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A Study of Sustainable Social Housing Community Design in Britain and China

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Abstract

Britain and China have experienced periods of rapid population growth and inadequate housing construction. Social housing is a form of housing tenure easing the housing pressure. It solves residential demands of different living patterns in middle to low-income groups. The sustainable strategy lies in three aspects:1. Making utmost use of the local natural environment; 2. Providing reasonable public space and suitable traffic to revitalize community awareness; and 3. The holistic design of multiple dwelling units for different people and long-term needs. This paper shows two projects – Park Hill in Sheffield, UK and Longnan Garden in Shanghai – as precedents of how to design social housing with sustainable approaches by following the local natural characteristics, by respecting traditions and the different demands of residents and the long-term housing usage. UP TO HERE Compared with China's 20-year social housing development, that in Britain has a long history and presents complicated multiplicities, could provide significant references. This paper shows that such communities could be design in steps: using the organic gallery apartment building layout, the special corridor system connecting the public function to neighborhoods, SI House theories optimizing the hostile design of dwelling units and components. During the design, the local nature and tradition should be respected. Specifically, the Park Hill is built up along the sloping field, four types of apartment units are based on the traditional terraced house, designed holistically for different families; the deck, which is called "street in the sky", is not only the traffic but also the active place promoting public and neighborhoods relationships; the renovation design retains the former structure and makes the maximization of indoor flexibility. Longnan Garden is surrounded by existing resident districts; the organic planning based on the traditional courtyards ensures the enough sunlight and river views in the community; the community environment is improved by the courtyards, which include the ground area and roof gardens; elevated corridors run through courtyards connecting common rooms on the second floor; the 7.6-meter-height skeleton is innovated from SI housing and the experience of European social housing. The paper summarizes the development tendency of social housing and provides reference for future.

Keywords: Sustainable, Social Housing Community, SI Houses, Regional environment, Traditional intention

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1. Introduction

Social Housing Communities have become an essential topic for residential planning and design in Britain and China. There are different special situations affecting the development of social housing communities:

After the second world war, due to the war destruction, residents displaced, baby boom and post-war economic revival, cities faced the serious housing crisis. Western countries almost focused building social housing. Park Hill is a typical post-war social housing estate in Sheffield, Britain. Sheffield is a traditional labor-intensive industrial city, which is famous for stainless steel. The steel-works and heavy trade attracted the immigration of rural manpower, with the factory mechanization, each ton of steel produced required less manpower and more skilled teamworking, part of this expansion occurred slums increasing. The growth rate of Sheffield's population after war leveled out a maximum population increase of 6 percent [1]. The requirement of residence grew rapidly, almost half residents would be for slum-dwellers. To solve the habitat problem, architects decided to put accommodations as many as possible and almost all city functions into one monolithic building, so Park Hill was designed by Jack Lynn and Ivor Smith and built up during the nineteenth century in a network of slum streets and courtyards with an enormous volume. Flat types vary to provide accommodation for one to six-person families, so that the building could be satisfactory for different people. It started as a thriving community for Sheffield's council tenants, but quickly descended into a sink estate. Due to the long-time wind and rain erosion and the replacement of inhabitants, the environment of Park Hill began to decline. Especially the wave of unemployment in the 1980s, crime and poor hygiene occurred in the high-density neighborhoods of Park Hill. Facing the post social housing time, the Park Hill was renovated to a comprehensive residential area, which contains social housings, flats and offices (Fig. 1). The structure was preserved, changing the indoor layout, components and so on. It is like the concept of Skeleton Infill Houses (SI Houses), which is fixed structure and variable interior.

The Social Housing is called as the Public Housing in China. It mainly solves the difficulties of housing requirements for lower middle-income groups. During the reforming and development of housing system in China, the Social Housing Community has been gradually becoming an important type of urban communities. The urbanization of Shanghai needs young labor and talent input. Longnan Garden is a sustainable social housing estate lying near Huangpu River (Fig. 1). It has effectively alleviated the housing difficulties for new employees in Shanghai. The estate focuses on the urban housing

demands for young high-quality talents who prefer to rent house in low price instead of buying a flat. Most of residents are young married couples or single. They accept small enough and flexible space for living. There are eight buildings in the estate, of which five are sets of small apartment units, two are sets of single dormitories with one for independent commercial building [2]. The community challenges the change of ultra-small house space and giving the possibilities of integrated use. The estate abandons the normal high-rise residential layout, experimenting the concept of courtyards context to balance the natural conditions and living comfort. Corridors from different level connect the public function and dwelling units. The designers of Longnan Garden summarized the law of European social housing development, considering the long-term needs after the period of maximum demand for social housing. So, the support structure is 7.6-meter concrete frame with the two-level steel structure indoor, this kind of structure could afford more flexible space and easier transformation than the normal shear wall structure.

Figure 1: Park Hill Community and Longnan Garden.

2. State of the Art

2.1. British Terraced Social Housing Experiment

The Terrace Housing is an appropriate housing type to combat urban sprawl in Britain. Its character is that a row of identical or mirror-image houses share side walls. The two-floor style is like the townhouse. Each house has its own front door opening to the street and the back yard is the necessary space. It retains a connection to the ground, unlike high-rise apartment towers. It is also an appropriate typology for housing the growing number of single-person households, single-parent households, childless couples, the divorced and the eldly [3]. Since the Second World War, many outdated or dilapidated terraces have been demolished for tower blocks building, because the high-rise apartments occupy a much smaller area of land. However, the research reported

by English Heritage in 2005 demonstrated that the traditional terraced housing actually costs less to maintain and occupy over the long-term life of the dwelling than more modern housing, largely due to the quality and life-span of the materials used. Sydney Cook, the famous social housing experimenter, paid attention to the superiority of terraced housing in social housing development, creating a low-layers and high-density [4]. Jack Lynn and Ivor Smith, the architects of Park Hill, they arranged the dwellings inspired from the terraced houses.

2.2. The development of Social Housing in China

Housing security is an important component of social security. After the reform and open-up, Chinese housing policy turned from welfare housing of government allocations to the cooperation between the commercial housing market and housing security system [5]. The social housing is the integral part in the new housing supply system The Ministry of housing and urban-rural development made an announcement that building the Chinese social housing, which is called public affordable housing in 2011 [6]. In the future 5 years, there will be 36 million social housing estates constructed in Chinese town and the acreage of social houses should account for 20% of total residential areas [7]. The present situation of Chinese social housing faces several negatives: 1. Poor adaptability and sustainability: the limited inhabit area is fixed and built in normal form for living function only; 2. The gap between the design and fact requirements: the government and the designers are still the leader in house design, the dwellers just take part in the trade, there is little negotiation between designers and users, residents are in a passive state so that usage problems are often occurred. 3.The Chinese housings are usually built in the style of high-rise apartment, it is a sort of high-density housing, though it is the effective to solve the living problems for huge population in tight land, not only the nature environment but also the society environment of community needs to be enhanced. It is phenomenal that housing demand is turning from quantitative increments to the qualitive improvement and form frequent renewal of existing houses to long-term housing possession and management in Chinese cities [8]. In 2006, the Chinese skeleton and infill (CSI) housing system was built accumulated the SI housing experience of Netherlands and Japan [9]. The characteristics of SI housing are adapted to the growing requirements for social housing development.

2.3. The concept of SI House

SI Housing system is originated from the open building theory, which is first articulated the principles by John Habraken. Under the guidance of professor John Habraken, the Stichting Architecture Research (SAR) was held in Netherlands, which is the institution specializing in the study of support structure and infills. The open building is an architectural method to design buildings that takes account of the possible to change or adapt the building during its lifetime [10]. The key to SI housing is the separation of buildings' Skeleton and Infill. The Skeleton includes structural elements, for instance, beam, plate and column; the Infill includes the change parts of building quality and usage update requirements, for example, nonbearing walls, windows and interior decoration [11]. The Skeleton has high durability and the Infill part is alternative according to the dwellers' needs. The house built in this approach could be more adaptable and sustainable. After World War II, most of countries carried out large-scale and standardized construction of housing, so that the housing style gradually evolved into a paradigm. As a result, there is almost the same residential pattern without considering the characteristics. The research of the SAR for the housing considers the diversity of housing to fulfill different dwellers' demands, so more and more governments and institutions pay attention on the SI house system.

As John Habraken argued that housing must always recognize two domains of action: the action of the community and that of the individual inhabitant [12], in the sense of use, the SI House also separates the common part and private part. The common part is regard as S-part and the private part is I-part. It is essential to be durability and security through professional maintenance and updating for S-part. And I-part should be changeable that resident could redesign indoor to adapt their different demands. Two parts are connected flexibly that there is no gap between the community and individual.

In contrast, the Skeleton and Infill parts of the traditional dwelling are fixed together, the space is uniformity and rigidity. The SI house has several advantages [13]:

1. Instead of the communal pipes in traditional dwellings, the SI houses separate the specific pipes from the public ones, so that it is convenience to maintain the parts in the process of running.

2. Comparing with the traditional houses, there is the clear about the rights of proprietary and utilization in SI houses. It is benefit to the implementation of management responsibility.

3. The working life of the SI house is longer than that of the traditional dwelling. It shows mainly two aspects: first, stable structure could achieve hundred years of living requirements, the indoor materials could be recycling used; second, the flexible infill could be adapted not only the function of dwelling but also the usage of post-housing time, the indoor space could be easily reused in hotel and so other commercial needs.

As the practice of the open building theory in the field of housing, the SI house has experienced the development and evolution of nearly half a century. Since the 1990s with the introduction of sustainable architecture, many characteristics of the SI houses have been endowed with a new meaning of sustainable development. For instance, Kodan skeleton and infill (KSI) housing system has been carried out by Urban Renaissance in Japan. The infill is separated from skeleton completely, it could alternate the indoor without damage the housing structure to fulfill the different demands based on age change. In practice, the KSI house improves Japanese housing sustainability, extends the dwelling life and improves the efficiency of resource utilization [14]. The government of Malaysia also carries out Industrialized building system (IBS) to regard the separation of skeleton and infill as the essential indicator of sustainable residential industrialization [15].

3. Methodology

3.1. Fieldwork

It is necessary to get the original data of the estates through the fieldwork. The foci of the fieldwork were on views of the local on development of sustainable social house, recording the existing situation and influence of change for the regional environment. For instance, the photos taken at the scene contrast the old and new texture of Park Hill, visually and the walking experience has acquired the traffic and layout characteristics from the slope site. The adaptation of house sustainable unit for the young was understood through the interviews of residents in Longnan Garden. Fieldwork is conducive to get the details and supplement the research information from the literature.

3.2. Literature retrieval

The theories may provide the foundation for understanding the development of social houses. Information retrieval includes three aspects: first, the records of social housing

development of two countries; second, the information of the estates and the appropriate design theories finally. To study British social housing, it is necessary to discuss the traditional houses, such as terraced housing, and the design of Park Hill estate is based on the traditional planning. The Longnan Garden is a representation of Chinese sustainable social housing community, which has the special planning and connection learnt from Chinese garden space theories. The concept of SI housing is also considered in realizing the sustainability of social house estates.

3.3. Comparison

The study on social housing focuses on the comparison between two constructed estates from Britain and China. Both of two countries attach importance to indemnificatory housing in urban renewal. The British social houses are classical to solve the housing crisis. As the most populous country, China regards the development of social housing as the key to solving the lack of housing under the rapid process of urbanization. Though there are different development degrees and backgrounds between two countries, they all pay attention to the role of housing security in urban renewal and development. The comparison of two sustainable social housing communities mainly discussed the context situation and the design strategy. In terms of the design strategy, it mainly included layout planning and dwelling unit design and so on. By summarizing the commonness of two precedents, the trend of sustainable social housing development is revealed: 1, the profiting crowd is middle and low- income population for social housing; 2, two layout planning's made full use of the site advantages and the disadvantages of the land were weakened by the sustainable design; 3, the holistic design is the essential part in sustainable design of social house; 4, considering the space function for post-housing time should be the feature of sustainable social housing community, durability reflected not only in quality but also in service life. At the same time, the regional characteristics and local tradition influence the sustainable strategy in each estate.

4. Result Analysis and Discussion

4.1. The organic planning based on local charactirestics

The Park Hill estate is on the hilltop in the east end of Sheffield, UK. The social house community is built following the hillside (Fig. 2). The site is steeply sloping, enabling

the designers to maintain a constant roof level though the buildings ranged from 4 to 13 storeys. The scheme is divided into two parts (Park Hill 1 and Park Hill 2) by an area of flats erected in Part 1 site is a wide platform in the hillside, with a constant fall towards the north. That of Part 2 is the hilltop with a panoramic view of Sheffield below. The landform of stage 1, as it drops and narrows towards the north, a continuous building-form was designed to make use of this constant fall of the site for providing ground-level entry. The obtuse angles were defined by the prevailing south-westerly wind, the continues layout-planning with the range of angles provided the panoramic views across the city and form a series of connected courtyards around the buildings at the same time. The elevated position afforded residents broad scenery and reduced air pollution from industries to the northeast. Because of the limited site, the shape of the building is long and continues belong the terrain. It stands formidably on the contours of the hill, drawing a unique skyline and fulfill the residents welcomed cityscape.

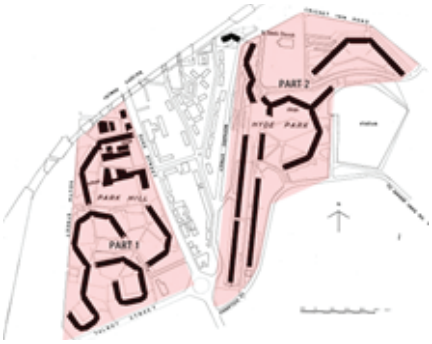

Figure 2: Park Hill Planning.

Comparing with the continues building-form of Park Hill community, Longnan Garden is a combined type construction consisted of eight buildings. The estate gave up the high-rise and low-density determinant housing pattern and used panel housing pattern with courtyard groups instead (Fig. 3). There are a large number of existing residences to the east, west and north of the site and Huangpu River is close to the west. So that the impact of sunlight and the unobstructed river view should be considered. Four U-style and seven-floor social dwellings were settled on the north of the site and their entrances of the semi-enclosed shape are opposite, to avoid self-shading and satisfy the sunlight of the bottom. In the south, three backward buildings lead down progressively towards the riverside to weak the barriers of sunlight and landscape. These three high-rise residences away from sunlight calculation, from west to East are 12-storey small skip-floor apartment, 7 to 12-storey corridor type small apartment, 8 to 17-storey single dormitory [2].

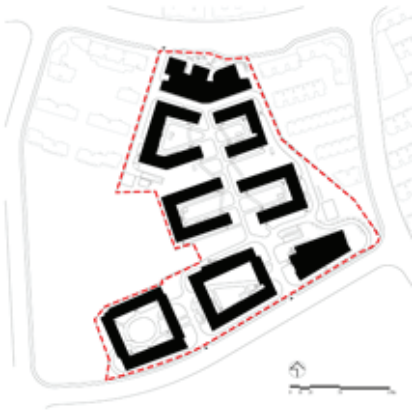

Figure 3: Longnan Garden Planning.

4.2. Sustainable dwelling units design

The dwelling units of Park Hill estate are arranged consistently inspired by the traditional terraced houses in Britain. Each of these units contained a one-bedroom flat (yellow), a two-bedroom flat (blue), a two-bedroom duplex apartment (red) and a three-bedroom compound apartment (green). The types of apartments varied to provide accommodations for one to six-person families. Four types of apartments occupied three storeys in vertical. Three levels are connected by the H-frame containing the stair columns and the litter tunnel. The entrances of four inhabited units were arranged on the same side of the corridor deck in the second level (Fig. 4). This shape also gave each household privacy and quiet. The former style of the aesthetics was Brutalism: the skeleton was the exposed reinforced concrete structure with the brick curtain walling in purple, terracotta, red and cream. Concrete is widely used because its economy and durability are suitable for cheap construction in large numbers. The renovation kept the former concrete structure and got rid of the indoor decoration, creating the open space indoor and more nature light to enhance the living condition.

Due to the guide rule of social housing and the land price in China, the dwellings are narrow and small. Longnan Garden is a social housing community mainly for young people. Because of its cost-effective and flexible compact space, the minimal house type is fit for the single and young couple. The concept of SI housing was considered in sustainable dwelling units design. The storey height of normal public house is from 2.7m to 2.9m and it is too limited to change for other function. The research team created a 7.6 meter-height reinforced concrete skeleton in No.5 apartment, which is separated into 2.8m, 2.0m and 2.8m, containing two jump-layer houses (Fig. 5). Each jump-layer house is around 25m^2 including one bedroom, one living room & dining room space, kitchen and toilet. The steady unit is the 7.6m height skeleton including two dwellings

vertically, the pipelines are exposed for easy maintenance. It is not only the challenge of space settlement in minimal social houses but also the sustainable strategy of long-term usage adapted to flexible function.

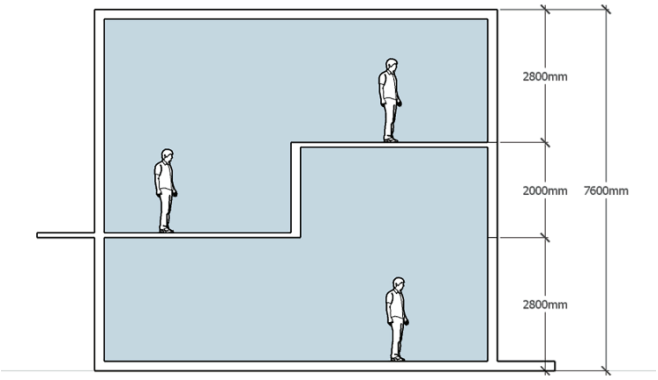

Figure 4: Jump layer of the unit in Longnan.

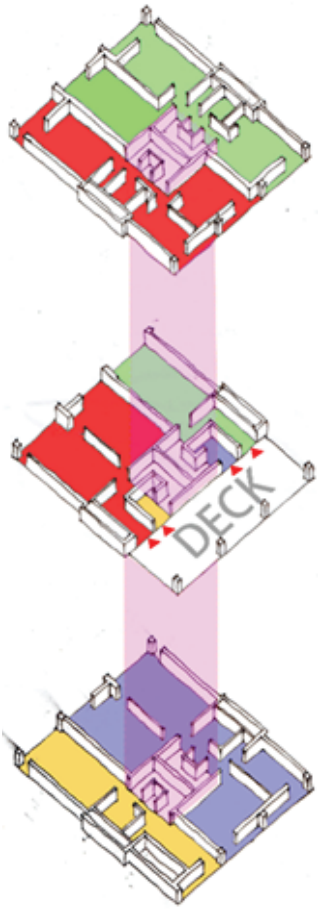

Figure 5: The dwelling units of Park Hill.

4.3. The resilience of community through the special traffic and public function

The Park Hill is a high-density environment and a comprehensive micro-society. It used to gather 995 flats for 3000 people [16]. There are a shopping mall and a community centre at the end of the building, of the northern lowest point of the site. Now the area has its own nursery school and bigger playground on the courtyards surrounded by the building. Inspired by Le Corbusier's Unité d'habitation and the Smithsons' unbuilt schemes, the Park Hill estate includes an ingenious corridor every three levels, which is regarded as the street in the sky. The series of horizontal access 'decks' in front of the entrance doors of apartments are the mainly active places. They are not only mainly traffic paths but also wide enough for daily public lives (Fig. 6). Through the renovation of Urban Splash in 2007, the horizontal access of traffic renovation still makes use of the streets in the sky, even though the decks are encroached a little by dwellings, they are provided a significant threshold, a public space, to each group of four dwellings. In the vertical traffic, the lifts and stairs are set within the structural frame shows masterly respect for what existed before.

Figure 6: The street in the sky.

In the situation of narrow and small dwellings, the open spaces are the most important activity places in Longnan Garden. 'The smaller houses, the more public space' is the strategy of balance the efficiency and environment in the community. There are numbers of two-storey-overhead semi-outdoor spaces in the northern multi-layer area. There is a common place on the second floor in each building of the community and two overhead corridors connect these common places together (Fig. 7). The concept of corridors and courtyards are from the tradition of Chinese garden. The courtyards are not only consisted by the surrounding of the layout planning, but also reflect in the public balconies and roof gardens. There is a prominent public terrace on the corridor every two storeys of the dwelling, which is to get the sunlight from east and west. The roof gardens cover the residences fully with the cultivated plants, the plants and the roof pools could reduce the indoor temperature and save energy. The corridors are

not only the horizontal traffic connecting the separated buildings but also the meander paths through the landscape of courtyards. The regular arrangement common places break the closure of communication in neighbours. Vivid accesses and public functions contribute to the vitality of the community.

Figure 7: Corridors, courtyards and dwellings.

5. Conclusion

For the two communities in Britain and China, though the period and backgrounds are different, they are all built to solve the urban housing problem for low and middle-income groups. To fulfil the sustainable, it is basic that the design should be suit to local conditions, such as the strip layout along the hill and the enclosing layout among the high-density district. Durability is the key not only in structrue but also in usage, it is necessary to consider all ages and kinds of inhabitants with the adaptive unit design. the theory of SI House is the way to balance the sustanability between structure and function. And community transportation is regarded as the essential element enhancing the community sustainble, because the communication could be stimulated by convenient and open traffice place, the connection place could be not only the transportation place but also the platform of public activities. And green public place like courtyards are necessary. The key role of sustainable social housing community is to stimulate the vitality and interpersonal communication of community life through approaches. The sustainability of social housing community should be not only in physical property, but also in the ability of community.

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Conflict of Interest

The authors have no conflict of interest to declare.

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