technology in Japan could be practised in China.

“Little Universe” | “Little Universe” is the first project under the concept of CHS and Two Step. Its architect, Dr. Liu Dongwei, is the chief designer of CIBSDR who possesses deep interest in housing since his PhD years. In 1992 and 1998, he studied in Kyushu University and Osaka City University, respectively, as visiting scholar, and gained profound enthusiasm on Japan’s practice. He was persistent that Japan provided a fine example in extending a building’s life, and the support of imported technology prompted him to conceive an actual project. His genius and ambition were highly appreciated by Mr. Yang Shuangxi, who was the open-minded chief executive officer of the real estate company “Ideal World Group”. Based on Mr. Yang’s full support, the experimental project “Little Universe” was realised in Beijing in 2010.

The whole project consisted of eight residential buildings accommodating 486 families and two public buildings. For the

Fig. 16a. Overall layout of Little Universe. (Source: provided by the architect.)

Fig. 16b: Footsteps are avoided in open space. (Source: by author.)

Fig. 16c: The ring circuit. (Source: by author.)

Fig 16: Little Universe.

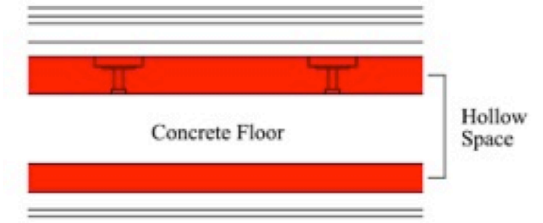
strict restriction on height, the buildings were only six to nine floors although the floor area ratio was fixed at 2.2. The facade was deliberately manipulated to create a pleasant scale. The open space between buildings was well designed by a Japanese company, and a ring circuit was designed to reduce the cars' interference. Important was the fact that, there was not any footstep in the open space. The architect's humanistic care of the elder, the disabled, and children have been fully interpreted (Fig. 16).

Its pursuit for long-term effectiveness was expressed above all in durable structure. Different from ordinary housing supported by brick, this project adapted concrete block with steel reinforcement, which had better performance in durability and maintenance. The block served not only as structure but also as decoration - traditional decorative material, such ceramic tile or coating compound, was excluded for their falling off had negative influence on the entire appearance. It was customised in factory and the colour chosen by the architect was similar to the brick. It seemed to be slightly dated to be coordinated with the ancient atmosphere in the district and the whole city (Fig. 17). This concept was accepted by both occupants and visitors. They felt that the community could grow up, accompanying users instead of remaining fresh and isolated. [41] Additionally, the architect was so impressed by the damage of facade caused by an aged external thermal insulation system that he adapted internal insulation, which was the minority in housing.

Inspired by Japan's practice, current dwelling's bad performance in durability was attributed to burying all the pipelines under the structure. The service life of the structure was designed for a minimum of fifty or seventy years in China, whilst

[41] China National Engineering Research Center for Human Settlements. *The Design and Technology of SI Housing (SI 住宅建造体系设计技术)*. Beijing: Architecture & Building Press. pp. 18.

Fig 17. The material of the façade. (Source: provided by the architect.)



(a) The construction. (Source: by author. According to China National Engineering Research Center for Human Settlements. *The Design and Technology of SI Housing (SI 住宅建造体系设计技术)*. Beijing: Architecture & Building Press. pp. 49.)

(b) Point-supporting form. (Source: provided by the architect.)

(c) Photo. (Source: provided by architect.)

Fig 18. The raised floor.

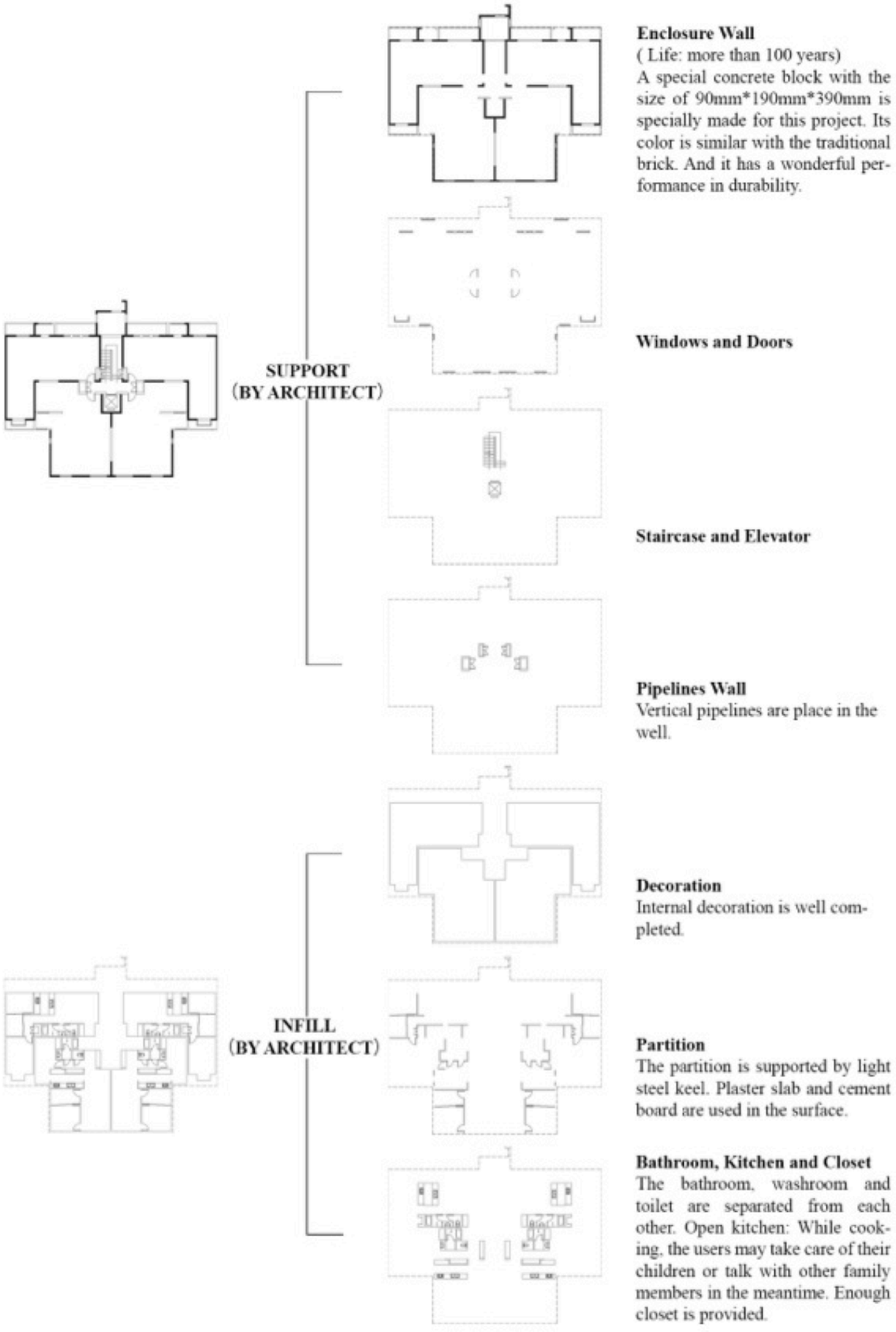


Fig 19: Layouts of typical units in Little Universe. (Source: by author.)

pipelines and equipment were normally with a maximum of ten to twenty years of service life. The mismatch indicated that two or three renovations against ageing could not be avoided in the whole life of dwelling. These renovations, no matter the collective routine maintenance or the users' automatic activity, inevitably had a negative impact on the durability of the whole structure.[42] In response, the separation of structure and matching facilities was the most important task in this project.

The popular approach adapted in Japan was to raise the floor 300mm from the slab, allowing the configuration of pipelines and wirings. For the source or lamps, flat wires were pasted on the wall and ceiling respectively. In this project, the floors were raised with Japan's point-supporting form, which was beneficial for pipeline laying (Fig. 18). However, the flat wire was declined, for using it instead of the normal round wire was quite impractical. In order to hide the wires to the partition or ceiling, double ceiling, and steel frame partition were adapted.[43]

The steel frame partition preserved the possibility of the users' re-division of interior space in the meantime. This requirement was illustrated by the possible change for two typical suites. The architect was convinced that within a family's whole lifecycle, there could be three different stages and at least two sub-divisions should be preserved in each suite. However, he never emphasised this aspect. In the interview with him, he mentioned nothing about the possible change in different family stages, and neither did he talk about his control of dimension with this aim. Conversely, he indicated that slight changes could be made but with the unexpected requirements, while users may move out instead of taking complete renovation when the apartment was no longer appropriate for their family.[44] Nevertheless, according to the post-occupancy investigation in 2012, some occupants had made slight changes to the partition to rationalise their suites. All of them highly valued the partition for its excellent performance in changeability.[45]

Little Universe has played a model role in the research on long-term effective housing (Fig. 19). In November 2009, "China International Exhibition on Housing" was held in Beijing, in which the exhibit included a sample house named "House of Tomorrow". The advanced concept and technology elicited strong reactions from professionals and organisations that specialised in long-term effectiveness and industrialisation. In 2012, the other experimental project Nanxiang began in Shanghai.

China Skeleton Infill Housing | The other counterpart is the research in Jinan (Shandong Province). Early in 2004, the experience on industrialisation, CHS, and Two Step in Japan has drawn the attention of government officials in Shandong province. In 2006, the research on the combination of Japan's practice with China's reality has been formally conducted.

The profound achievement was represented as "The Technical Guideline for Construction of China-Skeleton-Infill Housing" (CSI), which was released in October 2010. In this guideline, the separation of Skeleton (referring to the

[42] Liu Dongwei et al. (2009) Research and Development of Life Cycle Housing System by the Concept of Long-lived Habitation and the Demonstration of Project Construction. (百年住居建设理念的 LC 住宅体系研发及其工程示范). *Architectural Journal*. 2009(08). pp. 1-5.

[43] China National Engineering Research Center for Human Settlements. *The Design and Technology of SI Housing* (SI 住宅建造体系设计技术). Beijing: Architecture & Building Press. pp. 36.

[44] Interview with Mr. Liu Dongwei.

[45] Miao Qing (2014). *Investigation and Analysis on the Living Situation in CSI Housing. (CSI 住宅的居住状况调查与研究分析)*. Tongji University. Master's Thesis.

durable and public components) from Infill (referring to the flexible and individual components) emphasised equally CHS and Two Step. As CHS, it was regulated that the short-lived components should be separated from the durable components. For example, the water supply and sewage piping, heating system, electric lines were separated compulsively from the structure. And the changes of the former should not disturb the latter. [46] Meanwhile, in accordance with Two Step, the ownership or control was emphasized as "the individual parts are separated from the collective parts". For example, "collective pipelines are supposed to be placed in the independent vertical well, and the connecting pipelines linking the collective to private cannot be intervened. In addition, the details on design, construction and acceptance were specifically regulated.

It seems that the role of users was deliberately weakened except the item that "at least three changes are suggestive to be conceived in each suite. Large-span structure and changeable partition are recommended in order to make the change possible"[47]. That was the direct result of the popularisation of commercial housing. The user's change of their dwelling was still prepared for the functional long-term effectiveness. However, it cannot be excessively advocated for two reasons. First is that the preoccupancy change seems to be not necessary since commercial housing has provided enough choice for consumers, while the individual activity before or after occupancy seems to go against the overall trend of industrialisation. Second is that the process of change will cost considerable time and energy. When the apartment is no longer appropriate,

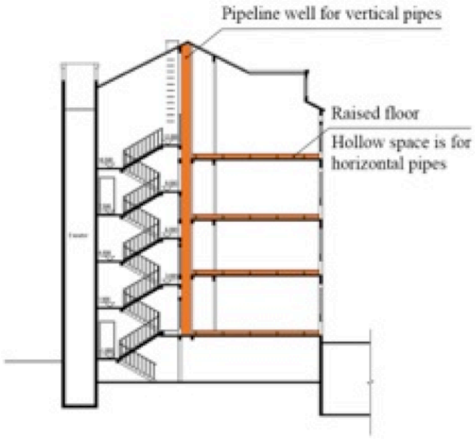


Fig. 20a: The arrangement of pipelines. (Source: by author. According to original drawing provided by the architect.)


Fig. 20b: Photo of external appearance. (Source: by author.)


Fig. 20c: Raised floor. (Source: by author.)


Fig. 20d: Interior space. (Source: by author.)
Fig. 20: Experimental project in Jinan.

[46] Centre for Housing Industrialisation attached to Ministry of Housing and Urban-Rural Development of the People's Republic of China. (2010). *The Technical Guiding for Construction of China-Skeleton-Infill Housing*. Beijing: China Architecture & Building Press. pp. 5.
[47] Ibid. pp. 4-5.