



REVIEW

Challenge-driven design for public housing: The case of Hong Kong



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Abstract

Public housing (PH) has existed in Hong Kong for six decades. Previous and current challenges that have been encountered over time function as a collective driver for design progression. However, such challenges have remained under research to be able to draw useful lessons from them. To understand how this established motif can suit the sustainability-conscious era, this study uses Hong Kong as a representative case for sub-tropical compact cities by critiquing its PH design against multiple constraints. The objective of this study is to trace the historical relationships between challenges and design progress as well as to assess current and future implications of sustainability trends on PH design. By synthesizing data from literature, policy documents, and empirical evidence, this research develops an evolution map for PH design in Hong Kong that is driven by seven major challenges. Based on this map, a conceptual framework for intersecting considerations that envisages five main future prospects toward future PH design is also established.

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1. Introduction

1.1. Design challenges for public housing (PH)

PH became a major theme in residential architecture after the Second World War (Broto et al., 2008) as a response to the sharp decline in the number of available houses and the drastic increase in population across war-torn cities. The term for PH and its eligibility criteria may vary across regions, but the objective of providing affordable dwelling to those in need remains the same. Even when urban backdrops are markedly different nowadays, PH still represents a considerable portion of the overall housing provision in some Asian economies, i.e., 46.7% in Hong Kong (Census and Statistics Department (CSD), 2013a) and over 80% in Singapore (Housing and Development Board (HDB), 2013). Mainland China comprises 25% of the global population, but affordable housing in this area only makes up approximately 10% of its total housing portfolio (Mok, 2013). This situation explains the ambitious target of Mainland China, i.e., an output of 36 million units by 2015 (National Development and Reform Commission (NDRC), 2011).

After decades of development, how have PH designs evolved against multiple challenges and kept abreast with the present era of sustainability, particularly in the aforementioned Asian economies that still rely considerably on PH to address housing inequity? According to its dictionary definition, a *challenge* is a demanding but stimulating situation, task, or problem that requires considerable determination, wisdom, and strength to satisfy (Cambridge Advanced Learner's Dictionary and Thesaurus, 2013; Collins English Dictionary, 2013). Although the concept of sustainability traverses across geographical boundaries, challenges remain context-dependent and can significantly influence the

formulation of policy priorities and vernacular identities. Nevertheless, challenges that are encountered over time under a particular context are seldom employed as an integrative driver in design progression.

Sustainable development has been commonly noted as underlining the capability of satisfying both short- and long-term requirements of different generations in symbiosis. However, only a few studies have mentioned that an overarching concern should be expressed toward the needs of individuals at the bottom of the economic pyramid, given that poverty and inequity significantly increase the chance of environmental and other types of crisis (United Nations (UN), 1987). Considering that environmental degradation, population growth, and poverty are inextricably bound, and each issue is impossible to address independently (UN, 1987), PH provides a good opportunity to manage these issues holistically. However, the unique contribution of PH to realizing the vision of multi-spherical sustainability is frequently understated. Under the triple-pillar principle (UN, 1992), sustainable PH implies adopting inter-generational social equality to approach economical accommodation within ecological carrying capacities. Following this logic, PH design should adapt to a sustainability challenge to balance budget consciousness, environmental enhancement, and social inclusiveness.

1.2. Objectives and methods

To fill in this gap, this study is based on Hong Kong being a regional exemplar during its 60 years of PH design progress against a persistent mismatch between the high demand for housing and the intermittent shortage in land supply, among other challenges. Situated in the sub-tropical Pearl River Delta region of China, Hong Kong stands as one of the densest metropolises in the world, with a mid-2012 population



Fig. 1 Hong Kong district map 2013. Note: The nine new towns are marked by circle. Background source: <http://www.chinatouristmaps.com>.

density of 6620 persons per km² (CSD, 2013a). As illustrated in Fig. 1, the city comprises Hong Kong Island (the Island), the Kowloon Peninsula (Kowloon), and the New Territories. The three major regions collectively occupy a land area of 1104 km². With only 20% of the areas being naturally developable (Yeung and Wong, 2003), most of the remaining developed lands are created through reclamation.

By mid-2013, 46.5% of the territorial population of 7.18 million (CSD, 2013b) relies on PH in two major forms—29.6% in public rental housing (PRH) and 16.9% in subsidized sale flats (Housing Authority (HA), 2013a). As a major PH provider, the Hong Kong HA has been statutorily committed to develop, retrofit, and manage an increasing stock of PH estates since 1973. By March 2013, the 162 PRH estates of HA are accommodating over 2 million people (Long Term Housing Strategy Steering Committee (LTHSSC), 2013). To address the re-emergence of PH supply deficiency, the government of the Hong Kong Special Administrative Region plans to provide approximately 179,000 PRH units within a 10-year time frame starting in 2013. The target annual PRH supply accounts for nearly 40% of the total local housing supply (Transport and Housing Bureau (THB), 2013).

Addressing the existing undersupply problem represents a key part of the contemporary history of Hong Kong. Moreover, this process can offer useful insights to the East Asian region by sharing the experience with areas that have similar compact urban settings as Hong Kong and with Mainland China. The latter is an ambitious PH player with a pressing need to flatten its learning curve in this regard. This study aims to synopsise the history and reality of PH design in Hong Kong, as well as to contribute a conceptual framework by outlining major considerations toward sustainable PH design, in general. The *history and reality*

referred to in this paper are divided by the year 2003. The major reason for such division is the outbreak of the severe acute respiratory syndrome (SARS) epidemic, which heightened awareness of PH design professionals and the society as a whole on the crucial relationships between occupant health and environmental degradation. Such relationships were previously considered insignificant in vertically compact high-rise living quarters, including PH estates in Hong Kong. The three objectives of this study are as follows:

- To profile historical challenges and assess their influence on design progression,
- To understand the local implications of global trends on urban regeneration and building sustainability for local PH design, and
- To outline emerging and future prospects for satisfying sustainability challenges in PH design.

Desk and evidence-based studies were conducted to complement each other. Factual data were obtained from policy documents, official reports and circulars, and academic publications on local PH development. Empirical evidence was collected through housing workshops and conferences. In addition, field trips were made in regions where PH estates are concentrated. The rest of this paper is organized in as follows. Section 2 provides a brief review (from 1953 to 2003) of PH design progress in Hong Kong. Section 3 focuses on 2003 onwards by analyzing the latest policy initiatives and design innovations. Section 4 synthesizes the key findings into an evolution map of PH design in Hong Kong, which has been driven by seven major challenges since 1953. By combining historical and current perspectives, the final section also concludes the article

by providing a conceptual framework for considerations and five future prospects toward sustainable PH design.

2. Seven challenges: Hong Kong (1953-2003)

The central theme of this section is to present how challenges that have been encountered over time influence PH designs in Hong Kong. As a crucial but missing component of extant PH literature, this section provides an overview of the seven major challenges encountered in PH. These challenges are presented in chronological order, but can be meaningfully grouped into three sub-categories based on their nature.

- *One shortage - Shortage in land provision* (a leading long-term obstacle);
- *Three crises - Squatter hazard, social unrest, and SARS*; and
- *Three shifts - Shift in living pattern, demands, and demography*.

References are obtained from an enriched body of related literature. Considering that some important events or milestones are described or debated on by virtually each author, albeit from different viewpoints, a list of all citations is provided to avoid unnecessary interruptions and repetitions for easy reading. The list includes: [Civil Engineering and Development Department \(CEDD\), 2012](#), [Dickinson \(1963\)](#), [Gabriel \(1999\)](#), [Grange \(2003\)](#), [HA \(2000, 2000-2002, 2012a, 2012b, 2012c, 2013b\)](#), [Housing Authority and Housing Department \(HAHD\), 2011](#), [HM \(2003\)](#), [LTHSSC \(2013\)](#), [Tong and Wong \(1997\)](#), [Tsang \(2006\)](#), [Yan \(2006\)](#), [Yeung and Wong \(2003\)](#), [Yip \(2010\)](#), [Yuen and Yeh \(2011\)](#).

2.1. Squatter hazard

As Hong Kong rose to become a major trading port during the mid-19th century, its hilly geography became a major hindrance to its housing development and caused a congestion of tenement buildings along the harbor front. The large influxes of immigrants since the 1930s exacerbated this problem and resulted in a sprawling area of timber squatter huts across the forested hills. Such make-shift houses, which were constructed in the face of financial hardship, posed tremendous fire risk. On Christmas night in 1953, a huge fire destroyed a squatter camp and left 53,000 people homeless. This tragic event marked the beginning of PH development, which had not yet received political priority in any period in history. Government provision became the only means to address such massive housing shortage. In 1954, the fire victims were successfully settled in emergency housing units. On average, five adults shared an 11 m² unit. Cooking was carried out at the corridor outside the unit, whereas tap water and sanitary facilities were centralized. The ground floor was partly reserved for basic community facilities and partly as an open space for natural ventilation. This hallmark of stilt houses, which is ubiquitous in sub-tropical southern China, remains as a feature of current PH estates.

2.2. Social unrest

The Resettlement Department, which was the predecessor of the Housing Department, was established in 1954 to provide long-term housing options to other people who need them, apart from the 1953 fire victims. The first multi-storey PH estate was completed in 1957. Considering the persistent squatter problem and the steady increase in income of local residents, the local government announced its PH policies in 1964 to accelerate the provision of resettlement estates. By 1965, PH residents reached 1 million. Nevertheless, intermittent riots, which were partly triggered by the overcongestion problem in resettlement estates, erupted during the late 1960s. Hence, formulating the first Ten-year Housing Program (1973-1982) became reasonable. This program aimed to provide permanent and self-contained housing to 1.8 million people (out of the total population of 4.2 million during the time). However, implementing this ambitious program inevitably caused an immediate surge in land demand.

2.3. Shortage of land supply

On the side of Hong Kong Island, the distance between the relatively flat waterfronts and the hilly regions is averaged at approximately 1.3 km, which physically limits infinite land acquisition. By the late 1960s, most developable lands on the island and in Kowloon had been virtually used up. The pressing need to decentralize the increasing population in these overcrowded urban regions ushered in a new town development model to practically implement the Ten-year Housing Program by stages. This new development model, which mixed public and private housing developments, also offered an unprecedented opportunity for housing architects and urban planners to work together and create a new-generation PH prototype of the Twin Tower blocks. Apart from an increase in flat size and an optimized layout, these high-rise estates were equipped with self-contained social and recreational amenities and were modeled largely on the British planning philosophy of self-contained community development.

2.4. Shift in living pattern

During the 1980s, advances in construction technologies made building high-rise estates with up to 35 stories possible. Although these technological improvements significantly increased land-use efficiency and substantially reduced construction costs, the vertically compact housing style led to increasing concerns regarding its influence on internally and externally built environments. Flat design optimization was carried out in various aspects, including the elimination of windowless rooms in each flat, the shortening of long and dark corridors, and allowing self-partitioning by residents. As quality public spaces and amenities increasingly became a design focus in PH estates, landscape architects started to join the scene during the 1980s and later became fully involved in designing open spaces and outdoor recreational facilities with housing architects.

2.5. Shift in demands

During its beginning, PH still largely functioned as an emergency resort. Following the flat design norm, minimal space allocation was adopted to meet time pressures, overcome cost constraints, and achieve construction efficiency. The changing demographic and economic backdrops that began in the 1980s resulted in the increasingly diversified demands of PH residents. Consequently, spatial standardization was no longer a panacea for optimizing development potentials. By contrast, rigid design formulas were under intense debate because of the negative effects of their proliferation, namely, monotonous streetscapes that sharply contrast with the internationally acclaimed harbor-front skylines, cookie-cutter estates with low individual community identities, and low flexibility in furniture and fit-out arrangements for residents. Some breakthroughs were gradually made during the 1990s to provide a variety of flat mixes. The standard design approach was finally superseded in 2000 by the non-standard approach under the new site-specific strategy.

2.6. Shift in demography

The issue of the increasing aging population (60 years and above) first emerged during the 1980s. The traditional housing design was aimed primarily for the needs of families and physically able individuals, which left single elders inadequately housed, particularly in the older estates. The enactment of the Residential Care Homes Ordinance in 1996 forced the closure of many private homes for elders. This event further intensified the demand to rehouse this long-neglected yet rapidly expanding population group. With the implementation of the Ten-year Housing Program (1997–2006), the concept of “aging in place” was promoted to satisfy the life cycle requirements of residents. A universal design approach was introduced to new-generation PH estates, in which additional attention is given to interior fit-out details, multi-room layouts, barrier-free facilities, and convenient access to transportation, shopping, and other amenities.

2.7. SARS

The outbreak of SARS in 2003 raised public awareness on health and hygiene issues that stem from the compact, and sometimes, overcrowded living patterns that are ubiquitous in Hong Kong. During the peak of the epidemic, various public spaces were closed while communities were engaged in hygienic measures to reduce the incidence of respiratory viral infections. The outbreak also caused design professionals to rethink on how energy efficiency can be simultaneously satisfied with people-oriented issues in the advent of sustainable building designs. Promoting sustainable communities became an underlying factor of subsequent housing policies to boost the local economy, and consequently, stimulate a supply-side pursuit for value-added housing design to regain public confidence. Environmental sustainability has become a priority in designing new PRH estates and retrofitting existing housing stock with continuing efforts to green PH estates and their surroundings. To

specifically address the possible transmission of diseases through old drainage systems, which had been identified as the medium through which the SARS virus had spread, HA collaborated with local academic institutions in developing innovative solutions to update drainage and ventilation systems, with good prospects in market applications.

2.8. Summary

PH in Hong Kong was primarily a response to the aftermath of the 1953 squatter fire, which was a result of the widespread problems of squatter sprawl and housing congestion. Lasting solutions that can eradicate serious housing inequity that undermines social cohesion were urgently required from the government side. The four major shifts in 60 years of development are summarized as follows.

- **Low-cost housing:** an emergency resort to offer temporary shelters to the 1953 fire victims and resettlement estates to low-income groups during the 1950s and 1960s
- **Quantity in housing:** the Ten-year Housing Program during the 1970s offered permanent housing to citizens who need them and rehoused those living in resettlement blocks.
- **Quality housing:** a paradigmatic shift during the 1980s that resulted from the shifts in demography, demands, and living pattern.
- **Sustainable housing:** adoption of a people-oriented strategy that began in the 2000s to satisfy increasing public demand for sustainable communities.

Given that land acquisition became a major obstacle in sustaining the Ten-year Housing Program implemented in 1972, PH development in remote urban peripheral areas had been at the forefront in shaping the nine new towns in the New Territories and in Kowloon (Fig. 1). Table 1 summarizes the evolution of local PH design since 1953 in 13 key dimensions.

3. Global trends and local manifestations

Excluding the three short-term crises, the rest of the obstacles identified in the previous section persist to the present. PH design at the local level has been further complicated by urban regeneration and building sustainability, which are the two key drivers of globally built environments.

3.1. Urban regeneration

In many post-industrialized cities, most difficulties in urban regeneration originate from districts and old-generation new towns with aging housing stock, lagging infrastructure, serious environmental problems, and high concentration of low-income families. The local housing situations are further complicated by the following issues, among others.

3.1.1. Demographic shifts

The New Territories and Kowloon accommodated 82.1% of the local population in mid-2012 (CSD, 2013a), and 89.6% of residents living in HA permanent housing in 2012 (HA,

Table 1 Design progression of public housing design in Hong Kong since 1953. Sources: compiled from various sources.

| Category | 1950s | 1960s | 1970s | 1980s | 1990s | 2000s onward |
|--|---|---|--|---|--|---|
| Design focus | Emergency, low-cost | | Quantity | Quality | | Sustainability |
| Major challenge | Shortage of land supply | | | | | |
| Long-term | / | | | Shift in living pattern, demand, and demography | | |
| Short-term | Squatter fire | Social unrest | / | | | SARS |
| Milestone of policy | The establishment of the Resettlement Department in 1954 | Review of housing policies | Ten-year Housing Program (1973 - 1982) The establishment of the Housing Authority in 1973 | Long-term Housing Strategy | Ten-year Housing Plan (1997-2006) | |
| Mainstream philosophy | Minimal provision of basic living standards | Standardizing block and flat design | Building self-contained community | Standard block Multi-room flat Comprehensive facilities | Universal design community | Site-specific Value-driven Environmental sustainability Kowloon, New Territories |
| Primary location | Hong Kong Island | | Kowloon, New Territories | | | |
| Height (number of floors) | 2-7 | 8-16 | 20-23 | 35 | 40 | |
| Unites per floor | 60-72 | 32-58 | 30-34 | 14-36 | 16-18 | |
| Average flat size (sq.m) | 11 | 14-27 | 36-44 | 28-55 | 17-52 | |
| Space allocation per person (sq.m) | 2.23 | 2.23 | 3.25 | 5 | 7-10 | |
| Flat type and features (new improvement only) | Single room No water or electricity No ensuite facility | Self-partition Kitchen and bathroom Balcony | Cross-ventilation Water and power supply Full-range ensuite facilities | Multiple rooms Self-partition Better lighting and ventilation | Various standard flats Flexible partitioning | A combination of standard and non-standard design |
| Type of community service (new addition only) | Basic ground-floor open space | More ground-floor open space | Shops, car parks, bus terminals, community and recreational facilities | Covered walkways, pools, gardens, playgrounds, cooked food centers | Commercial complexes | Mail box type disposal system for material recycling |
| Type of external greenery | / | Minimum provision | Green space provision specified in the local Planning Standards and Guidelines | More variety of design for external works | Themed landscape design for each estate Harmony | Soft landscape Minimal 20% greening coverage of the site area Site-specific |
| Representative block type | Mark I, II | Mark II to VI | Twin Tower | Trident | | |

2013b). Situations are different from those of 60 years ago when most local residents lived in Hong Kong Island. A contributing factor to this shift is the relentless effort to develop nine new towns as an effective decentralizing strategy to accommodate the continuously growing population over the last four decades. Among the nine new towns, seven are situated in the New Territories and one is located in Kowloon. By 2010, the nine new towns collectively accommodate approximately 3.3 million people, and the number is expected to rise to 3.5 million by 2017 (CEDD, 2012). The significant concentration of PH population in the New Territories and in Kowloon indicates a high concentration of low-income population in these regions. Moreover, among the 271,000 PRH flats in 2013, 37.2% are 26 years old and beyond the block age (HA, 2013b). This figure, which presents a significant increase from the record of 12.5% in 2003, indicates aging and substandard housing stock amid accelerating environmental degradation. The increasing volume of unfit housing that requires retrofitting or replacement has a considerable influence on the urban regeneration process.

3.1.2. Dual shortage

Under significant demographic shifts and severe social and environmental problems, “urban living space” was identified as one of the three key niches that are relevant to long-term local sustainability, whereas the strategies of redevelopment, rehabilitation, preservation, and revitalization were promoted to address degeneration of old urban quarters (Center for Sustainable Design (CfSD), 2004). To satisfy long-term requirements for housing and infrastructure, several land supply options, including rezoning land, redevelopment, land resumption, and reuse of ex-quarry sites, have been adopted (CEDD, 2012). Among other efforts to alleviate the reemerging shortage in PH is a 9.17 ha development that can provide 13,300 PRH flats (Legco, 2012). With the theme “homes in the park,” this new project is part of the 320 ha Kai Tak development to transform the former airport region into an international hub for tourism, sports, housing, and business (CEDD, 2006). An unparalleled advantage of this mixed-use model lies in the shared network of transportation infrastructure and public amenities. However, initiating PH development at this scale is virtually impossible in the built-up inner city districts on the Island and in Kowloon, wherein numerous market-led land-use claims are competing. From the perspectives of economy and affordability, land price is sufficiently high to discourage any attempt to turn such prime locations into PH estates.

3.1.3. Pencil development

To address this dual shortage, all suitable sites (regardless of size) have been acquired to maximize PH production (HAHD, 2011). A number of additional small developments on or adjacent to established PH neighborhoods are currently being established. These projects are the latest versions of sporadic *pencil development*, which has been favored for a long time by many local private developers and is typically characterized by a single high-rise development on a small infill site (Adams and Hastings, 2001). On one hand, pencil development can boost PH production in

every bit of renewable land in already intensified living quarters with spatial, geotechnical, environmental, and regulation constraints. On the other hand, the negative effects of weakening the existing vicinity by disregarding the need to upgrade or expand key infrastructure, public amenities, and transport networks in due course still need to be controlled or curbed in such sporadic developments. This community-level issue is closely related to another global trend at the building level.

3.2. Building sustainability

In many established economies, a significant portion of the post-war housing stock that was mass-produced during the post-war era is now outdated (Lawrence, 1997). Design insufficiency characterized by stereotyped minimalism, decontextualization, and environmental ignorance is regarded to have significantly contributed to such issue (Brown et al., 2000; Gu, 2011; Williamson et al., 2003). In principle, the Organisation for Economic Co-operation and Development (2003) recommends that sustainable buildings should be resource efficient, energy efficient, pollution preventive, environmentally harmonious, and methodically integrated. In practice, building performances are increasingly being monitored by innovative and comprehensive sustainability tools such as life cycle assessment and performance benchmarking systems in nearly 60 countries and regions (Kibert, 2013).

3.2.1. Environmental enhancement

In Hong Kong, environmental sustainability in PH design has become a social imperative in the wake of the 2003 SARS epidemic. Although improving poor air quality has long been a focus of environmental improvement, health and social issues that are closely associated with environmental degradation remained low on the local policy agenda even after the SARS epidemic (Ng, 2012). In 2010, the local government began aiming for a voluntary carbon intensity reduction of 50%-60% (from the 2005 level) by 2020 to position Hong Kong as a green exemplar of China (Environmental Protection Department (EPD), 2010). This program was followed by the launching of the first sustainable building assessment tool tailored for Hong Kong, i.e., the Building Environmental Assessment Method Plus (BEAM Plus). Given the sub-tropical climate and the predominantly high-rise built environment in Hong Kong, BEAM Plus considers a sustainable building to be safe, healthy, comfortable, functional, and efficient (Green Building Council (GBC), 2012). As of 2011, 15 PRH projects were assessed under BEAM Plus and 3 achieved platinum level (HA, 2012d).

3.2.2. Comprehensive measures

Despite the general lack of concern for economic-environmental and social-environmental sustainability before the implementation of BEAM Plus, local PH design has been at the forefront of building eco-friendly, safe, healthy, sustainable, user-oriented, and cost-effective living communities (THB, 2009). A site-specific and value-driven approach has been developed to optimize site potential, improve flat suitability, and enhance estate identity (Legco, 2009). Compiled from various sources (EPD, 2013; Fung, 2007,

Table 2 Sustainability initiatives and innovations on public housing design in Hong Kong from 2004 onward. Data sources: compiled from various sources.

| Aspects of concern | Key initiatives and innovations |
|-------------------------------|--|
| Site acquisition and land-use | Participation in strategic and regional studies to identify suitable residential land Rezoning of non-residential sites “BEAM Plus Ready” - Gross floor area concessions with BEAM Plus registration |
| Urban planning and design | Technical studies in traffic, environmental impact, air ventilation, water supply, drainage and sewerage capacities, etc. |
| Environmental design | Micro-climate studies Noise-tolerant building design Carbon Emission Estimation Energy efficient lighting Hybrid ventilation Reuse of reclaimed water (rainwater harvesting and plant irrigation system) |
| Landscape design | Increase greening ratio Adopt various forms of greening - rooftop, vertical, and slope |
| Block and layout design | Universal Design None-Standard Design Modular flat design Flexible housing production mix |
| Lifecycle impact | Low waste building design Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) Method |
| Design procurement | Strategic partnerships with academic institutions “Enhanced two-envelope system” to put more weighing on the performance and design input “Open Design Competition” to secure optimal site specific design for featured PH project “Design and build” to pursue a more integrated design and production processes “Direct appointment of consultants of different disciplines” to seek interdisciplinary expertise |
| Design optimization | Integrated feedback and knowledge management system Independent consultancy mechanism to conduct resident surveys for new PH projects after a 10-month move-in period |
| ICT-aided design | Building Information Modeling (BIM) for generating highly accurate 3D data Adoption of web-based Geographic Information System (GIS) HOMES - an on-line collaboration and management platform for stakeholders in accessing the whole project cycle information Drawing Management System as the first cross-divisional platform for drawing management |

2010; HA, 2000, HA, 2000-2002, 2007, 2010, 2013a; HAHD, 2011), Table 2 presents nine major types of PH design initiatives and innovations established since 2004 to achieve improved design quality.

For example, fully adopting a flexible housing production mix model requires strong inputs in both design and technical aspects, which leads to reforms in procuring consultancy services. Since 2004, an independent consultancy mechanism has been positioned as part of the integrated feedback and knowledge management system, upon which the modular flat design can be revised and optimized (HA, 2007). In 2012, the updated version of BEAM Plus introduced an alternative route to assess building energy by encouraging the passive design strategy (GBC, 2012) to achieve comprehensive efficiency in space and energy use as well as in construction and operation costs. In line with the sustainable building design guidelines promulgated in 2011 (BA, 2011), model client briefs and contract specifications were introduced to ensure that all new PH projects would be BEAM Plus-ready, with a minimum of gold rating for 2015/2016 onward (HA, 2013d). Aside from fostering industry-wide awareness in building sustainability,

the granted extra gross floor area concession can be used to increase the number of dwelling units. This strategy is one of the latest approaches to address the undersupply of both land and housing.

4. Conclusions

This section combines the findings from both historical and current perspectives and draws conclusions from these two dimensions.

4.1. Six-decade progression

Fig. 2 summarizes the six decades of PH design progression in Hong Kong into four key stages. Progressive development, from an unbalanced emphasis on economic perspective to a balanced pursuit of triple-bottom sustainability, is made possible by the interplay of two collective forces, namely:

- Two global trends - urban regeneration and building sustainability; and

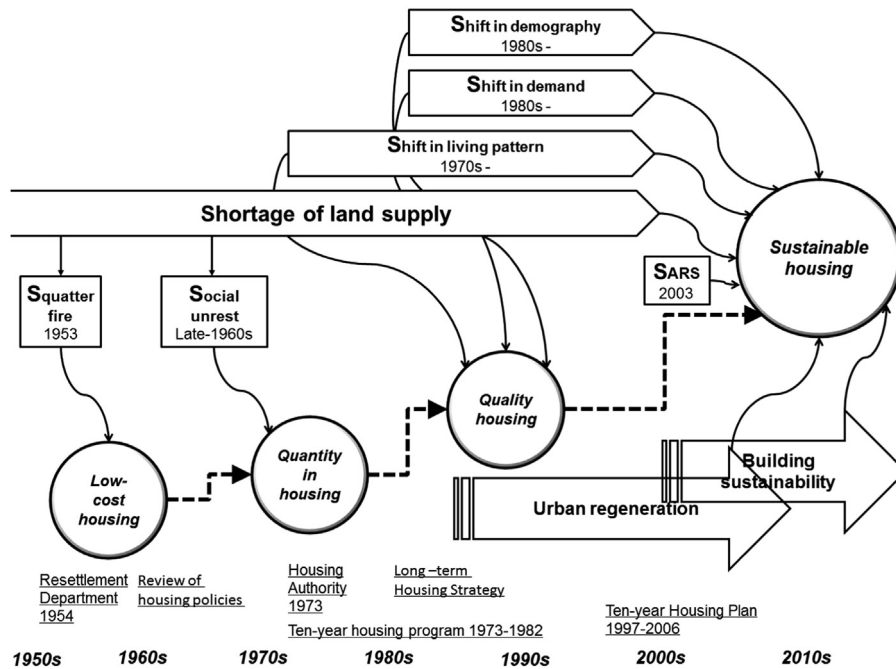


Fig. 2 An evolution map of public housing design in Hong Kong.

- Seven major local challenges - three short-term crises, three long-term shifts, and one persistent obstacle.

In form and function, PH in Hong Kong has evolved from simple low-rise living quarters with single-room flats and communal sanitary facilities into sophisticated high-rise buildings with self-contained multi-room flats. Community facilities and amenities have also developed both in variety and sophistication. Coupled with financial and climatic constraints, the shortage of land supply, as the leading challenge, has largely made high-rise living predominant since the 1970s. Given that each block is regarded as a vertical community, the unique urban environment is endowed with amenities and landscape that exhibit vernacular and regional identities such as pillared arcades, podium/sky gardens, and social and commercial facilities connected by covered walkways. The incremental upgrade, which has been driven by multi-dimensional challenges over time, indicates that sustainability should not be considered as an add-on feature but as a process that should be attained stage by stage. Some of these challenges are unique to the territory, several are common in the Asia-Pacific region, and others are globally relevant.

Moreover, this progress has dual implications for crises. First, the positive role of a crisis in revealing a fatal weakness that would be otherwise be left unattended during normal days is frequently ignored. Despite its disastrous outcome, a crisis can catalyze a profound change, e.g., the 1953 squatter fire, the late 1960s social unrest, and the 2003 SARS epidemic provide strong evidence, among others. In addition, as exemplified in the case of Hong Kong, an emergency response, instead of being an end in itself, becomes a prologue to a comprehensive undertaking that places great importance to a city and its people. This phenomenon conveys another important message, i.e., although a crisis may short circuit some political procedures

to catalyze a paradigmatic change, continuing to make progress for the sake of the users over time requires increased determination and additional systematic inputs regardless of how incremental the procedures have been. Hong Kong deserves credit in this regard. One practical implication for Mainland China is the lesson that its ambitious social housing target cannot be achieved in an instant but through perseverance.

4.2. Future prospects

Given that economic hardship motivates fighting for value, challenges such as land availability, high density, and environmental degradation function as key drivers in seeking effective housing solutions that are easy to scale for mass production, high performance, and resource consciousness. Although the preceding challenges have given significant impetus to achieve noticeable progress in PH, designs must respond to several emerging realities that are outlined as follows.

4.2.1. Sustainability at various scales

Although PH design has shifted away from traditional function optimizing and form making to place making and community building, a spectrum of urban issues with extensive social influences must be considered. For example, would the reemergence of the highly controversial pencil development be upgraded from merely being a quick fix to being applied as a means to renew old housing stock and satisfy the demands of the new PH population? By inheriting both positive and negative housing legacies from previous eras, pursuing a careful approach to initiating developments or redevelopments without overburdening existing neighborhoods and environments is imperative. Consequently, design must extend the logic of buildings to

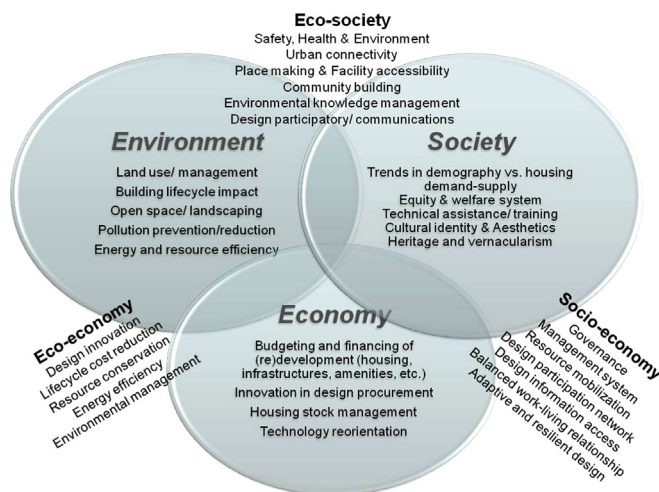


Fig. 3 A conceptual framework of intersectional design considerations towards sustainable public housing.

community and city scales, which requires framing district-based housing problems with community representatives and collaborating with organizations that work toward urban regeneration.

4.2.2. Pre-post adaptation

The public sector that develops and manages substantial PH stock under budget constraints will always face the priority-setting issues of where and how to best budget and finance housing adaptation, improvement, and maintenance. The ever-diversifying user demand resulting from demographic shifts will place an unforeseen pressure on housing stock, which is required to be adaptable to cater to the growing variety of households. Employing forward thinking in designing enduring and adaptable housing is instrumental in reducing the recurrence rate of urban decay, which largely results from the fast-forward and low-cost driven housing design of the post-war era.

4.2.3. Standardization versus creativity

With the primary objectives of mass production, minimal services, and low budget, PH has relied on a highly standardized design code over the past decades. However, future designs will be driven by the diverse needs of occupants for flats and estates with more variety, higher performance, and greater flexibility than old models. Design processes will be subjected to comply with extensive and strict statutory obligations, as well as client specifications and supplementary guidelines. However, a highly standardized design process is a double-edge sword. Code-compliant buildings should not be achieved at the expense of stilted creativity, and simultaneously, solutions should not be sought merely to score high in sustainability evaluation systems.

4.2.4. Vernacularism and resilience

Pressing environmental degradation issues and devastating disasters have forced housing professionals to rethink the value of passive design strategies. Worldwide, vernacular architecture has resulted from gaining experience in

satisfying contextual challenges. Such architecture creates the best possible built environment with locally available resources. History provides rich and diverse passive solutions to produce sun-oriented and insulated, as well as naturally ventilated and lighted housing, with smartly landscaped surroundings and well-preserved ecosystems. Low-tech and high-tech solutions to sustainability should evolve in parallel.

4.2.5. Interdisciplinary communication

With the rapid progress in information communications and technology (ICT), design has become interdisciplinary and participatory oriented. The interplay between adaptable sustainability and ICT demands that the decision-making process should be synergized with physical, cultural, environmental, and aesthetic considerations with financial, technological, and network capacities. Hence, a string of changes ensues. An example of an already noticeable change is that localized indices and methods are developed to assess the local feasibility of different options. Consequently, housing professionals will be required to develop a strong familiarity with sustainability assessment tools. The fact that local regeneration projects have always been conflict-laden indicates a pressing need to increase constructive interaction with client and user groups, intensify inputs for design team management, and develop close collaboration with facility management crews. Tapping the infinite potentials of ICT in using design as a communication platform will provide considerable challenges and opportunities.

To design contextually sustainable PH such as those discussed in preceding sections, Fig. 3 presents a conceptual framework for considering several intersecting portions of the three main aspects of sustainability. Developing a sustainable PH design involves seeking economically and environmentally sound paths to address housing inequity as one of the biggest challenges in building an inclusive society. This logic applies to any given economy, regardless of whether PH accounts for a small or large portion of the overall housing provision.

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