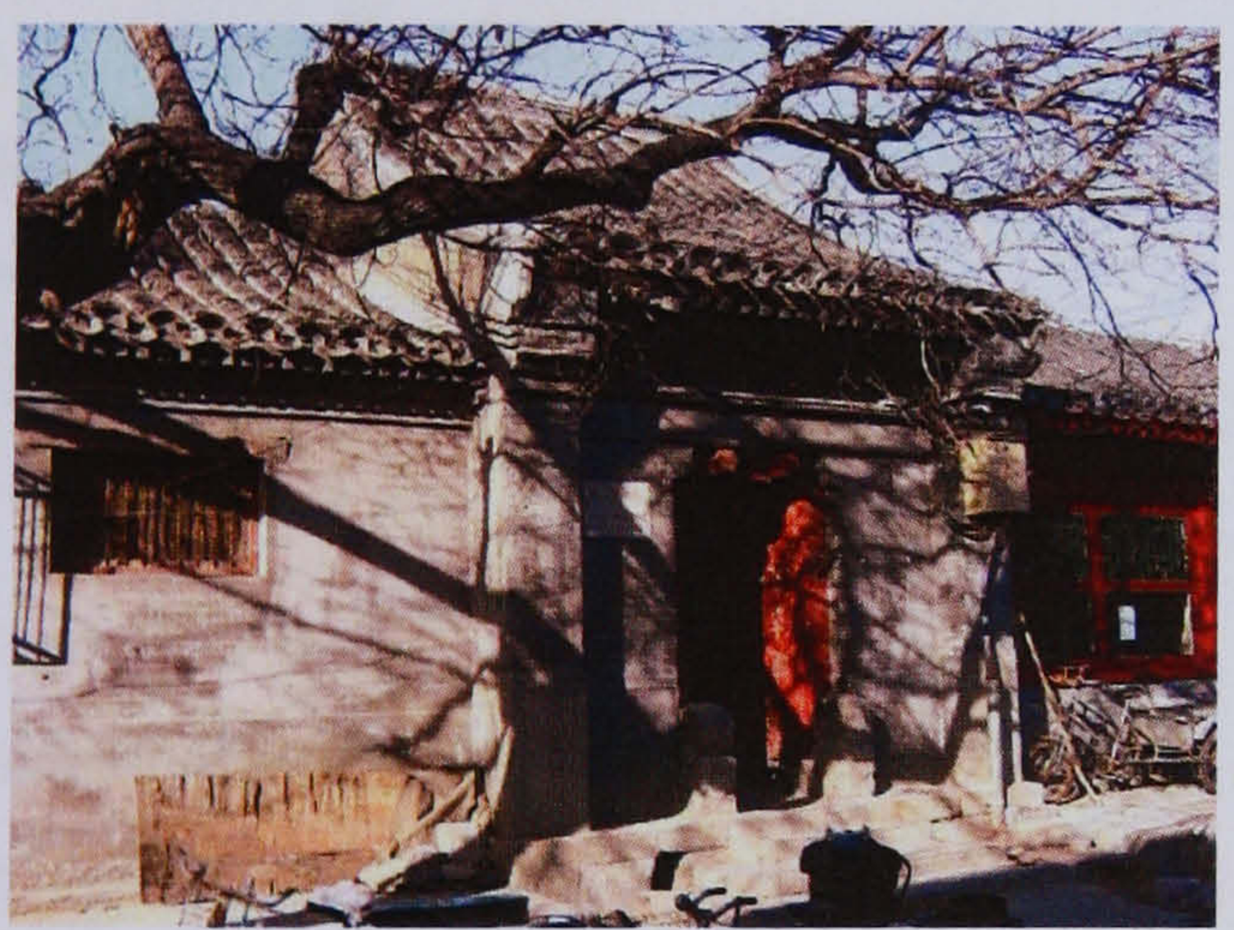
From one family to multi-family courtyard living, transformation has helped to create a semi-public space inside the courtyard/yard which has encouraged communication among neighbours. However, this transformation has not followed the Confucianist 'family order' values, the communal 'cell' of each yard and the courtyard has replaced the family 'cell'. though, there are still a small number of private courtyard buildings which have still kept the original plan layout. The secondary buildings such as the verandah, and the 'er' (ear) room have a great potential to be transformed into a living room, modern kitchen, toilet and other service rooms (Fig.9.17). These need to be upgraded, particularly the private courtyard buildings (no 111 of lane 8), by, for example, changing the wood rice paper of the windows into glass, installing modern facilities such as toilets, kitchens, drainage systems, garages and so on which improve the living quality of the courtyard buildings.

Fig. 9.17 Transformation of the verandah into an enclosed living space in no 111 of lane 8

The yards/courtyards have a great potential for transformation for the courtyard dwellings, which leave the decision regarding the open space up to the resident. From the previous plan studies, we can see that the main transformation process of the courtyard building is to sub-divide the buildings groups into small units, and then build the new buildings and extensions inside the yard and courtyard. Courtyard buildings groups, the yard and courtyard units are normally separated by the walls, and connected by the decoration gate, ear room, or the aisle (see Chapter 7.3). This layout also allows the potential transformation work to be easily carried out with minimum effect on other parts of the buildings. Meanwhile, the yard, courtyard, the secondary buildings, the internal open plan layout of the buildings all make it easy to fit the new activities/functions into the courtyard buildings groups. From the survey, we can see that *Fuwang fu* mansion, number 39 of lane 8 and partly numbers 51 & 53 of lane 6 have been transformed into office buildings. Numbers 51 & 53 of lane 6 have been partly transformed into the restaurant, and other new uses such as the hotel, health care, education, commercial, retail and so on have been brought into the courtyard buildings. The previous studies also suggested that the current density of the neighbourhood started to decrease with the clearance of the extensions and new buildings inside the yards and courtyards when the conservation work started in 2002.

9.3.2 The structural transformation studies

The Chinese beam-column framed structure means that much of the observed transformation work has a limited influence on the buildings, which for example gives the front and back buildings the potential to be opened up to the public lanes, but has no serious influence on the living quality of the main courtyard. Opening up the front and back buildings to the lanes will help to bring new uses and front activities to the *hutong*, and will also help to enrich the vitality and create the personality of the courtyard buildings.



Right: restaurant, lane 3

Right: a garage, Lane 3

Fig. 9.18 The transformed front buildings

From the survey, we can see that the front buildings of number 129 and 71 of lane 8 have been transformed into garages without touching any major structure of the building groups. The only work that needs to be done is to demolish the nonload-bearing enclosure walls (Fig.9.18). The verandah on number 111 of lane 8 for example, can be easily transformed into a living room by building an enclosure wall outside the verandah. The main room behind the verandah can be easily extended by moving the non-bearing wall into the front of the verandah, as number 129 of lane 8 did. The internal open plan layout of each building means the transformation work can be easily carried out. Meanwhile, the Chinese structure and modular system also make it easy to repair and to replace the existing structural elements.

9.3.3 The section transformation studies: response to climate

The section typology studies in Chapter 8 have suggested that the courtyard, yard, and the buildings together can achieve a good quality of natural light, ventilation, humidity and so on. What is the influence of the new extension, construction and the transformation to the courtyard buildings' comfort level? This part of the study will briefly examine the effect. The focus group interviews will help to collect the current residents' view of the comfort level of the transformed courtyard and the buildings.

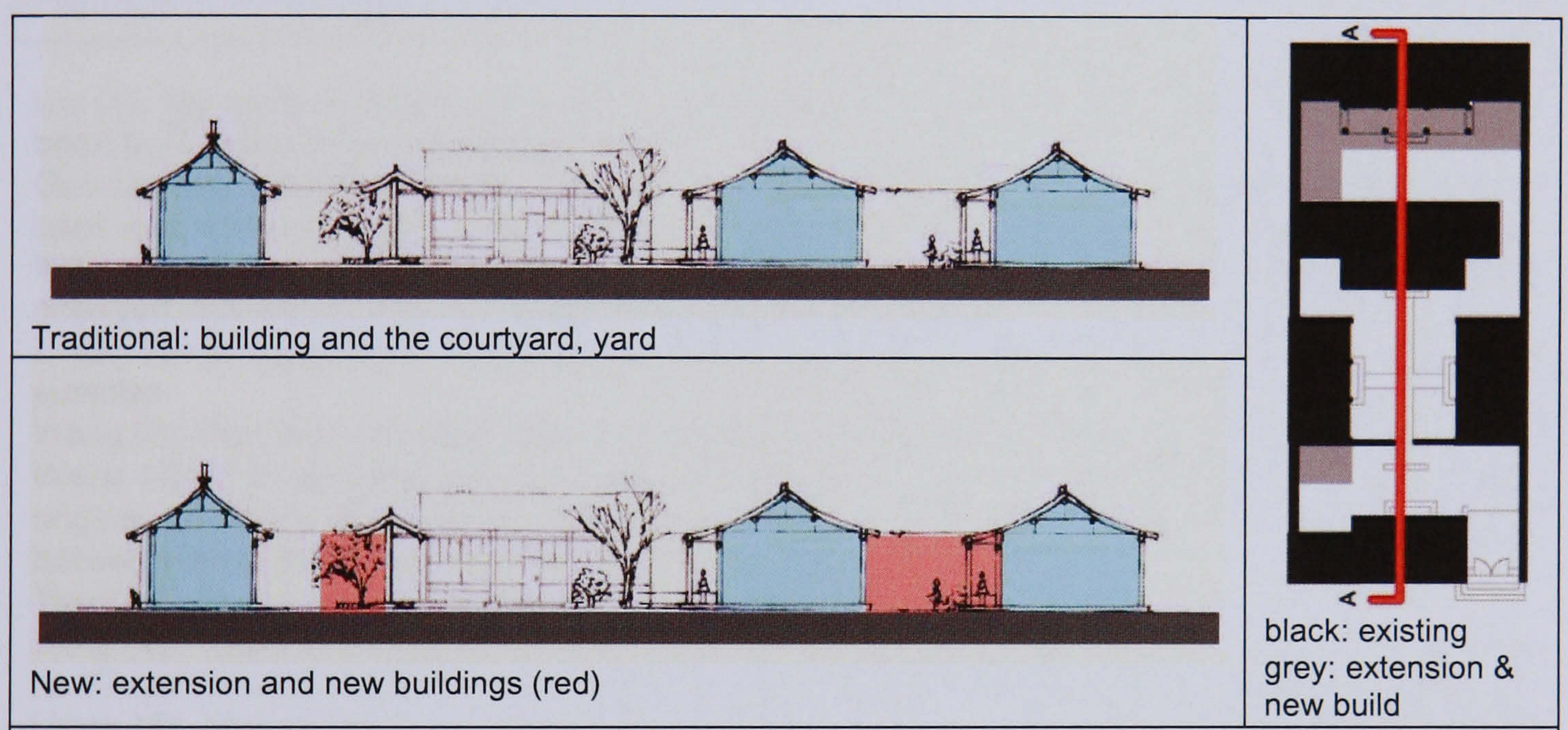


Fig. 9.19 One courtyard unit: No 129, lane 8

From the focus group materials, we learn that the residents generally think the new extension, and the construction of the buildings inside the courtyard yard have blocked the natural sunlight, ventilation, have caused the humidity problem, and that the effects on the back yard and the front yard are particularly serious.

Zhang (2): Not a very strong natural light here, you know here is the backyard, maybe this is the reason. Particularly, during the winter, there is almost no natural light at all. The summer we can feel a little bit at mid-noon, so it is very cool during the summer.
Wang (2): She is right, the natural light is not enough, you see, I have put all my flowers at the higher level to let them get the natural light.
W (2): The problem may come from when we enlarged the room and occupied the corridor, so the yard is much smaller than before, anyway, it has been changed a lot (Fig.9.19).

The extension inside the main courtyard will block the sunlight and also decrease the natural ventilation which is generated by the front and back yard during the summer, and also will create a damp problem because the evaporation strategies are not working (see

Chapter 8.2).

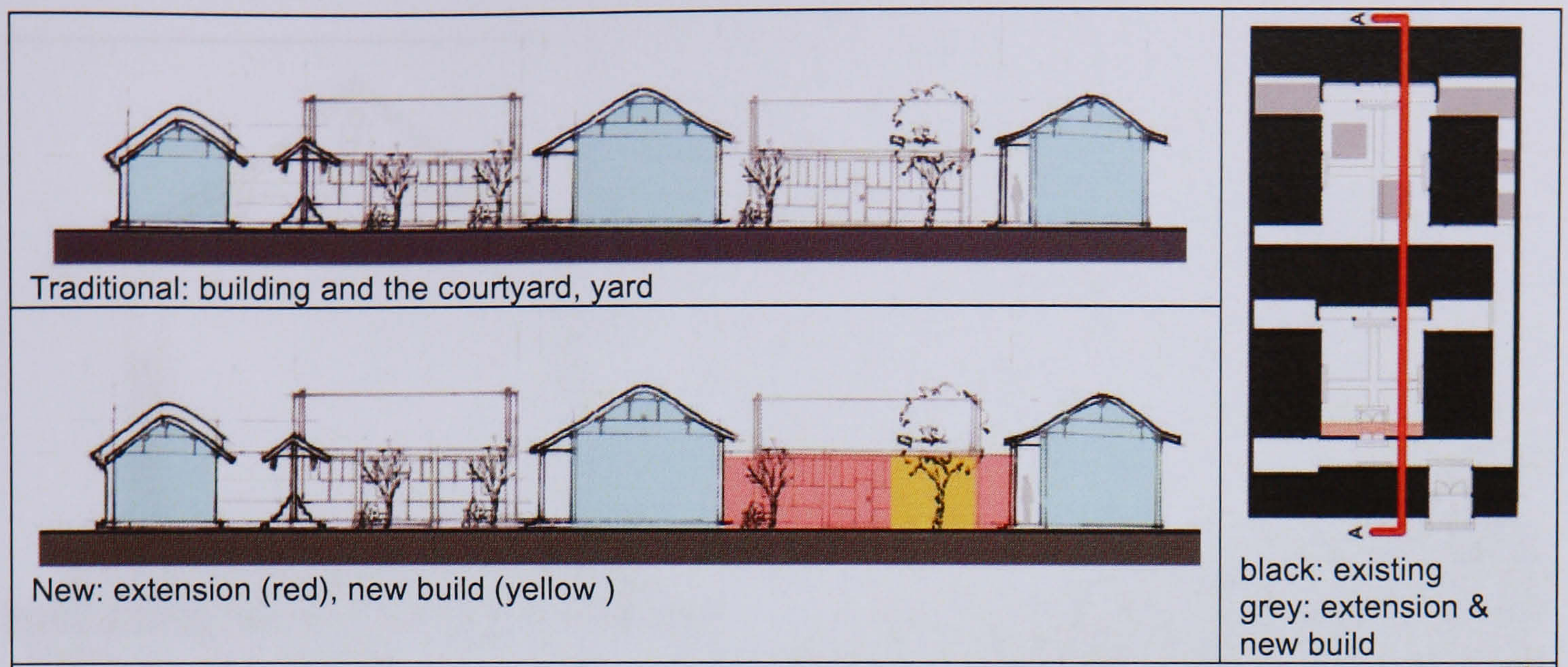
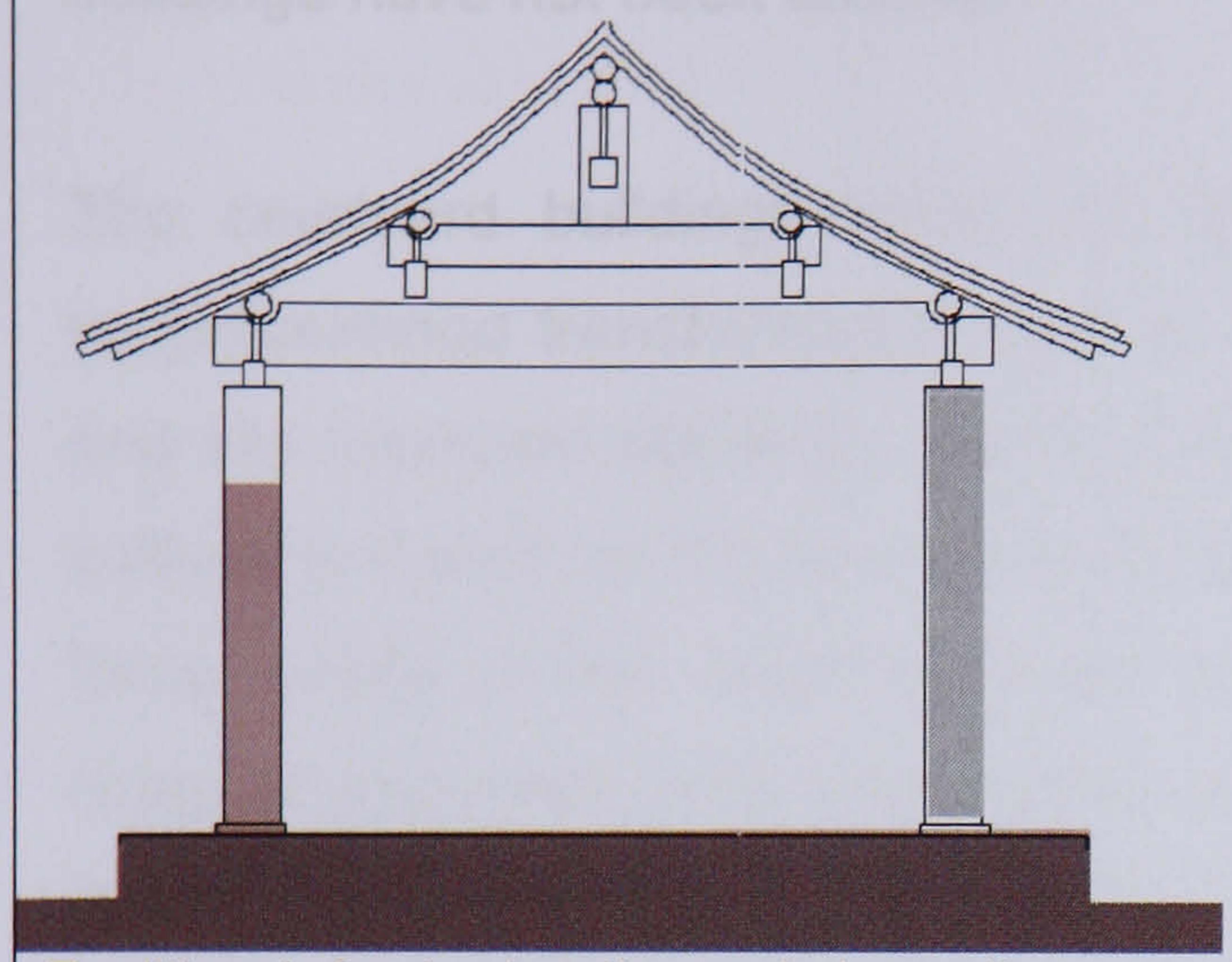


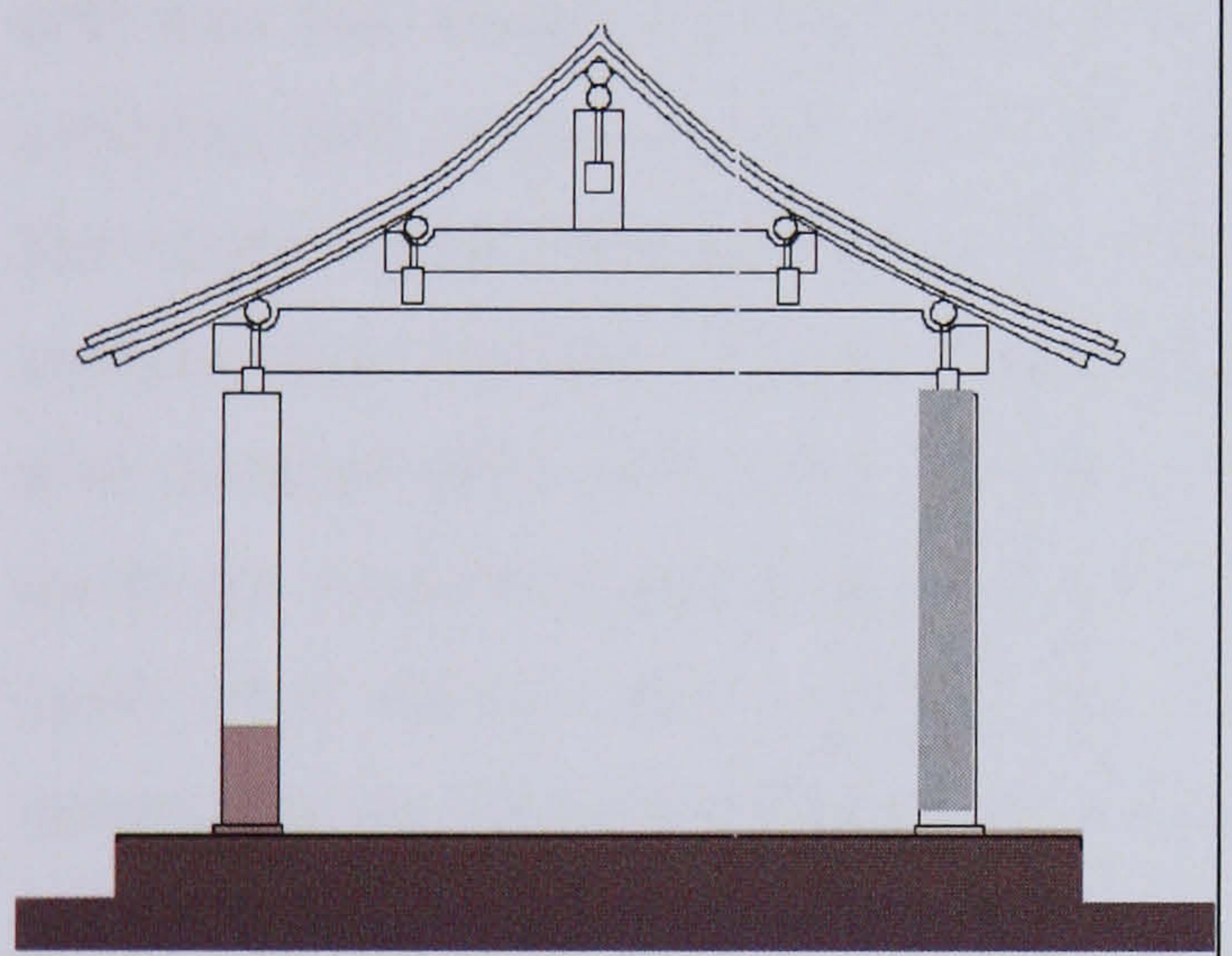
Fig. 9.20 Two courtyard unit: No 21 of lane 2

Liu (1): My room is facing east, so it is not very good, and also a lot of new buildings have been built, there is no natural light at all.
Guo (3): My dwelling is facing south, it has a large window and natural light can access the back wall of the room, and the ventilation is also very good. I feel it is very comfortable, since the new kitchen has been built in the front and back of my house, everything has been changed, there is almost no natural light or natural ventilation.
Li (3): He is right, there is almost no light or ventilation and also it's very damp during the summer.
Wang (3): We have to install the air-conditioning and electric heating, the bill is very high.
Wang (4): It is all because of the new buildings occupying the courtyard. The light in the original courtyard dwellings is good, and if there is just a small gap (after transformation) between the buildings, where could the natural light come from?
Tian (4): There is no courtyard at all and no ventilation either.
Yang (4): Today's courtyard is like a labyrinth, residents build everywhere they can. There is no 77, as I went there to visit my friends. I could not find the exit route, it is very funny, isn't it?
Liang (7): This dwelling is 'winter warm and summer cool', but just for the south orientated rooms. Currently, the new buildings such as the kitchen occupy the courtyard place, block some of the natural sunlight and also reduce the natural ventilation as well (Fig.9.20).

However, the sub-division of the multi unit courtyard buildings group into smaller courtyard units basically has no significant effect on the living quality of the courtyard buildings, because none of the five basic buildings and building elements of one *Yuanluo* (courtyard buildings) unit have been transformed during this process. However the large courtyard buildings can be easily transformed into smaller courtyard buildings. The extension and construction works inside the first (front) yard have a limited effect on the comfort quality of the main courtyard buildings group, but this transformation will influence the microclimate of the main courtyard, the front and back yards which normally act as the cool containers for the main courtyard during the summer (see also Chapter 8.6, the section typology). The transformation work on the secondary buildings such as transforming 'er' (ear) buildings into the kitchen and toilet room have actually improved the living standard inside the courtyard buildings and have no significant effect on the physical living environment. Furthermore, opening up the front and back elevation also gives the buildings better natural sunlight and ventilation (Fig.9.21).



Traditional front elevation: whole wall or small windows



Transformed front elevation: open to the public

Fig. 9.21 Opening up the front elevation, Nos 51 & 53, lane 8

9.4 Conclusion

As the above transformation studies indicated, many factors have been identified as the shaping forces in the transformation work on the neighbourhood, which includes the planning policy, influence from different cultures, upgrading, natural disaster and so forth. From the historical studies, a transformation cycle of the courtyard living environment could be identified as follows: the 8 mu (5336sqm) plot size was first used by the rich and noble to build their dwelling, the plots left were used by the ordinary residents. As time went by, the large courtyard buildings were divided into smaller courtyard unit to hold more families, and then extension work was carried out from the secondary buildings such as the verandah, ear room and so on. When still more space was needed, the extensions were built inside the courtyard/yard to produce a greater living area. When the construction reached its climax, the decline process started with the demolition of the extensions inside the courtyard/yard (in

2003), which the transformation work will reverse. During this transformation cycle, the structure of the front buildings, the left and right wings and also the main buildings have not been touched.

The courtyard buildings living environment of 1st through 10th lanes of *Dongsi* neighbourhood transformation studies were a two phase study: the neighbourhood and the courtyard buildings. At the neighbourhood level, the demolition of the social cultural foci such as the archways, temple and temple fairs had a great impact on the living quality of the neighbourhood, which became isolated from the larger scale living environment. The emergence of modern traffic and the high rise residential blocks also has had a negative influence on the street communities and their activities. But the emergence of the new uses, the opening up of the front elevation and also the creation of the communal inner courtyard/yard can help to enrich the activities and create jobs for the local communities. At the courtyard buildings scale, the nature of the courtyard buildings unit and also the flexible nature of the structure system have provided a huge potential for the courtyard building to be sub-divided and amalgamated, and have permitted the extension and construction of the new buildings inside the yard and courtyard. The timber framed structure and the internal open plan layout also provide the potential for further transformation without destroying the existing structure. Currently, conservation work has started, some of the temporary extension and construction works inside the courtyards and yards have been demolished. The refurbishment work has also been carried out, and some of the historic religious buildings have been restored as well. The conservation work on the courtyard urban neighbourhood living environment should follow a deep understanding of the courtyard living environment. Therefore, the identification of the primary shaping forces on the transformation work inside the studied neighbourhood, the study of the transformation values of the traditional courtyard living environment, and also the understanding of the traditional Chinese urban courtyard living environment transformation cycle will all help the future conservation and also the regeneration work on the urban courtyard neighbourhood.

Chapter 10 Findings and recommendations

The primary aim and focus of this study was to investigate and identify the shaping forces of the physical configuration and arrangements of the courtyard living environment at *Dongsi* neighbourhood in lanes numbered 1 to 10, and furthermore to understand the ecological design values as seen in the courtyard living environment studies. This research included two phases of study; the place and morphology studies of the neighbourhood environment and the typology studies on the courtyard buildings environment. The following sections contain a discussion of the research findings and implications taken from the historical courtyard buildings environment studies in relation to the research questions set out in section 3.1. Furthermore, there are recommendations for further studies on the traditional courtyard environment and the context.

10.1 What are the primary shaping forces of Chinese traditional architecture and how have they shaped the urban patterns and the great variety of courtyard buildings in China?

Chapter 4 gives an overview of the way in which Daoist and Confucian philosophy, *Fengshui* (wind and water), *Wangcheng* (ideal imperial city) theory, and building construction manuals *Yingzao fashi* (Building Standards) in the Song dynasty and *Gongchengzuofa zeli* (Building Regulations) in the *Qing* dynasty formed the foundations of the Chinese traditional way of understanding and creating their urban environment.

As the research showed in Chapter 1, Daoism is a philosophy of deep ecological thinking and is not necessarily antiscientific. It therefore provides a key to understanding the ecological values inherent in building forms which are shaped by this way of thinking. Daoism is founded on a way of working with nature which is not harmful. It suggests that humans can work with nature in a harmonious way, and regards man as one part of nature rather than isolated from it; it applies this 'harmonious' relationship to all activities. On reflection, Daoism, in many ways, is akin to deep ecology (Naess, 1989), with the primary influence on traditional Chinese architecture mainly focused on how to construct a human environment that responds to nature in a harmonious way. Furthermore, it suggests how simple but fundamental architectural thinking (such as the replication of the courtyard type) can be broadly applied to the manmade environment. Confucianism mainly focuses on social order and the social duty of humans, suggesting that everyone has his own position inside a family, society and country. Neo-Confucianism has further explained the origins of the universe. *Yin* and *Yang Qi* (energy) principles, Five Elements principles and so on, are again used as principles for constructing individual dwellings through to whole settlements.

Within a courtyard buildings group, Daoism and Confucianism have been carefully considered and have also been symbolically represented through the layout of the courtyard buildings, as explained in Chapter 4, and as the above discussion suggests, the fundamental philosophy guidelines (Daoism and Confucianism) reflect a deep ecological way of thinking. Therefore the following conclusions and discussions will try to explore the ecological values of the historic urban courtyard environment as revealed by this study.

The ideal *Wangcheng* (Imperial City) planning strategies drawn from Confucianism have further given practical and ideal physical planning guidelines for an ideal Chinese capital city layout (section 5.1).The city as it was laid out in the Ming dynasty (1367-1644) was 6,650 meters by 5,350 meters and then the outer city of 7,950 meters by 3,100 meters was created in the *Qing* dynasty (1644-1911)(Wu, 1999), the real city size of traditional Beijing therefore, has always been much larger than the theoretical ideal 3735 meters by 3735 meters. Furthermore, the drum and bell tower, the market, the Forbidden city (Imperial Palace), the state court, the ancestral temple of the imperial family and the altar of land and harvest were all precisely located from north to south along the central south-north axis of the Imperial City following

Wangcheng principles. This ideal city model clearly indicates an enclosed city that was prearranged by the central urban axis (with urban landmark buildings) and a hierarchal urban grid transport system, creating an urban form with a strong spatial identity and orientation. Furthermore the hierarchal urban transport system helped to create a permeable and walkable neighbourhood plan, and potentially helped place different types of uses along different types of urban road.

The studies of *Fengshui* theory have suggested that the fundamental design strategies of courtyard building groups were to hold the positive 'Qi' (energy) and avoid the negative 'Qi' that are produced by wind and water. Therefore, in a traditional Chinese man-made living environment, the choice of site of the city and also the courtyard building groups, the placement of the buildings and even the furniture, have all been influenced and guided by *Fengshui* principles. *Feng* (wind) and *shui* (water) were the main concern of *fengshui* theory, therefore the following discussion and conclusion of the courtyard environment studies can help to examine the values inherent in how the courtyard responded to the local physical environment in relation to these factors.

Furthermore, the buildings standards and regulations were a way of enforcing minimum standards on traditional Chinese building types. This in turn reflected a deep economic concern, however, because the origin of this system was based on the pursuit of an economical method of construction and an avoidance of waste of building materials.

Therefore, a simple traditional Chinese urban courtyard buildings group in Beijing can indicate the design values inherent in it in many ways. These include Chinese philosophy, architectural and urban planning theories and also building construction techniques/economic concerns. Further, each aspect of thinking had its own focus. The above discussion indicates that all the primary thinking is fundamentally related to an ecological concern in the courtyard construction, therefore the following discussion and conclusion will step further to explore the ecological values in the historic urban courtyard studies.

10.2 To what extent has the *Dongsi* neighbourhood, Beijing been shaped by Chinese traditional philosophy, architectural theories and also the architectural construction manuals? How does the urban form relate to the climatic, socio-cultural and economic conditions that have prevailed in Beijing?

10.2.1 *Fang* (ward) system and *Baqi* (Eight Banners)

The historical studies have identified lanes 1 to 4 as part of *Sicheng Fang* (ward), and indicated that lanes 5 to 10 belong to *Nanjuxian Fang* (ward), which were part of the 36 basic urban wards of the traditional Beijing city in the *Ming* (1368-1644) and *Qing* dynasty (1644-1911). The Ward system was used as the basic urban neighbourhood unit in ancient Chinese cities, and the use of the *Fang* (ward) system in traditional Chinese cities can be traced far back in Chinese urban history. The physical characteristics and also the morphology of the Chinese ward system should be studied further to help to understand the built environment of a standard traditional Chinese neighbourhood unit. Traditionally each ward was identified by an archway, however, the use of the *Fang* system in the *Qing* dynasty was rather weak, and the management of the city employed the *Baqi* (Eight Banner) system instead. The *Baqi* (Eight Banners) system in the *Qing* dynasty provided another important social source of identification to the neighbourhood, which was strictly focused on the urban management of traditional Beijing. This study also proved that the urban boundary may not only be shaped by the physical context such as the city wall, road and edge-defining buildings, but can also be classified by the social cultural domains.

10.2.2 Four major social culture foci of lanes 1 to 10 of *Dongsi* neighbourhood: archways, temple and temple fairs, *hutong* and entrance gate

(a): Archways

The study proved that *Dongsi* archways buildings were one of the dominant urban landmarks, nodes and spatial transition points in the traditional neighbourhood, which indicated a strong social and spatial identification in the neighbourhood. The archways were used to mark the original points of the wards, the social cultural identification of the street, the entrance of the important religious and public buildings and so on. Meanwhile, archways also created a good place for social gathering inside the neighbourhood. The painting and the decorations of the archways were also a good example of public artwork, which helped to generate the richness, identity and visibility of the neighbourhood.

(b): Temple and temple fairs

The regular temple fairs inside the *Daciyanfu Gong* Taoist temple also suggests that the front courtyard of the religious building was the most important place of social gathering inside the neighbourhood. It attracted many worshipers, visitors, retailers, pedlars, fortune tellers, opera singers and so on. Meanwhile, the temple was also used as a museum for collections of stone inscriptions, a religious book library, garden, poorhouse and so on. In essence, the temple was also the centre for social cultural activities, which in turn enriched the social cohesiveness of the neighbourhood.

The courtyard layout of the temples made it much easier to fit them into the urban grid system, and the temples' structures were also flexible and easily transformed into other uses such as private residences, educational institutions and so on.

(c): *Hutong* (lane)

The *Hutong* was the most important place of transition used daily by the residents before entering their private courtyard dwellings. The co-existence of rich and poor residents inside the same *hutong* was one of the most significant characteristics of the Chinese traditional living area. Studies of the *hutong* have also suggested that the *hutong* could (and still does) play a role as the service road, morning market and a place for holding different types of social activities, which gave a strong identity to each resident, each family, each small or large community, and also had a welcoming human scale, which was/is comfortable for visitors. Visitors can either explore the rich social cultural context of the *hutong* and the courtyard buildings, or easily take part in the community activities (such as Chinese chess, cards, singing Beijing opera, and chatting with local residents etc). The proportion of 6.5 meters wide, and 700 meters in length (with at least one sub lane linking to the main lanes), and also the street width of less than 1.3 (the width of *hutong*/the height of buildings) all helped to create a good sense of street enclosure and the appropriate walking distance to achieve a liveable street.

(d): Entrance gates

Finally, the entrance gates of different courtyard buildings from the neighbourhood also indicate the richness, diversity and social economic status of the different types of courtyard dwellings (also see 10.3.3.1).

Generally, the neighbourhood research findings suggest that there was always a lack of 'open' public squares, public parks and plazas inside the traditional Beijing city. However, this does not mean there was a lack of social or public gathering places. The four major social foci (archways, temple and temple fairs, *hutong*, and entrance gates) identified from the neighbourhood studies provide an identified place for the social, cultural and economic activities and gatherings. The edge-defining buildings of the *hutong*, and entrance gates to the courtyard buildings have all helped to provide a physical, social cultural and spatial control to the urban voids.

Apart from identifying the character of places, the hierarchy of the spaces is also an important characteristic of public places. Archways and temples denote district level; the *hutong* (lanes) are for local communities; and finally the entrance gates relate to individual street communities. In contrast to contemporary urban public space, the four types of social foci that were identified from the neighbourhood place studies can help to achieve a cohesive place from the district to the neighbourhood, and then to the local communities and finally, the private family.

10.2.3 Hierarchal urban grid and series of urban void (courtyard and yard) urban patterns

The basic urban morphology of the city was a hierarchal urban grid (at urban scale) containing a series of urban voids (at courtyard buildings scale). Urban patterns were clearly expressed through the two dimensional figure ground studies, as in, for example Fig 6.3. The hierarchal urban grids and urban patterns have helped to provide a highly permeable, legible and accessible neighbourhood, which include the main and minor roads for major public transport and commercial uses, with *hutong* (lanes and sub-lanes) for local communities. The series of urban void (courtyard and yard) urban patterns furthermore have helped to provide flexible plot patterns (easily divided and amalgamated) with the open sky inner space.

10.2.4 Flexible use of the standard 8 *mu* (5328 sqm) plot size, (helping to create a mixed community with the co-existence of rich and poor)

The flexible arrangement of 8 *mu* standard plot size strategies helped to achieve a mixed community. This plot arrangement has created a unique neighbourhood which allowed rich and poor to live together and also had great potential for the further amalgamation or division of the courtyard building groups. Furthermore this planning strategy helped to create a dense urban neighbourhood devoid of 'ghettoised' slums. The imperial and noble family, the businessman, the ordinary residents and the servants all lived in the same neighbourhood at the same time. This arrangement of the plot has also allowed for economical division and subdivision transformation works inside the courtyard buildings, the findings for which will be introduced in the following section.

10.2.5 The mixed use living quarters

The studies of land uses show that historically the neighbourhood was a mixed use residential neighbourhood, which included the religious Taoist temple with associated temple fairs building, traditional shops at the *Dogsi Beijie* (main road), the imperial mansion buildings, larger scale courtyard buildings, small courtyard buildings (which possibly provided their services for residents in the large courtyard buildings) and so on. All have greatly enriched the diversity of the neighbourhood.

10.2.6 Street typologies and the urban grid

There were four street typologies according to conventional Chinese planning principles which were also evident from the case study. These include main roads (24 Bu, 37.2m), minor roads (12 Bu, 18.6m), main lanes (6Bu, 9.3m) *hutong* and sub lanes, (without a conventional standard width, but normally half the width of the main lanes). There were basically no dead ends in this hierarchal urban grid transportation system, creating a permeable and walkable neighbourhood. Furthermore, landmark buildings and commercial buildings built alongside the main road provided a social, cultural and economic service at district level. Further local commercial, social and cultural buildings were traditionally located alongside the minor roads to provide the local neighbourhood with their services. The main lanes *(hutong)* were generally less than 1000 meters long and also the use of at least one sub lane to link the main lanes has strengthened the pedestrian character of the neighbourhood. Meanwhile, the main lanes *(hutong)* could also hold different activities/communities, the convenient morning market and so on.

10.2.7 Four types of spatial hierarchal transition points inside the neighbourhood

Historically, there were four main hierarchal spatial transition points illustrated in the historical analysis of the case study: The *Dongsi* archways to the neighbourhood and the main road; the concession and front public yard space for the important religious and public institution buildings; the edge-defining buildings (different uses and spatial orientation) to each main *hutong*; and various entrance gates to the courtyard buildings. These four types of spatial hierarchal points (which have now vanished) provided a coherent spatial transition from the city to the neighbourhood, from the neighbourhood to each main lane and the important public buildings, and finally reached each personal courtyard building.

10.3 To what extent do the courtyard buildings found in the Dongsi, Beijing neighbourhood themselves reflect Chinese traditional philosophy, architectural theories and also architectural construction manuals? To what extent do they also reflect the climatic, socio-cultural and economic conditions that prevail in Beijing?

10.3.1 The *Yuanluo* (courtyard) and *Yuanzi* (yard) terminology

Following various principles extracted from the Chinese philosophy of Daoism, Confucianism and *Fengshui* theory, five distinct elements of courtyard structure were discernable. These were front buildings, the wing buildings, the main buildings, the courtyard itself and also the enclosure wall. This comprises a *Yuanluo* (courtyard) unit, and the left urban inner void (front and back yard) with the surrounding buildings comprising a *Yuanzi* (yard) unit. The replication of the courtyard, or yard unit has achieved a simple but diverse courtyard buildings environment.

10.3.2 Two classes of building types

Roofs, storey heights and bay widths were the three basic parameters of buildings in the study area. Furthermore, the five conventional roof types classify the courtyard building dwellings of the neighbourhood into two general classes: the imperial building types (the hip roof and the hip-and-gable roof types) and the ordinary building types (the gable roof and the flush gable roof types). To the ordinary residents, the following entrance gate studies would help to indicate the social status of the ordinary residents (10.3.3.1). Therefore, each courtyard building has a clear social identity, although the rich and poor can live in the same neighbourhood.

10.3.3 The spatial and social hierarchal arrangement

10.3.3.1: Five entrance gate types

Five types of entrance gates were also illustrated by the field studies. These were (from higher social status to lower social status): *Wangfu* Mansion entrance gate; *Guangliang* (broad) entrance gate; *Jinzhu* entrance gate (golden post); *Ruyi* (free) entrance gate and *Zai* (narrow) entrance gate. The comparison of the five entrance gates has strongly suggested that the deeper and wider the entrance gate, the higher the social status of the owners. The location of the entrance gate also strictly follows the social status of each family, as southeast to northwest was the most privileged direction, allowing the resident to obtain happiness, wealth and health for the family according to the *fengshui* principle, and therefore, the family with higher social status would take this position.

10.3.3.2: The plan layout

The study of the number of bays in the main courtyard buildings confirms that the use of an odd number of bays (3, 5 and 7) was typical within the neighbourhood. However the discovery of the unusual two bay wing buildings in the neighbourhood runs against some conventional views of the odd number bay system for the buildings, and suggests that in fact the construction of the buildings was relatively flexible, although there were many conventional construction strategies, as follows:

1) In the most usual configuration, the south oriented courtyard unit in the front building located on the southern side was traditionally used by visitors and male servants as a study room and so on; the wing buildings located on the

west and east sides were used by the next generation of the owner, with females located in the right hand building, and males located on the left. The main building was located furthest from the courtyard unit, this was used by the owner and also reserved for family worship and religious uses. The studies of the courtyard unit plan therefore reveal that each family member had a unique social identification, which was reflected in their physical location inside a courtyard unit.

2) The majority of the courtyard building groups have a south-north axis. The courtyard unit can be extended following this south-north axis, and also can be extended following a west-east axis. The building layout of each courtyard unit therefore matched the requirements of one family unit.
3) The west axis was traditionally linked with the east axis by a moon gate located between these two courtyards. The link between the north-south axis of courtyard units usually started from the front yard and continued through an aisle located to the rear of the wing buildings, or the er (ear) building of the first courtyard unit.
4) Many activities were held inside the same courtyard unit, such as religious worship, leisure and so on.
5) The deeper the main buildings were located inside the courtyard buildings group, the higher the social status the buildings had.

10.3.4 Three types of transition points inside a courtyard building group

The screen wall, the decoration gate and verandah provided a spatial transition from the external public space to each private room. The screen wall was the first transition point after entering the courtyard building group, a transition point that indicated the direction of the front yard (whether relating to the front building, or a main courtyard and buildings deeper in the plan). The decoration gate provided the transition from the front yard to the private courtyard and buildings, and was also the focus point of the courtyard building group because of the artistic decoration and also the spatial transition between the visitors, servants and the family members. The verandah provided another level of spatial transition from the internal courtyard to the completely private living space.

10.3.5 The use of the service room '*er fang*' (ear room)

In the secondary building the *er* (ear) room was traditionally used not only as the service room to the main buildings but also as a bedroom, library, meeting room or general purpose room, which provided great potential for flexibility within the courtyard design to meet the owner's needs.

10.3.6 The traditional Chinese colour schemes

The studies of the colour schemes in the neighbourhood have proved that red, green, blue, white, yellow and grey were the main colours used for the local buildings. The research studies suggest that this colour system was not born out of unthinking worship or superstition, but indicates the strong psychological feelings towards the local physical built environment where the Chinese live and as such, the colours were used to represent direction, colour, gender and emotion. Red was used to represent the south and the element of fire; it was also used to represent happiness and blessings. Since the south is the direction of sunlight and associated with light winds, the colour was mainly used on pillars, girders, windows, and doorframes. Green was used to represent the east, wood and male gender, and it further indicated posterity, peace and harmony; it was usually used on girders, window panels, door frames, terracotta glazed roofs and so on. White represented the west, female gender and metal elements. Furthermore it indicated peace, purity and was mostly used in coloured decoration. Yellow was only used by the royal family, and represented central and the element of earth. Black was rarely used for residential buildings because it represented north and the element of water, and indicated grief. Grey was the native material colour of the brick and tile and worked closely with the

Chinese colour scheme in Beijing. Furthermore, an important aspect of the use of colour was the use of oil painting to protect the wooden structural system from decay and fire. This colour scheme enabled cultural symbolism and building functionality to co-exist.

10.3.7 Timber, brick and tiles as materials

From the field investigation we see that timber, brick and tiles were the main materials for the traditional Chinese buildings. Timber has good mechanical qualities to resist earthquakes; this was demonstrated in the 1976 earthquake in Beijing, when most of the courtyard building structures in Beijing survived in a relatively good condition while more modern buildings were destroyed. Meanwhile, timber was also light in relation to its strength, easy to work and carve, easy to mass produce and to standardize, and cheap to transport from the south of China by canal. Brick and tiles were the main materials for the construction of the building enclosure, which were mainly produced in the rural area of Beijing using local clay, and the internal cellular structure system of the unglazed brick allowed the noise, sunlight and water to be absorbed, but these also created humidity problems, therefore cavity wall strategies were used to ameliorate humidity problems.

This structure system was flexible and adaptable. It could be easily repaired and/or extended, particularly by adding an 'er fang' (ear room) to the main structure outside the main room. The timber structure system also allowed the walls to be non-load bearing. Therefore, the position of doors, windows, and enclosed walls was flexible and could be easily transformed. The timber structure therefore, in many ways, was similar to the modern steel structure system, for example, because the *Doukou* modular system allowed mass construction, standardized construction, easy extension and repair, and also prefabrication.

10.3.8 Traditional Chinese modular system strategies

The *DouKou* modular system was, for example, employed in the construction of the major buildings of the imperial *Fuwangfu* mansion, and the use of a 6.7 cm *DouKou* module indicated the size and proportion of these Qing imperial buildings. The modules of an ordinary building (without the *Dougong* bracket system) were determined by the diameter of an eaves column, and these modules also determined the buildings' size and proportion.

10.3.9 Bays: number and width

The number and width of bays within a building's structure were used to show the social and economic status of the residents. The dimension of each bay, for example may vary from 2.7 meters in an ordinary building to 5.6 meters in the imperial mansion buildings. Meanwhile, the number of bays may also vary from 1 bay to 2, 3, 5 and 7, as evidenced from the field studies. The distance between the two furthest purlins (depth of the building) can vary from 5 meters to 18.5 meters, and a ratio of 8:5 between the general bay and general *purlin* (the width and depth of the building) was also evidenced from the case studies. These structures provided an internal open space which was divided only by the partition walls and thus this internal spatial arrangement allowed the potential transformation according to the owner's actual need.

10.3.10 Building decoration treatment

Decorative treatments here refers to the walls and openings of the buildings. The walls of the buildings that faced the courtyard and yard were normally 600mm high. The external wall and back wall were normally completely enclosed, though sometimes had small windows.

Two major window types i.e.,windows with side-hung casement and top-hung casement windows (see section 8.1.5) have been used for the local buildings. The lattices (also for security reasons) and papercut work which created the infill to the frame also created an important extra layer to a traditional building. When residents looked out at the courtyard gardens, the effect of the lattices was to divide the outside into many sections, stimulating the imagination and achieving a rich effect of light and sight.

Doors also performed many functions within the courtyard dwelling. The different door types included the entrance gate to the buildings group; the decoration door to the private living quarters; the door to the buildings at the front; the screen door at the back and also the interior door frame for the bedrooms. The patterns of decoration used on the doors vary widely from geometric to abstract forms. Furthermore, each type of door also clearly indicated the spatial domains of the place; the entrance gate doors created a transition between the public space and the private space, the decoration door provided a spatial transition between the relatively public front yard to the completely private family courtyard place, the family space through the door to each member's private room, and finally, the internal doors which were mostly only the door frame, provided a transition between different functions.

10.3.11 Five types of microclimate and the control of '*Qi*' (energy)

Depending on the location of the yard, courtyard, buildings and also their surrounding buildings, five main types of microclimate may be classified within the courtyard structure. These were the single courtyard microclimate; the front yard and associated buildings; the main courtyard; the second courtyard and main buildings; and the rear yard and its buildings.

10.3.12 Comprehensive courtyard microclimate strategies

The openness of the different types of yard and courtyard (aspect ratio) created a complex microclimate courtyard which was capable of generating good quality natural ventilation for the buildings in the summer. The heated air of the larger size courtyard rises and brings in the relatively cooler air from the front and back yard and also to the aisle through the openings. This therefore achieved a high standard of natural ventilation and kept the buildings relatively cool in summer. During the winter, the larger solar shadow index of the courtyard allowed more sunlight to penetrate into the main buildings, allowing winter warmth, however the front and back buildings normally received less direct sunshine in all seasons.

10.3.13 Natural sunlight control strategies

The southerly orientation of most of the courtyard buildings groups helped capture solar heat for the main buildings. The form of building enclosure, however, also played an important role in achieving a good quality of natural sunlight. The pitched roof of the traditional buildings allowed more sunlight to penetrate into the buildings, the yards and courtyards. The curved eaves played an important role here, in restricting the higher horizontal summer sunlight to the external wall but allowing the lower horizontal winter sunlight to reach deep into the buildings. Meanwhile, trees played an important role in filtering the sunlight and creating shade during the summer months. During the winter, however, the leafless trees allowed sunlight to reach the interior of the main buildings. Trees also played an important role in decreasing the problems of overheating of the west and east wing buildings, by providing shade during the day.

10.3.14 Natural ventilation control strategies

During the summer the southerly breezes helped cool south-north orientated courtyards and associated buildings. Moreover, the different proportions of the yards, courtyard and aisles worked in conjunction to create a through draft to benefit as much of the courtyard grouping as possible. During the winter, however, the fully enclosed north elevations of the courtyards protected the structures from cold winter winds. The enclosed courtyard buildings group layout also helped to protect the buildings from the harsh weather such as the spring sand storms from the northwest.

10.3.15 Humidity control strategies

The natural ventilation created by the varying openness of the courtyard, yard and aisle also helped to alleviate excess humidity within the courtyard buildings; this is achieved by encouraging air movement. The use of water features such as the pool and jar inside the courtyard also helped to reduce the temperature through evaporation in the summer. The cavity wall system which was normally filled with limestone also helped to absorb the moisture from inside the buildings and then released it into the courtyards and yards during warm, sunny days.

10.4 How have the traditional courtyard neighbourhood and dwelling found in *Dongsi* neighbourhood been adapted to the changing socio-cultural conditions in the 20th Century? Has this transformation fundamentally changed the values and approaches inherent within the neighbourhood and individual buildings or have these stood the test of time?

10.4.1 The disappearance of the socio-cultural foci

The most striking way in which the socio-cultural aspect of the neighbourhood has been transformed in the recent past is the decline of the traditional socio-cultural foci. The tragic demolition of the *Dongsi* archways in 1950s meant the loss of the most important physical, socio-cultural, and spatial identity of the neighbourhood since the construction of Beijing City in the *Yuan* Dynasty (1276-1368). This left the main street of *Chaoyangmen Nei Dajie* (the main road) completely open, and effectively destroyed the identity of the ward and main streets that *Dongsi* archways had once represented. The demolition of the *Daciyanfu Gong* Taoist temple during the Cultural

Revolution in 1960s also severed the neighbourhood from its own past, and damaged the rich social, cultural and economic activities that the temple and temple fairs created.

At the level of the individual courtyard group, the buildings' decorative details such as the stone lions that were located at the front gates, screen walls, and the decorative gates inside the courtyard buildings have been damaged or removed for political reasons, because of socio-cultural change, or natural disaster. Thus, the demolition of the *Dongsi* archways and the *Daoist* temple, the weakened function of the entrance gate, and the demolition of the secondary buildings has destroyed the social and cultural coherence of the neighbourhood and thus cut it off from its heritage and cultural meaning, and the neighbourhood has become like an isolated island that is surrounded by the busy road.

10.4.2 From a traditional mixed use to a modern mixed use neighbourhood

This study has revealed that the traditional courtyard neighbourhood has demonstrated a high level of adaptability and change over the centuries of its existence. In recent decades, however that change has been more dramatic, with the emergence of new uses and types of buildings including offices, hospitals, buildings for health care, light industry, education, and a hotel. The buildings that have these new uses were easily transformed from the traditional courtyard buildings. With care, therefore, the courtyard urban patterns can be easily and organically renewed without completely demolishing the courtyard environment, which leaves great potential for future urban conservation and regeneration.

10.4.3 The emergence of vehicular traffic inside the neighbourhood

The increase of vehicular traffic inside the neighbourhood during the 20th Century has brought about another major aspect of change and transformation. The urban environment of the lanes (*hutongs*) in particular, has been changed. Generally, the 6-9 meter width allows through traffic, however the traffic has greatly impacted on the socio-cultural aspects of daily life in the *hutong* which were such important foci for social interaction, and in particular, it has reduced the levels of personal interaction among neighbours. The increase in traffic has also come about without an adequate parking strategy, which has created a rather chaotic environment in some parts of the neighbourhood. The noise has also had an impact on the quality of life for those in the front buildings, but the influence to the inner courtyard buildings is not significant because inner buildings are normally closed.

10.4.4 From the courtyard building groups to the communal courtyard living compounds

Most of the once private family courtyard buildings have been transformed into the communal courtyard compounds inside the neighbourhood. The courtyard or yard has been transformed into a semi-public place for local residents. The urban density has increased to 137 families from an ideal 20 families/hectare of the traditional neighbourhood (8mu for each neighbourhood planning policy), the number of dwellings has increased 7 times because of the division of the large courtyard dwelling. The focus group materials have proved that the communal courtyard and yard have provided a good place for social communication and activities, particularly for the elderly and children.

10.4.5 The transformation cycle of a traditional Chinese courtyard buildings group

The research also strongly suggests that the courtyard dwellings have not reached an end point of transformation, i.e., the current layout is not completely static but rather is undergoing continuous change. This can be seen as a series of specific stages:

1) Initial development. Standard 8 *mu* (5336 m^2) plots for important first residents with infilling of smaller plots by lower status residents.
2) Mature development. During this process, the residents of the rich family could buy the nearby plot when the members of the family increased; the poor family also could enlarge their plot when the family got richer.
3) Division of the large-scale courtyard buildings. The number of courtyard dwellings has increased 7 fold, despite the fact that the population density did not change significantly between 1910 and 2000. This process of transformation (division) also makes it possible to use the courtyard buildings environment for low-rise high-density contemporary urban living. Meanwhile, following the division of the large courtyard buildings, the courtyard and yard have been transformed into the communal space (section 9.2.2.5), the communal courtyard and yard also help to achieve a good quality social and cultural place for the residents who live in the same courtyard buildings group.
4) Extension work to the secondary buildings, courtyard and yard. The extension work can be done by working on the secondary buildings such as the verandah, 'er' (ear) buildings etc, and furthermore, the small scale buildings can be built inside the courtyard or yard; this growing process finally reached a climax when more buildings were constructed inside the courtyard and yard. Therefore, the courtyard, yard and secondary buildings offer great potential for renovation to the traditional courtyard buildings group. With sensitive design, a modern kitchen, toilet, shower room etc can be constructed inside the verandah, *er* (ear) room and the courtyard and yard.
5) The process of demolishing temporary buildings. Some of the temporary buildings have been demolished following the conservation work on the neighbourhood (started in 2002). However, the five main buildings (front buildings, left wing buildings, right wing buildings, main buildings, and enclosure wall) have been kept during the transformation process.

Taken as a whole, the courtyard living environment has demonstrated a great adaptability for urban living, and more importantly, the transformation process is a cycle rather than a dead end. This may also be seen as providing lessons for contemporary development thinking. The maintenance and reuse of the main buildings over time has demonstrated deep ecology and Daoist principles in practice. This illustrates that it is possible for humans and nature to work together in harmony. The understanding of this transformation cycle therefore, can also guide potential conservation and regeneration work on the neighbourhood for the future.

10.5 Can ecological design values and approaches that may be learnt from the *Dongsi* neighbourhood both in the urban form and the individual courtyard dwellings be used to develop a more ecologically sensitive urban regeneration to the site?

As the above research findings indicated, the traditional courtyard environment has implicitly embodied a deep ecological concern within the local built environment. This ecological way of thinking has critically shaped not only the physical urban morphological contexts, but also the socio-cultural and economic contexts of the neighbourhood. If the above research findings can help to explain the ecological design values that were learned from the traditional urban courtyard environment, then this part of the discussion will further focus on the conservation and regeneration principles on the current courtyard building environment of the lanes between 1 to 10 of *Dongsi* neighbourhood.

10.5.1 The maintenance and recovery of the socio-cultural foci of the neighbourhood

As the previous research findings suggested, there were originally four socio-cultural foci in the neighbourhood (the archways, temple and temple fairs, *hutong* and entrance gate) and these were not only the main socio-cultural focus but also the key economic generators for the neighbourhood as well. Therefore, the reconstruction of some of these foci may be advantageous to the neighbourhood and help to reinforce the identity of the area. Reconstructing buildings on the temple sites in some form and thereby providing a space for new temple fairs would also help to create a socio-cultural and economic opportunity for the neighbourhood. The reconstruction of the archways mainly for the minor streets such as the *Dongsi Beixiaojie* (a minor road) and *Chaoyangmennei Beixiaojie* (a minor road), and also reconstruction of the Taoist temple, for example, would help to highlight the transitional nature of these spaces and to reinforce the sense of identity of the space and place. However, it is impossible to build the archways to the main street such as the *Chaoyangmen nei dajie* (a main road) because of the scale of the street and also the demands of modern traffic. In contrast, the construction of archways on minor roads could not only provide spatial control and a socio-cultural and economic focus to the neighbourhood, but also may add coherence and richness to the neighbourhood.

Keeping the *hutong* both physically (which takes up less than 1.5m of the street) and supporting the social life that flourishes in them is a further key priority for a good quality urban life. Keeping different types of entrance gates in particular will provide a place for social and cultural gatherings, leisure and communication.

10.5.2 The conservation of the urban fabric

As the studies have indicated, the compact low-rise nature of the courtyard housing has allowed a high density (137 families per hectare), but also good quality environment. The series of inner voids (courtyards and yards) in the urban fabric also allows potential transformation work to occur inside in the neighbourhood for different, mixed-uses; therefore, keeping this pattern of urban fabric is also important to the future and gradual regeneration of the neighbourhood. The following strategies or principles that have been drawn from the courtyard environment studies can be used for the conservation work of the urban fabric.

1) The use of the hierarchal urban grid traffic system, which still includes the main road, the minor road and *hutong*. The main road should be used for the city scale grid, minor roads for the local scale and *hutong* for neighbourhood use.
2) The use of the street will follow the physical characteristics of the street length and the enclosure quality of the road. When the street has a larger than 3:1 street (cross section?) proportion, this type of street should be for neighbourhood scale public use. The archways can help to add the street enclosure quality to the space. The *Hutong* should have a less than 1.5:1 street proportion that allows good enclosure of the space for local community based gathering, activity and communication.
3) Keeping a clear spatial transition and legible framework within the neighbourhood demands the construction of a series of urban nodes such as the archways, the edge defining buildings and the entrance gates in the appropriate place.
4) A traffic control strategy is also important for good quality urban living, and basically public traffic should not be allowed to go through the neighbourhood. But a one-way driving policy can be applied to lane 6 (there are no old trees on either side of the road) and lane 9 (most of the buildings are new buildings between the traffic road lane 10 and lane 9). Furthermore, lane 3 should be kept as a traffic free hutong for the morning market.
5) Parking is the most challenging issue for the urban regeneration of the neighbourhood. From the study, we can see that the 6-9 meter wide *hutong* allows cars to pass through, but there are insufficient parking places in the current situation and parking on the street has imposed great pressure on the social and cultural activities of life in the *hutong*. However, from the previous studies, we can observe that the front walls of the front and back buildings of the courtyard building group can be opened up and used as a garage for the residents. This can be easily achieved, because the wall is independent from the timber structure of the building and this allows an easy transformation.

Meanwhile, the redevelopment of the poor quality modern buildings and the utilisation of underground space can be used for further car parking.

10.5.3 The use of the courtyard prototypes

From the previous plan typology studies, the location of each member of the family has followed the social status of the residents, however, it is very difficult to apply these principles to contemporary urban living. Nonetheless the spatial hierarchy which has been created by the traditional courtyard system can still be borrowed for a contemporary courtyard design. For example, the visitors can be located in the front yard, main residents can be located in the main courtyard and buildings, and the servants located in either the front or back yard. Furthermore, the colour system should also be carefully restored to the courtyard buildings with its social-cultural, aesthetics and functional thinking.

In the current courtyard environment, large courtyard buildings have been divided into smaller living units; one small family unit may occupy just the wing buildings or the front buildings, for example. This transformation works well with the current situation of smaller family units. However, the upgrading of the courtyard buildings is another important issue which is needed in order to respond to expectations of comfortable modern living. The secondary buildings such as the 'er' room and verandah play an important role in locating the modern facilities such as the kitchen, shower and toilet. Meanwhile, the screen wall and the decorative gate can also be used to indicate the location of particular families. The traditional structure system also allows simple modernisation works to be carried out without major disruption to the fabric or lives of the occupants.

Buildings and elements within them can, therefore, be transformed easily to reflect the needs of the occupants, and moreover, internal spaces can also be transformed according to need as well. Furthermore, the organic renewal of the poor quality buildings inside the courtyard compound should also be allowed to create low rise and high density urban living, and the poor quality buildings such as the wing buildings and the back buildings can be replaced by two or three storey new buildings to create a greater floor area for the neighbourhood. However, all the new construction that is based on demolishing the existing buildings of the courtyard compound should be designed very carefully.

For those poor quality modern buildings inside the neighbourhood, organic renewal should also be carried out, and new courtyard prototypes which are based on the understanding of the traditional courtyard values can be used to replace the poor quality modern buildings. All new construction should respect the local built environment very carefully and sensitively. The traditional structure system should also be respected, though modern steel structure systems can work well with the traditional timber systems. Therefore a good understanding of the existing modular system not only can help to build the new buildings, but can also allow reparation and extension of the structure.

The reconstruction of the garden is also an important issue in the regeneration of the neighbourhood, and the internal gardens may help to encourage social gatherings and add elements of leisure. This can also help to create a comfortable courtyard microclimate. For comfortable urban courtyard living, a good quality microclimate is essential, which is also one of the privileges of courtyard living. Therefore, a different aspect ratio (openness to sky) of the yard, courtyard and aisle should be achieved to get natural ventilation during the summer. Meanwhile, the construction on the south side should also be very careful, and not be influenced by the winter sun. The following strategies should also be mentioned as a means to achieve comfortable urban courtyard living:

1) The buildings should open to the south to maximise solar capture and be closed as far as possible on the north elevation to reduce heat loss.

2) Use the verandah (curved eaves) to control the sunlight, try to avoid the hot summer sun and get the winter sun.
3) Use plants inside the courtyard to block the hot summer sun; this particularly helps to avoid the west being over heated.
4) Use water features inside the courtyard/gardens to create a water evaporating system during the summer to get rid of hot air and moisture.
5) Use a cavity wall system to achieve good quality insulation.

10.6 Recommendations for further studies

This research has tried generally to apply contemporary research methodology to traditional Chinese environment studies, which helps to give a rational and systematic understanding of a real courtyard urban environment. The place studies and morphology studies for the urban neighbourhood, the typology and secondary buildings studies for the courtyard building groups all help to achieve a comprehensive understanding of the ecological values of the traditional living environment based on the study of lanes 1 to 10 of *Dongsi* neighbourhood. This type of study, I believe to be unique and contributes to the understanding of these dwellings and a way of life which is under threat of disappearing. However, this is just the first step in understanding the traditional urban courtyard buildings environment of a real urban neighbourhood of Beijing. The following issues are recommended for further study following the above research findings of the courtyard environment:

1) The high density low rise urban courtyard prototypes and the urban courtyard environment design guidelines should be studied further following the ecological design values studies of the traditional urban courtyard environment. New design guidelines should demonstrate a full understanding of the courtyard built environment, particularly of the deep ecology *Taoist* principles that humans should work with nature and with each other in a harmonious way. More practically, the use of *Fengshui* principles to keep positive energy and avoid negative energy should be respected , as should

the economic considerations/values from the traditional Chinese structure system, particularly the module system and the timber frame system.

2) China is now experiencing a very fast urbanization process. Many new cities have been created all over China without careful design. The city model from the ideal *WangCheng* (see Chapter 4.1.2.4) offers a vigorous, identical, extendable place for the courtyard environment, particularly in its choice of the ideal site, hierarchal urban grid, and the central axis strategies. An ideal city model based on the ideal *Wangcheng* could be used to provide Chinese historical urban planning guidelines; further research may investigate the practicalities of such an approach.
3) There are many important social culture contexts of the neighbourhood such as the Taoist religious buildings, the archways, the ward system and banner system that have vanished for many reasons. Research findings of the social, cultural and economic functions of the socio cultural foci have suggested that these socio-cultural foci have played an important role in achieving a coherent urban space for the urban residents and the visitors. Further research on this topic is recommended.
4) Finally this study was unable to obtain some of the precise physical measurements of the courtyard buildings which would have been highly desirable, but they were impossible to obtain, particularly where buildings were occupied. Further restoration and conservation works within the courtyard dwellings provide an ideal opportunity to record as much information as possible as the works progress. This would enable further and more detailed studies on construction techniques, specific responses to local climate etc to be carried out.

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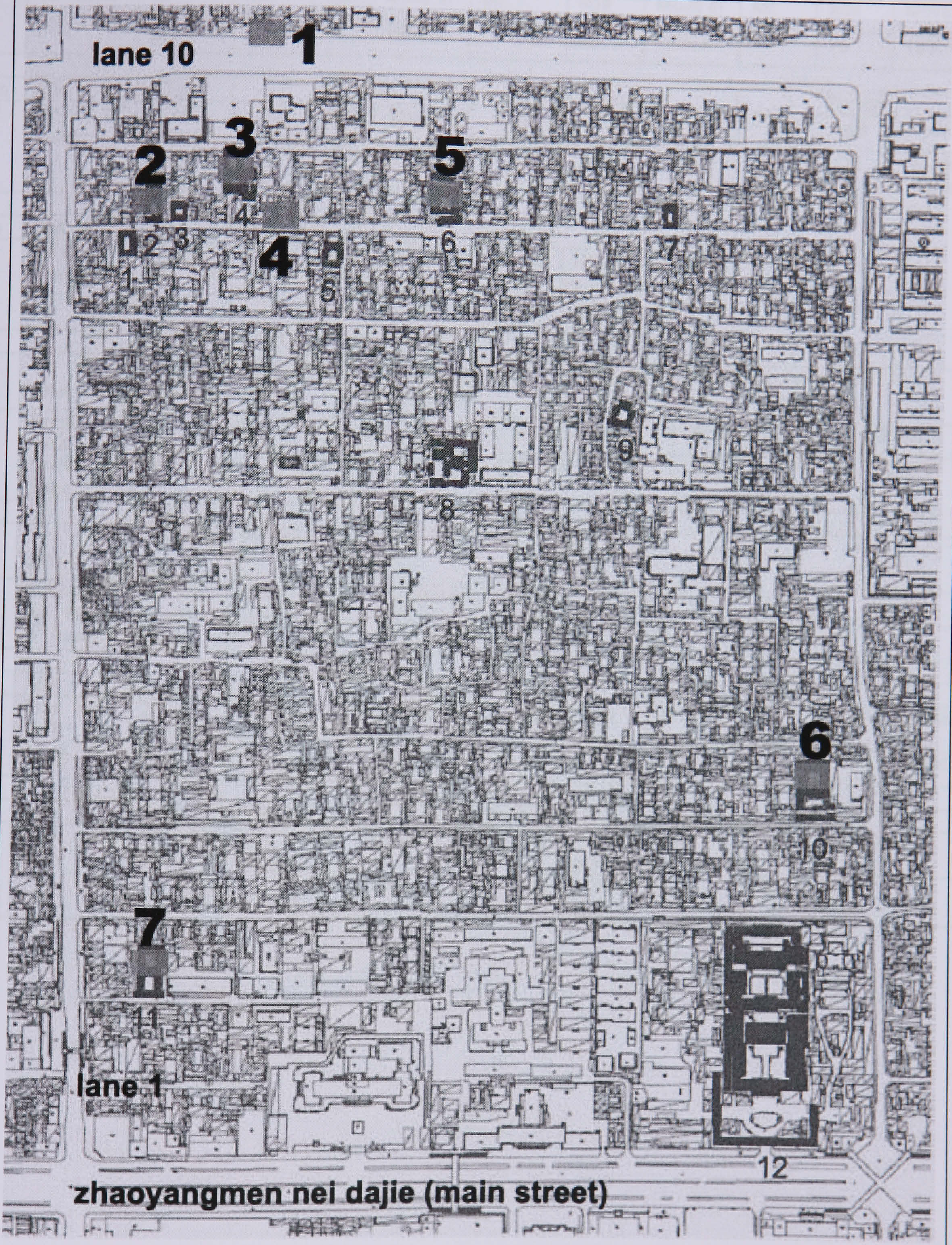
PAGE NUMBERING AS ORIGINAL

Appendix 1:

Chinese Dynasty and Periods:

	B.C
Shang dynasty	1480-1050
Zhou Dynasty	1122-221
Warring States Period	475-221
Qin Dynasty	221-206
Han Dynasty	206-AD 220
	A.D
Wei, Jin, Northern and Southern Dynasties	220-581
Sui Dynasty	581-618
Tang Dynasty	618-907
Five Dynasties and Ten kingdoms, including: Liao dynasty in North China	907-1125
Song dynasty, including:	960 -1279
Northern Song dynasty	960-1127
Southern Song dynasty	1127-1279
Jin dynasty in North China:	1125-1234
Yuan Dynasty (Mongol)	1276-1368
Ming Dynasty	1368-1644
Qing Dynasty	1644-1911
Republic	1911-1949
People's Republic	1949-

Appendix 2: The focus groups location map



The seven focus group sites

Appendix 3: List of focus groups research participants

No	**Site**	Time	Person 1			Person 2			Person 3		
1	**10^{th} Lane**	12^{th} March 04	Mr. Liu	age	Move in	Mr. Zhang	age	Move in	Mr. wang	age	Move in
				70	1950's		55	1950's		75	1950's

No	**Site**	Time	Person 1			Person 2			Person 3		
2	**No129, 8^{th} Lane**	24^{th} March 04	Mr. Wang	age	Move in	Mrs. Zhang	age	Move in	Their son: Mr. Wang	age	Move in
				63	1950's		62	1950's		36	Since born

No	**Site**	Time	Person 1			Person 2		
3	**No111, 8^{th} Lane**	2^{th} April 04	Mr. Zhu	age	Move in	Miss Ma (House keeping)	age	Move in
				67	owner		21	2001

No	***Site***	Time	Person1 age: 63		Person 2 age:56		Person 3 age:28		Person 4 age:25	
4	**Front gate of No103, 8^{th} Lane**	28^{th} March 04	Mrs. Yang	Move in	Mrs. Wang	Move in	Mrs. Tian	Move in	Mr. Zhao	Move in
				1960's		1960's		1998		2001

No	***Site***	Time	Person 1			Person 2		
5	**Yeshengtao No71, 8^{th} Lane**	28^{th} March 04	Mr. Tian	age	Move in	Mr. Wu	age	Move in
				68	1950's		63	1950's

No	**Site**	Time	Person 1			Person 2			Person 3		
6	**The gate No3, 4^{th} Lane**	27^{th} March 04	Mr. Guo	age	Move in	Mrs . Li	age	Move in	Mrs. Wang	age	Move in
				65	1957		42	1991		30	1986

No	**Site**	Time	Person 1			Person 2			Person 3		
7	**No3, 2^{nd} Lane**	6^{th} April 04	Mrs. Liang	age	Move in	Mrs. Rong	age	Move in	Mr. Zhang	age	Move in
				78	1954		55	1973		56	1954

Appendix 4: The focus groups open ended questions framework

Number	Components	Questions	
I Neighbourhood	Place	1	What is the most representative place (landmarks and urban nodes) of the neighbourhood?
		2	What is the place you regularly go to visit around this area?
		3	How can you access from the city to neighbourhood?
		4	Do we have any public activities (community)?
		5	Levels of safety?
	transformation	6	Could we talk about the transformation of the neighbourhood?
II Courtyard buildings	ownership	7	Who is the owner of the buildings?
	physical environment	8	How do you feel the natural light and ventilation inside the courtyard buildings?
		9	Do you fell comfortable to live in the courtyard dwellings?
	buildings	10	Can you talk about the buildings orientation and the uses?
		11	Could you talk about the landscapes?
		12	Could you talk about materials?
	community	13	Do we have any public activities inside the courtyard?
	transformation	14	Can you talk about the transformation of the dwellings?

Notes:
1: This study will focus on the traditional values of the neighbourhood and also the courtyard buildings; therefore, the residents who have a longer experience inside the neighbourhood will be the priority.
2: The transformation will include two levels, the neighbourhood and the courtyard buildings level (Q6 and14).

Appendix 5: Fieldwork timetable

Time schedule (week)	Research tasks in the field	
1.2	Pilot study in Beijing (the *Fayuansi* temple conservation area)	
3	contact and talk with the key informers in Beijing	
	Prof. An Rong	Beijing Institute of civil engineering and architecture
	Mr. Dong Zhang	Beijing Institute of civil engineering and architecture
	Mr. Jian Ding	IPPR design institute
	Mrs Manqian Zhu	Senior architect of IPPR design institute
	Miss Cheng Shen	IPPR design institute
4	prepare the field work at 1^{st} to 10^{th} lanes at *Dongsi* neighbourhood	
5,6	Start the documentary and archive review: ➢ Access to IPPR and get the preliminary survey result ➢ Visit the national library and the local book shops to get the historical maps, document and so on.	
7,8,9,10, 11	Collect and sort the data in the field. ➢ Direct observation ➢ Physical measurement ➢ Focus group	
12	Sorting all the collected materials	