

while the latter was provided by the state. It was with particular significance in the transition period of housing property. The architect planned to leave the Infill uncompleted; however, this proposal was realised only in three buildings. It was recorded that some creative users did achieve an appropriate result by arranging the internal space. Although the method of SAR 73 was not practised, this project also made a sound exterior with collective and public courtyards, which was quite different from the usual row-housing form. In the exploring stage, its achievement in both architectural and urban design was indisputable (Fig. 9).

Based on the success of the Wuxi case, Prof. Bao Jiasheng launched a series of systematic research afterwards. In 1988, the publication *Support Housing* was released, in which the basic principle and detailed method of Support Building theory, as well as the possibility of its realization in China, were further discussed. It is the first systematic book about flexibility written by a Chinese scholar. In 1992, the “Center of Open Building Research and Development” was founded at Southeast University. Its research concentrated on the improvement of design method, represented by efficient space, which developed a three-dimension flexibility and high-rise Support Building. Some instructive projects were realised, such as the staff quarter of Nanjing Daily and the Zhongnan High-rise Building (Fig. 10).

The introduction of Support Building had a positive influence on the on-going research on large-span housing. The diversification of the user’s family and requirement had been recognized in the 1970s, which promoted large-span dwelling. However, Support Building made the research even more targeted and organised. Accompanied by the development of building structure, the first large-span experimental project, “Building 23 in Huawei community”, was realised in Beijing in September 1991. It



(a) Overall layout.



(b) Photo.

Fig. 10: Zhongnan High-rise Building. (Source: provided by the architect, Prof. Bao Jiasheng.)

was a six-storey building with a building area of 5,781 m², accommodating 102 families. The basic unit was on the grid of 10.8 m, with two or three suites on each floor. The kitchen and bathroom were fixed as part of the base building, while the space leftover remained empty. It should be emphasised that various aspects of the user’s personal requirements, such as preference, family size, and economic status, were particularly emphasised. After the realisation of base building, eight

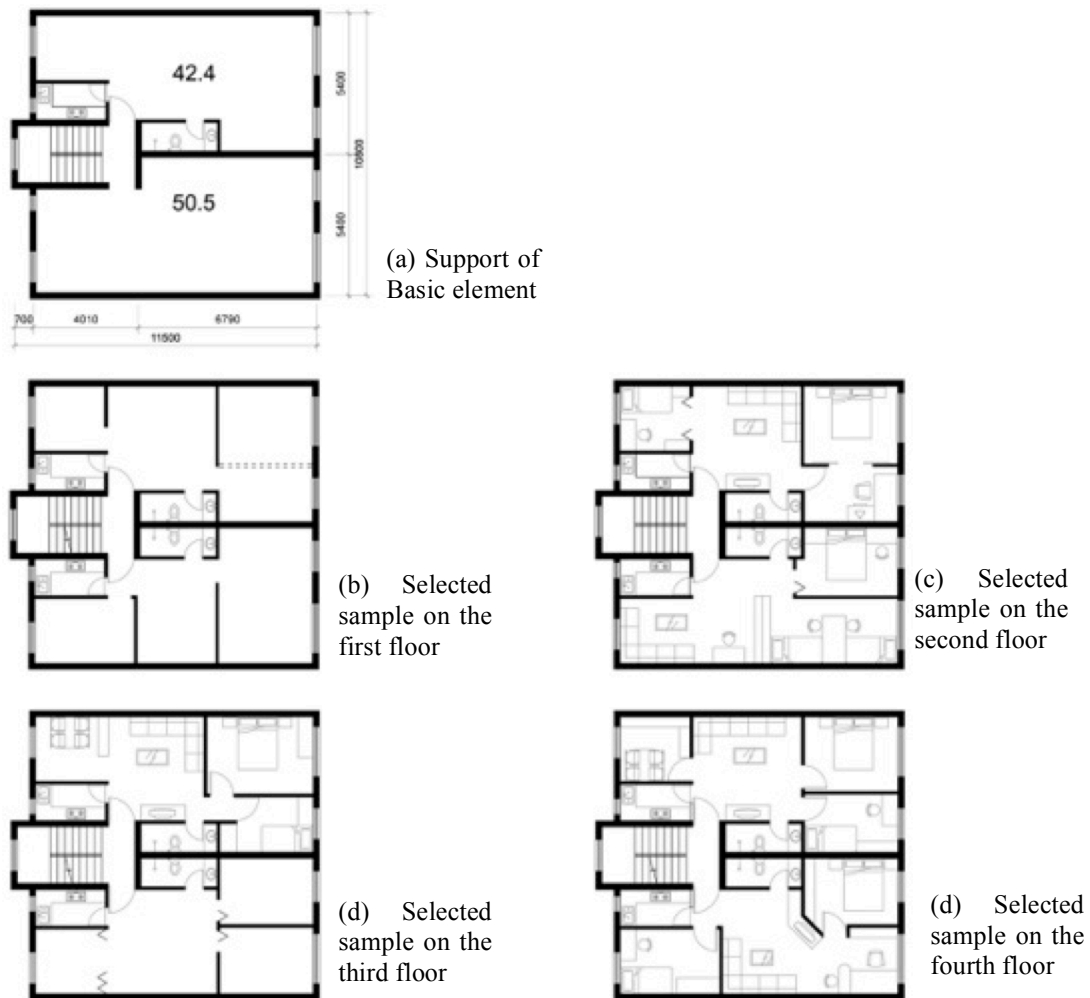


Fig. 11: Building 23 in Huawei community. (Source: by author. According to Zhou Feng, Zhang Nianceng, Zhou Peizhu. Design for Flexible and Large-span Housing and Experimental Project (灵活大开间多层住宅设计及试点). *Architectural Journal*. 1991 (12). pp.13-17.)

families were selected to practise the diversity. The internal space of these samples was designed and constructed by six factories. In this process, the material and installation of infill were primarily discussed (Fig. 11).²⁶

From 1992 to 1994, an intense research was launched by Ministry of Construction. Besides the research conducted by Prof. Bao Jiasheng, this was an additional systematic research towards Support

Building. The main task of it was to develop the appropriate infill system, which was applicable to the structural system at that time. The participating organisations included not only architectural design institutes, but also companies specialised in architectural physics, material, decoration, etc. Based on the interdisciplinary cooperation, they conducted a deep research on the dimensions of the base building, the material and construction of infill, the installation of pipelines and electric wire. As a result, a whole set of drawings was worked out as a reference. The research played an important role on the popularisation of Support Building in

²⁶ Zhou Feng, Zhang Nianceng, Zhou Peizhu. Design for Flexible and Large-span Housing and Experimental Project (灵活大开间多层住宅设计及试点). *Architectural Journal*. 1991 (12). pp.13-17.

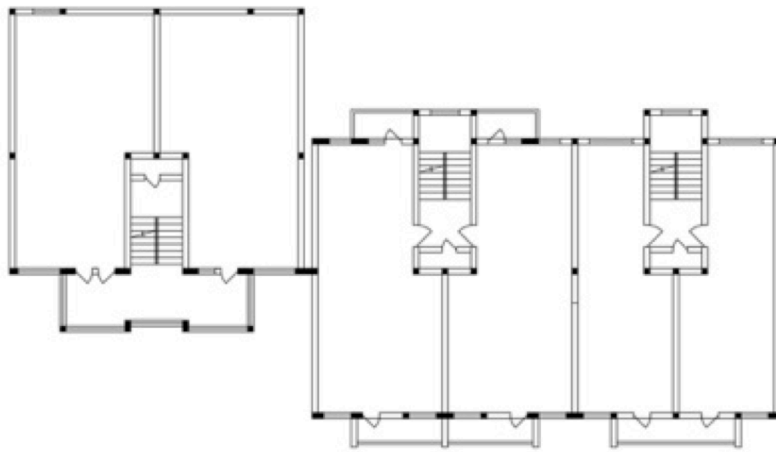


Fig. 12a: Support of Cuiwei Residential Quarter. (Source: by author. According to Research Group of “Infill System in Adaptable Housing” (1995). *Drawings of Flexible Space in Well Housing*. Beijing: China Architectural & Building Press. pp. 12.)



Fig. 12b: Photos of Cuiwei Residential Quarter. (Source: by author)

China since it made the technological details clear.

In the meantime, four experimental projects were constructed in Beijing, Changzhou, Taiyuan, and Shanghai, among which the practice in Beijing (“Cuiwei Residential Quarter”) attracted great attention (Fig. 12). Its base building is a three-storey building with three dwelling sections. Architects determined both the facade and the dimensions for each suite, whilst the subdivision of internal space was left to future users. Even the location of kitchen and bathroom could be arranged according to the user’s demand. The public pipelines were installed in the pipeline well in the staircase, and users completed the laying of

circuit branches after moving in. Similar to the “Building 23 in Huawei community”, after the construction of the base building, six suites with different areas were selected for the experiment of “infill”. With the direct cooperation of the companies at home and abroad, the diversity was fully expressed²⁷.

“Building 23 in Huawei community” and “Cuiwei Residential Quarter” were two typical cases in the 1990s. These practices had been accompanied with the revolution

²⁷ Research Group of “Infill System in Adaptable Housing” (1995). *Drawings of Flexible Space in Well Housing*. Beijing: China Architectural & Building Press.

on building structure. The small-bay housing was criticised in the 1980s for its restriction of internal space, and related research on the extension of structural span was conducted in the meantime. Support Building never connects itself with the feature of large-span. In practice, however, a fine base building was normally with a relatively large bay. If a space was designed for subdivision, the increase of its width, depth, or even height dimension was self-evident. The concept of Support Building and large-span building received a wide response, and related practice could be found in Hangzhou, Tianjing, etc. It was also a peak for the development of flexible housing in China.

When Support Building was gradually practised in multi-storey dwelling, high-rise housing developed rapidly due to its land saving advantage. As a result, this concept was applied in high-rise building as well. Similar to original practices, the most popular method adapted was to provide a spacious living space and to avoid load-bearing walls within the suites. It was found that, in practice, most projects made their layout complete before the users moved in. However, the users could change the layout without destroying the structure. Yingcui Haoting in Shenzhen (2000), Lijing Guoji in Beijing (2002), Huicui Huayuan in Shanghai (2003), Shekou Huayuancheng Phase 3 (2003), Maya High-rise Building (2007) were typical cases in this type. Within a similar shape, the specific layout could be quite different for various lifestyles. This advantage was of particular significance in commercial buildings, since it could help the housing to be accepted by the consumers.

Yingcui Haoting in Shenzhen (2000) was an appropriate example to explain the diversification. This project was next to Huanggang Port, which played an important role in connecting the mainland and Hong Kong. Provided the businessman might live in this community, both of the

two basic suites could be arranged as “house”, “SOHO”, or “business type”. In addition, the adjacent apartments could be connected as a spacious office.

Maya High-rise Building in Chongqing (2007) was another interesting project, which expressed the user’s control in a completely different way (Fig. 13). This project covered the area of about 7,000 m², consisting of two residential towers and a lower skirt section. In order to achieve maximum flexibility, frame-core wall structure was adapted instead of shear wall, which was the most popular structure in high-rise building. The layout for the whole building was rectangle, with a core-tube for vertical circulation in the centre and the space for suites around. In the original design, fifteen suites with various areas were provided for the future user’s selection. The smallest apartment occupied only half column grid (3.45m*6.9m), which was determined as a basic element, while the biggest could occupy four elements. The proportion of these suites was determined by the market. When pre-sale started, construction had just started on the skirt section. Based on the feedback acquired in the pre-sale process, the architect rearranged the proportion of suites, and the related drawing was completed for the tower building construction. Afterwards, according to additional market information, the proportion was changed for the second time to add the well-sold suites. The modified drawing was used in the construction of layers above the 25th. The repeated modification was also expressed in the facade, since different colours were given to each suite type. As a result, the external appearance was not the expression of the architect or the businessman’s preference, but a vivid record of the repeated process of decision-making.²⁸

²⁸ Li Haile & Ren Zhijie (2008). Control and Appearance of Architecture Design – Maya High-rise Residential Building Design (建筑中的控制及其显现: 玛雅上层高层住宅设计). *Urbanism and Architecture*. 2008(10). pp. 45-47.

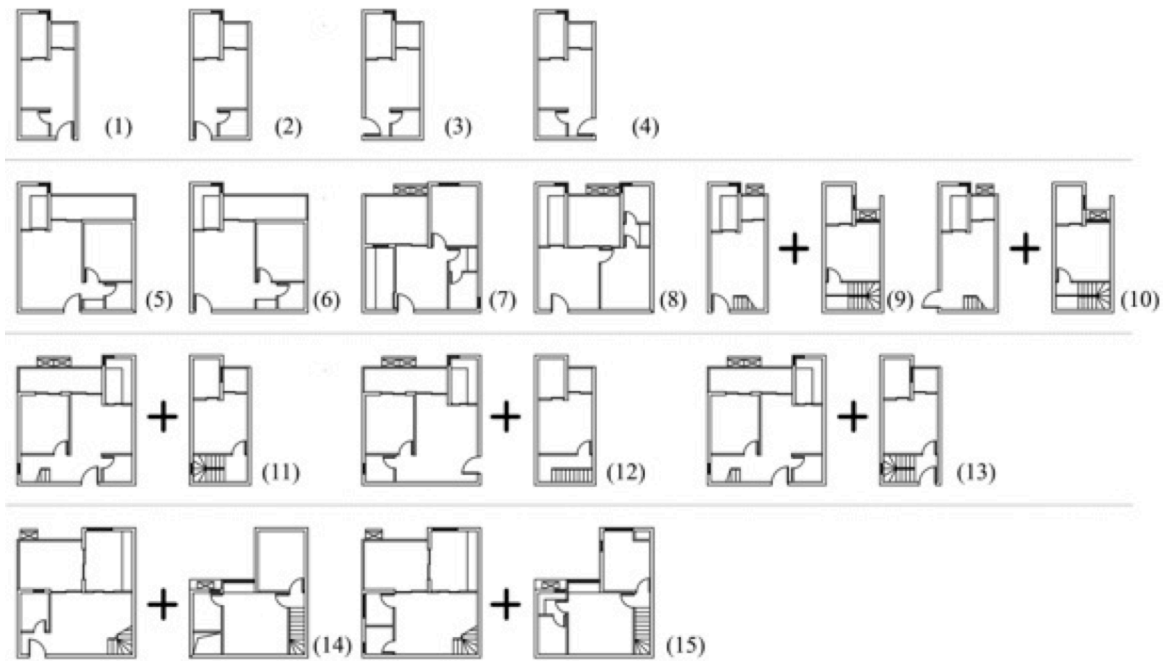


Fig. 13a: Apartments to be selected.

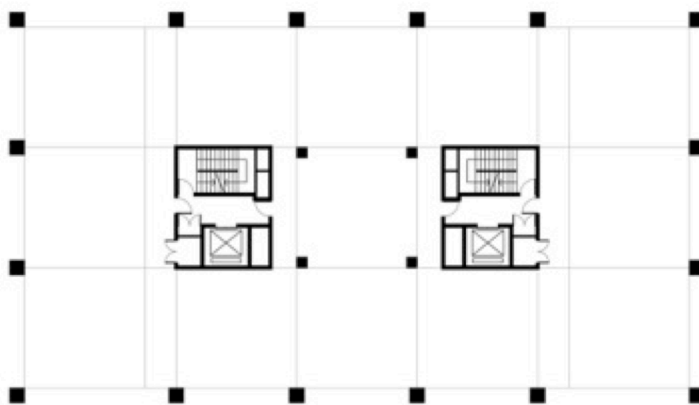


Fig. 13b: Layout of individual building.



Fig. 13c: Picture of the facade.

Fig. 13: Maya High-rise Building. (Source: 13a & 13b, by author. According to Li Haile & Ren Zhijie (2008). Control and Appearance of Architecture Design – Maya High-rise Residential Building Design (建筑中的控制及其显现: 玛雅上层高层住宅设计). *Urbanism and Architecture*. 2008(10). pp. 45-47. 13c, Ibid.)

User participation | User's control on their dwellings has always been practised in China. However, it was taken as an unorthodox activity caused by low productivity instead of a logic theory until the representative theory and practice in western country was introduced gradually. Since the early learning on Support Building in the 1980s, the user's initiative

has been primarily recognised. The research on systematic theories and practices abroad was launched only in the 1990s, concentrating on the collective decision in urban level and co-housing movements. In an unorganised way, it was initially represented as sporadic and introductory articles, among which Prof. Jia Beisi's attribution was prominent. In 1993,



(a) Structures built according to seismic standard.



(b) User participated in building.

Fig. 14: Reconstruction of ancient centre in Kashgar city. (Source: Wang Xiaodong & Ni Yiding (2011). *Old Neighbourhood Protection and Renovation in Kashgar* (喀什老城区阿霍街坊保护改造). *World Architecture Review*. 2011 (02). pp. 39-40.)

he systematically arranged this topic into four groups according to different degrees of user participation, and used plenty of practices abroad to interpret practical methods²⁹. Afterwards, a systematic and comprehensive introduction could be found in a handful of dissertations. For example: Dr. Tan Ying's research on public participation in planning and design in 2010³⁰, Dr. Zhang Rui's research on co-housing community in 2011³¹, etc. Based on these studies, professionals began to discuss the necessity of this topic, reflect on our loss, and tentatively propose the working process. There was no evidence demonstrating that Chinese practices were directly influenced by international research. However, their emphasis on users

did inspire the native study, and furthermore prompted academic attention on the initiatives embodied in self-built activity, which could be found in a few professional studies on old city or rural districts.

The respect for users, both their collective ideas and individual initiatives, was formally expressed in practices. The former was represented in the planning for Changning District (Shanghai, 1998) and the Consultative Planner Programme in Longgang District (Shenzhen, 2002). The latter was preserved in Support Building projects; however, the cooperation process of architect and user was normally skipped. Only under special conditions did architects design with individuals, represented by the reconstruction of ancient centre in Kashgar city (Xinjiang, 2009).

Xinjiang is an autonomous region administered by the People's Republic of China. For its strategic territory location, the separatist struggle of this region has never been completely extinguished. To avoid civil commotion, the state has to use more caution when dealing with its issues. In early 2000, the potential hazard of Kashgar city was observed for its location

²⁹ Jia Beisi (1993). *Housing in Long-term Effectiveness*. Nanjing: Southeast University Press. pp. 196-228.

³⁰ Qin Ying (2010). *Public Participation as Communicative Action - the Comparison, Illumination and proposition on Public Participation in Planning and Design at Home and Abroad* (作为交往行动的公众参与——公众参与规划和设计的中外比较、阐释与建议). Tongji University. PhD Thesis.

³¹ Zhang Rui (2011). *The Research of Co-housing Community Abroad* (国外“合作居住”社区研究). Tianjing University. Master's Thesis.

in the earthquake zones of the Kunlun mountain and Tian mountains. The non-restrictive and crowded dwellings forced the reconstruction, especially in the ancient city centre. The project was officially announced in 2009, and the respect for the inhabitants' opinion could be found throughout the whole process, which was conducted in four steps. Firstly, more than 20,000 questionnaires were handed out to find out if the inhabitants would like to live in this district anymore. After that, users with positive answers were suggested that they remove the old houses by themselves. And then, architects who were appointed by the government came to users and designed for them according to their precise desires. The user's confirmation was necessary for the accomplished design. Finally, the government built the dwelling structures according to seismic standard, while the householders completed the ancillary components. This project was unique in the aspect of user participation in China. Both its scale and time cycle were incredible, especially for an urban district occupied by commercial housing (Fig. 14).³²

Besides the governmental practices mentioned above, practice promoted by informal organisations emerged sporadically in the recent years, represented by "Co-housing Activity"³³ against high price of commercial dwelling in the city. Most practices were with beautiful wishes, but suffered setbacks particularly due to the state-owned property of construction land. The reverse situation could be



Fig. 15a: The framework.



Fig. 15b: The final result.

Fig. 15: Hsieh Ying-chun's practice in the reconstruction of Yangliu Village (Sichuan, China). (Source: <http://photo.zhulong.com/renwu/detail429.html>)

demonstrated by its counterpart in rural district, in which self-built activity was still preserved. In the 2000s, the unfavourable building situation and peasants' valuable capabilities began to be recognised. Several professionals devoted themselves to help the non-professional buildings, among which the Taiwanese architect Mr. Hsieh Ying-Chun is the most prominent. Since 2004, he has continued to help people in the remote villages of Hebei, Anhui, Sichuan, etc. His contribution has been to provide simplified framework for the peasants to fill in (Fig. 15). Besides, the dedication from "Non-government Organisations" (NGO) cannot be neglected, not only in professional guidance but also in financial support. During the reconstruction of the Sichuan earthquake, it played an important role in helping peasants to rebuild their houses.

³² Wang Xiaodong & Ni Yiding (2011). Old Neighbourhood Protection and Renovation in Kashgar (喀什老城区阿霍街坊保护改造). *World Architecture Review*. 2011 (02). pp. 38-43.

³³ Co-housing has a different motivation in China when compared with the practices abroad. It is activated by dissatisfaction with the high-price of housing. The promoters believe that the pursuit for profit of the real estate businessmen raises the price of commercial housing. Consequently, they tried to control the whole building process by themselves in order to have affordable housing.

The reconstruction of Daping village after a 2008 earthquake was a representative project conducted by NGO. Located in the mountains, the village had its special cohesive strength - different from the empty nest, few inhabitants went out for work. Liao Xiaoyi, as the founder of a NGO and promoter of this reconstruction, attributed this phenomenon to the inhabitants' deep love of their homeland. She believed the emotion was an irreplaceable source helping inhabitants to rebuild their home. What's more, in the long period of building their own housing, the native villagers were even more specialised in choosing appropriate methods and local materials than professionals were. Consequently, in the design and construction process, as many issues as possible were determined collectively. For instance, the overall layout was approved by the villagers, the average size for each person was fixed by inhabitants, the type and area for their dwelling were selected by householders, and all the dwellings were built by villagers. Besides, the academic lessons of architectural design and construction were taught by experienced experts in order to improve the inhabitants' participation capability. In the meantime, the title of "Local Engineer" was established, which was given to the most creative "designers". This method was not only conceived to encourage the inhabitants' creativity, but also to select the talented ones who would be the backbone force and local experts in the future construction.

BRANCH 3: LONG-TERM EFFECTIVENESS

Reflection on service life | When quantitative shortage of housing was relieved in the 1990s, professionals and the authorities began to reflect on the losses in the past development, among which the limited service life of housing was the most prominent aspect.

Although the authoritative institute gave no precise answer, the limited life of dwellings has been indicated by some explanations from native specialists. In his master's thesis, Xie Shanpeng cited seven professionals' judgements, in which thirty years was recognised as the average life of modern urban housing.³⁴ This means the average life of housing is much shorter than the expected number of more than seventy years.

This phenomenon was originally predicted in 1990s in the criticism on user's repeated renovation. With the improvement of people's living standard, simply furnished apartments were no longer satisfactory. Depressed occupants decorated houses by their own hands - to repaint the wall, to relay the pipelines, to change the equipment, or even to move the partition. Excessive renovation caused a serious waste and negatively impacted on building structure.³⁵ The discussion on building life was motivated sporadically in the criticism on excessive decoration, and has drawn wide attention since the 2000s.

While the problem came to be realised, responsible scholars began to explore the factors attributing to this phenomenon and seek for a solution. Besides blind policy, the inadaptable space and difficult maintenance were taken as two major reasons. For the former, the changeability of internal space was still advocated. It was no longer an approach towards diversification, but a remedy to the inevitable and forced change in the future. To the latter, the intense work was concentrated on the organisation of pipelines. The discussion on this problem

³⁴ Xie Shanpeng (2012). *Probe into our city housing useful life* (我国城市住宅使用寿命探讨). Xi'an University of Architecture and Technology. Master's Thesis. pp. 25-35.

³⁵ To deal with the damage of structure caused by repeated decoration, the roughcast housing was approved by the state in the 1990s. However, it was soon substituted by the well-decorated housing.

began in the research on flexibility in the 1990s. Since both the bathroom and partition could possibly move, the change of pipelines and electric wire had to be prepared correspondingly. It was essentially serving for the diversification and subsequently focused on the components which could be moved by users. Research in the 2000s treated it with a different objective. Based on related research abroad, it was perceived that the service periods of various components could be quite different. And these components were advised to be separated in case of future maintenance as a response to the ageing problem.

Chinese research in this branch began by learning from Japan and was supported by the development of industrialisation. The building quality in its whole lifecycle - from design, construction, use, to demolishing - was paid equal attention.

Inspiration from Japan | The earliest attention on flexible housing in Japan occurred in the 1970s. Similar with the experience in China, it began with introducing the Support/Infill concepts, architectural methods, and existing European projects, and then put the methods into practice. As one of the important developments, Century Housing System (CHS) started in 1980 with the aim of extending the life of new housing. In its approach, based on the interface problem study, components with shorter durable years were separated from the longer durable components. “For example, piping and wiring must not be buried in cast concrete or other structural components”. Raised floor was generated consequently. CHS was normally combined with the Two Step³⁶ method in practice, and dozens of projects were built, such as the Next 21 project in 1994.³⁷

³⁶ Two Step method refers that the architects design the collective sections, while the users decide their individual space.

³⁷ Stephen Kendall & Jonathan Teicher (2000). *Residential Open Building*. London: E & FN Spon.

Early in the 1980s, widespread interest in Japan’s practice began to surface in China, led by the China Institute of Building Standard Design & Research (CIBSDR)³⁸. From 1988, a close corporation was built with CIBSDR and Japan International Cooperation Agency (JICA), which was chartered with assisting economic and social growth in developing countries in order to promote an international cooperation.³⁹ In the following twenty-plus years, a number of specialists were sent to China and helped the local architects with housing development.⁴⁰ The assistance was concentrated on design method in the 1990s, in which the large-scale investigation on living conditions and the research on well housing were prominent results. In the 2000s, further guidance was made on industrialisation, such as building units and their interface. The concept of CHS and Two Step moved into the view of Chinese architects and then real estate developers. Further visits were made by them, especially on the related projects. In the annual conferences for information exchanging in 2007, it was formally decided that the mature industrial

pp. 17-26.

³⁸ CIBSDR is affiliated to China Architecture Design & Research Group, which is a state-owned institute, and previously was attached to the Ministry of Construction. Due to its property, this enterprise takes on not only design, but also plenty of scientific research especially on housing. In the past years, it played an irreplaceable role in improving the design and construction of housing.

³⁹

http://en.wikipedia.org/wiki/Japan_International_Cooperation_Agency

⁴⁰ Liu Dongwei, Jiang Hongbiao, Yu Lei (2012). The Development of Housing Industrialisation in China and the Technological Development (中国住宅工业化发展及其技术演进). *Architectural Journal*. 2012 (04). “There were totally four projects in twenty years. (1) Research on comfortable residence in cities (1988-1995); (2) Research on advanced housing technology and training centre (1996-2000); (3) Residential performance identification and building units qualification (2001-2004); (4) Programme of prompting residential energy-saving (2005-2008).”