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Applicability of 'Aging in Place' in redeveloped public rental housing estates in Hong Kong

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ARTICLE INFO

ABSTRACT

Rapidly aging society is a global phenomenon with serious societal impact. With the rapid growth in the aging population in Hong Kong, it is foreseeable that every flat unit will accommodate one senior citizen. To address this looming problem, the Hong Kong Government has introduced several aged friendly home design elements and care facilities to redeveloped public rental housing estates. This study aimed to investigate the implementation of the "aging in place" philosophy, through evaluating the applicability and effectiveness of those facilities. A redevelopment project, the Un Chau Estate in Hong Kong was selected as a case study. Ecological theory is applied to evaluate the case study at micro, meso and macro scales. The methodological approaches include (a) a questionnaire survey, (b) face-to-face group discussions and (c) in-depth interviews. Results reveal that senior satisfaction levels with the new elements investigated were below the levels of perceived importance. In particular, the seniors emphasized the lack of a sense of home and privacy in their residences. They were, however, moderately satisfied with the independence and dignity and comfort and health elements. The results also reveal that the provision of common facilities is not up to standard in meeting the needs of the elderly. The majority of the elderly consistently opined that aging in place is their priority. To some extent, the extreme case of Hong Kong as a showcase of a dense populated aged Asian city, sheds light on how public housing (re) development can be designed to facilitate aging in place. A more comprehensive and refined approach at micro, meso, and macro scales is necessary to guarantee the satisfactory implementation of aging in place.

1. Introduction

As defined by the World Health Organization (WHO), a society is known as an 'aging-society' when people aged 65 years and above comprise 7% or more of the total population, 14% and above as 'aged-society' and 20% and above as 'super-aged-society' respectively. In the coming decades, the number of people aged 65 and above will dramatically increase across the world. This presents a number of challenges including the type of accommodation, the location of accommodation, availability of necessary supports and care as population age while maintaining a life of comfort and dignity.

To accommodate the needs of the growing number of elderly people, more residential care services, and nursing homes, may not only be unsustainable but in any case, runs counter to the principle of 'aging in the community' (Wong, 2015). Similarly, the concept of Residential Care services (RCS) is not in line with the wishes of the elderly to live out their last years in their homes and communities (i.e. aging in the community). Aging in place is seen as enabling the elderly to maintain

their independence and social connections (Wiles, Leibinnz, Guberman, Reeve, & Allen, 2011) while providing a sense of home, independence, dignity, privacy, comfort, health and safety to residents for the sake of their well-being (CUHK, 2003).

The concept 'Aging in Place' expresses the desire to age in a familiar environment with some dignity and degree of independence (Rowles, 1994). Social gerontologists suggest that 'aging in place' is the most humane and cost-effective way for the elderly to grow old because it avoids the trauma and various hassles of over-caring for the aged (Heumann & Boldy, 1993). Seniors face challenges of deteriorating health. The elderly have physical and emotional needs different from others. Contrary to elderly nursing homes, in which the elderly enjoy low levels of privacy and dignity, aging in place enables them to happily age in their self-contained homes, with specially designed features to cater for their needs. Thus, staying in a familiar living environment with appropriate and sufficient supportive care services enhances the quality of life.

In the literature, there is strong support for seniors' preference to

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live in their own community (aging-in-place) rather than live in residential care homes (e.g., Bayer & Harper, 2000; Callahan, 1993; Davey, Nana, de Joux, & Arcus, 2004; Frank, 2002; Judd, Olsberg, Quinn, Groenhart, & Demirbilek, 2010; Keeling, 1999; Lawler, 2001; WHO, 2007). The American Association of Retired Persons (AARP) found that the vast majority of aged people in the US prefer to remain in their own home as long as they can live comfortably and with minimal danger (Basaraba, 2016). Since rapid aging brings serious economic and social impact, policy makers throughout the world are emphasizing the concept of 'Aging in Place' in their strategic directions affecting the elderly.

Hong Kong, like all other developed cities and countries, is confronted with serious challenges posed by the rapid increase in senior population. Leading developers in Hong Kong have explicitly mentioned that the provision of housing for the elderly is not in their plans, while some do not even want to comment on the issue (Seniority Issues, 2016). The challenge of aging population in Hong Kong has been fueled by various demographic and societal factors. For example, the health condition of the elderly has been deteriorating severely over the past two decades because of increased longevity (Chui, 2008). Besides, the traditional Chinese virtues have been deteriorating rapidly in the local society, and the spirit of mutual help and respect among people is also gradually diminishing with evidence in the increased numbers of elderlies that stay alone (HKSAR Census and Statistics Department, 2011). On top of these, the demand on institutional care services has been increasing to an unendurable and unaffordable level, making this alternative not only financially not sustainable but also inadequately available to cater the elderly housing needs (Chui et al., 2009; Tsang, 2016) because of poverty level among the elderly since one in three older adults live below the poverty line as of 2014 (SCMP, 2015). These challenges are predicted to be even more severe in the coming decades due to the increased life expectancy and the declining birth rate. To address this looming aging problem, experts are calling for a revision of the current housing system.

In its 2015 Policy Address, the Hong Kong Special Administrative Region (HKSAR) Government emphasized the importance of 'aging in place' as the main core consideration when designing and planning elderly housing. In recognizing the necessity of the elderly to enjoy their last years in their home with dignity and autonomy, the concept 'universal design' was introduced into public housing design by the Hong Kong SAR Government (Wai, 2001). As early as 2000 and since, the Government has attempted to incorporate certain facilities and particular elements of housing design, which are in line with the aging in place concept, into its public housing redevelopment programme to accommodate the needs of the elderly.

Although the benefits of aging in place to wellbeing/life quality of elderly people in different socio-economic and demographic backgrounds have been explored in the previous studies, to date, public rental housing estates has only occasionally been discussed and little evaluation on the effectiveness of redevelopment programme in accomplishing aging in place. As the number of elderly population living in public sector, as well as redevelopment projects on public rental housing estates, are anticipated to increase in the coming years. Whether or not the seniors living in public rental housing estates are satisfied with these newly incorporated designs and facilities is yet to be investigated. It is imperative to evaluate the designs and facilities already provided in these redeveloped housing estates in accordance to the changing needs of the elderly and how well aging in place concept has been adopting under the redevelopment programme.

This study is different from previous studies for a number of reasons. First, the age range of the elderly living in one residential estate varies significantly. This is very much different from an elderly couple (often same age range) living in a single house. In this high-rise high densely context, therefore a standardized/generalized form of aging-in-place measures (which adopted in single family housing) may be ineffective to meet varying needs of different seniors as their needs may vary.

Besides, the traditional designs of the public rental housing schemes in Hong Kong did have no measures to address special needs of the elderly people. Most of the PRH schemes, in which a large proportion of the elderly people are living, are structurally unable to accommodate alternations to meet the needs of the elderly (Leung, 2014). To accommodate such needs of the seniors, new housing schemes should incorporate facilities and design elements in line with the universal design approach (Deng, Chan, & Poon, 2016). Second, there has been no any comprehensive study to understand the varying needs of the elderly in a high-rise context, not only in Hong Kong, but also elsewhere. There is also no any clue (due to lack of studies) as to how effective the provisions introduced (more than a decade ago) into the redevelopment process of the public rental housing estates.

Thus, the present study aims to evaluate the effectiveness of the facilities and design elements introduced into the redeveloped public rental housing estates in Hong Kong. This is necessary: (a) to understand the extent to which housing design elements and the facilities provided under the redevelopment process of PRHs are sufficient to cater to the special needs of the elderly; and (b) if not, to understand and plan suitable housing enabling the elderly people of the future to age more conveniently and with dignity. The structure of the study is as follows. It reviews the literature on issues and challenges involved in aging in place, housing design and community care services globally and specifically in Hong Kong. The Methodology describes the questionnaire surveys and the in-depth interviews and group discussions. The empirical results are discussed among the findings from the above empirical data analysis. Finally, the conclusion and policy implications are drawn for this research.

2. Literature review

2.1. Aging in Place

Aging-in-place is defined as 'living in the community, with some level of dignity and independence' (Davey et al., 2004). Aging-in-place enables the elderly to maintain a level of independence and autonomy, keep the connection with social support services, including family and friends, and maximize self-fulfillment and preferred lifestyle (Boldy, Grenade, Lewin, Karol, & Burton, 2011; Callahan, 1993; Keeling, 1999; Lawler, 2001). It has received attention from policy makers in the elderly housing domain as well as health service providers to avoid the costly alternative of institutional care (elderly or nursing homes) (WHO, 2007).

The concept 'aging in place' has been in policy forums at least for the past two decades (Boldy et al., 2011). Evidence shows that majority of the elderly people prefer to live in a familiar environment, and avoid institutional care (Chan, 2014; Hansen & Gottschalk, 2006; Koukkari & Sarvakanta, 2005). For instance, The American Association of Retired Persons (AARP) survey, carried out in 2010, reveals that 88% (age 65 and above) of respondents strongly prefer to remain in their own homes as long as possible, while 92% emphasized they want to remain in their familiar communities (Policy Development & Research, 2013). Much previous research has concluded in favor of aging-in-place (Bayer & Harper, 2000; Judd et al., 2010) and home-based care compared to institutional care (Chappell, Havens, Hollander, Miller, & McWilliam, 2004; Grabowski, 2006). The reasons are: (a) it brings happiness to the elderly community; (b) it is economical compared to other options such as nursing homes and elderly care centers; and (c) it brings better health outcomes for the elderly (hence it might also increase life expectancy).

Lawton (1982) highlighted the importance of interaction between the physical home environment and personal competence in achieving the well-being of the elderly people, by emphasizing how changes to the physical environment enhance the independence of an elderly person. Howden-Chapman, Signal, and Crane (1999) and Means (2007) emphasize the significance of quality of housing regarding size and design as well as insulation in achieving aging in place. Lawler (2001) found

that social support, in particular, the quality of social support would also enhance aging in place. Although some point out that appropriate quality housing is a necessary thing for good social support and community care, the quality of social support has been capable of alleviating the negative effects of immediate environments (Wiggins, Higgs, Hyde, & Blane, 2004).

Oswald, Jopp, Rott, and Wahl (2010) emphasize the importance of the environmental gerontology discipline in achieving aging in place. Wiles et al. (2011) agreed that the community and neighborhood elements, beyond the home, have been recognized as important factors in the older adult's ability to stay put. The neighborhood environment and the longevity of residence may be positively related because older people may have a greater sensitivity to the neighborhood community (Glass & Balfour, 2003). Therefore, apart from housing options, Wahl and Weisman (2003) stressed the importance to enhance recreational opportunities and, also amenities and transportation to facilitate physical activities and social interactions.

2.2. Elements of successful aging in place: universal design and community care services

No standard formula or guidelines exist for successful aging in place. The degree, nature, types of design parameters and care services for the aging in place depend on the nature of the particular housing and care service providers (Chen, Yang, & Zhang, 2015). However, Heumann and Boldy (1993) identified several standard guidelines on successful aging in place, under the following circumstances: (a) personal dignity and functional independence is maximized; and (b) the provision of appropriate support is maximized. Two important elements have been identified as necessary to achieve successful aging in place: (a) **appropriate home design** (**universal design**), and (b) **comprehensive community care services**.

Universal design, an underlying design philosophy, is defined as providing homes that remain beneficial over time as changes accompany age (MetLife, 2010). It implies sustainability or meeting the needs of the present while preserving for others for future use. This universal design concept, which was designed by the Center for Universal Design at North Carolina State University (MetLife, 2010), can be readily applied to designing a house for the elderly to achieve aging in place. The 7 principles of Universal Design are summarised in Table 1 (Connell et al., 1997; MetLife, 2010). However, not all these principles are necessarily applicable to all buildings.

Healthy community environments with all supportive facilities need to be established for the older adult to age comfortably in the community. The supportive services include activities of daily living and instrumental activities of daily life (Pendleton & Schultz-krohn, 2012). These activities include health management and maintenance, community mobility and safety and emergency maintenance. The community support services would certainly minimize the dependency of elderly people on various institutional services. Basic design concepts for aging in place are barrier-free environments, visitability, accessibility and adaptable design (Lawlor & Thomas, 2008).

To guarantee the success of aging in place, it is also very important to understand the challenges and obstacles encountered by elderly people. Seniors who live alone at home encounter several problems in their daily lives. The common challenges identified by researchers are listed in Table 2 (Ormond, Black, Tilly, & Thomas, 2004). Policy makers should be aware of these obstacles and challenges to take the necessary corrective measures and facilitate a trouble-free life allowing seniors to participate actively in their communities (Rubin, Renkema, Downie, & Romer, 2009). A home environment that does not meet the changing needs of an elderly person can easily prevent successful aging in place.

2.3. Universal design & Comprehensive Structural Investigation Programme in public housing (re)development in Hong Kong

2.3.1. Public rental housing and universal design

Since 2002, the Housing Authority (HA) began to adopt universal design principles in its public rental housing estates (Chui, 2008). The first public rental housing estate to use the universal design concept was the Shek Kip Mei phase 1. Table 3 summarizes the universal design features which can be found in public rental housing estates in Hong Kong. Furthermore, the Government introduced two statutory documents to guide barrier-free design to enhance accessibility for the Elderly and Persons with Disabilities throughout the built environment. These are the Disability Discrimination Ordinance (in 1996), and the Residential Care Homes (Elderly Persons) Ordinance and the Design Manual - Barrier Free Access (1997). In 2008, a revised version of the 'Design Manual: Barrier Free Access 2008' (DM 2008) was introduced with some modifications to the original standards.

2.3.2. Comprehensive Structural Investigation Programme and redevelopment

In 2005, Housing Authority launched a Comprehensive Structural Investigation Programme (CSIP). To better assess the redevelopment potential of aged estates, the Housing Association endorsed the Refined Policy on Redevelopment of Aged Public Rental Housing Estates in 2011 (2013/703 http://www.info.gov.hk/gia/general/201307/03/P201307030279.htm). In considering clearance and redevelopment of the estates, the Housing Authority will refer to the findings of the Comprehensive Structural Investigation Programme on structural safety and cost effectiveness in repair works, and also examine the build-back potential, as well as and the availability of suitable decanting resources for the estates concerned. This is to address the issue of building sustainability and redevelopment potential, in order to better utilize valuable land resources and to increase flat production. By reviewing the specific site characteristics and developable area in the vicinity, the Housing Authority will conduct a series of detailed studies including technical and environmental impact assessments, local master planning, urban design and the development intensity, etc., and will also discuss with relevant bureau and departments with regard to the supporting facilities including community, welfare, transport and educational facilities, of the district concerned. Only after the completion of the relevant assessments can the Housing Authority confirm the feasibility of redeveloping an estate and draw up a suitable implementation programme accordingly.

Table 1
Seven principles of universal design.

Principle	Definition
1. Equitable use	The design provides equal access and opportunity- useful and marketable to users with diverse abilities.
2. Flexibility in use	The design accommodates multiple uses and users - a wide range of individual preferences and abilities.
3. Simple & intuitive use	The design with easy communication – simple charts and signs provide easy directions to all the users regardless of the background of users.
4. Perceptible information	The design provides tactical clues - necessary information to the user, regardless of the users' sensory abilities or ambient conditions.
5. Tolerance for error	The design provides 'undo' button - minimizes danger and the consequences of any accidental or unexpected actions.
6. Low physical effort	Features to accommodate frail and those with poor balance – designs to maximize comfort with a minimum of fatigue.
7. Size & space for approach and use	Easy and accommodative - sizes and space appropriate for all irrespective of the nature of users (i.e. body size, posture or mobility).

Table 2
Common challenges faced by the seniors aging in place.

Area(s)	Details
Housing design	
1. Appropriate housing	*Accessibility issues*: lack of accessibility features such as missing grab bars in bathrooms and insufficient door width for accommodating wheelchairs.
	Affordability issue: difficulties in keeping up with maintenance cost and increasing rent, particularly for those with fixed income.
2. Safety	*Safety issues*: mainly falling due to weak physical conditions such as weak eye sight and loss of hearing. Difficult to hear emergency alarms/signals. Some may even be vulnerable to crime
3. Home repair & maintenance	Difficulties in keeping up with home repair and maintenance works; also finding affordable and trustworthy repair companies.
Health problem	
4. Personal care	Due to poor mobility of elderly, some are in need of assistance with personal care.
5. Health care	Due to frail health conditions, they are in need of significant health care needs such as preventive care and treatment for chronic conditions. Yet, financial and transportation limitations may hinder access to health care in time.
Social network	
6. Transportation	Elderly with limited mobility or with wheelchair may need special transportation arrangements. Others who often rely on public transportation may also find difficulties because of the changes of transport network/route.
7. Community involvement	Poor mobility of some seniors may hinder participation actively in their communities.

Table 3
Universal design features in public rental housing in Hong Kong.

Scale/level	Design features
Micro-scale	
Physical home design	
Bathroom	• Non-slip flooring
	• Grab bars
	• Vertical rod type sliding shower-head and soap holder
	• Lever type shower, basin & sink mixer
	• Sunken shower
Interior design	• Increase door width
	• Shallow entrance door threshold with beveled edges
	• Large light switches and doorbell push button
	• Light switches, doorbell push button, door phones, socket at convenient height
Meso-scale	
Estate design	• Signage
	• Barrier access routes
	• Connect domestic blocks to major estate facilities
	• Avoid level changes & promote continuity and convenience
Macro-scale	
Community care	• Personal care
	• Health care/prevention care
	• Transport facilities to care

The present study focusses on redeveloped PRH, instead of PRH in general. The reason is that the governments, from time to time, attempted to incorporate certain design elements and provisions (in line with universal design standards) to enhance 'age-friendliness' within flats and the outside environments in estates. Only few such PRHs have been subjected to redevelopment process. The majority of PRHs was only subjected to simple repair and maintenance works. From 1988 to 2009, 57 public rental housing estates have been redeveloped under the CRP (HKSAR Housing Authority, 2007). In redeveloped estates, in compliance with the Design Manual and the principles of AIP, overseen by the Buildings Department, aged-friendly design standards, features and facilities have been incorporated into (a) housing units and (b) the estate environments. As for the housing units, various aged-friendly design elements have been installed/fitted in shower and toilet areas (i.e., redesigning bathtubs and installation of grab rails) and living areas (i.e., increasing door width, widening the doorway with supply of ramp; raising floor slabs of the balcony to avoid uneven floor levels between living rooms and shower/toilet areas). As for the estate designs, ramps, handrails, dropped kerbs and signage have been installed in the common areas of redeveloped public rental housing estates. Not only there have been no studies investigating the effectiveness of these design features and facilities in redeveloped PRHs, there also have not been a single study concentrating the wellbeing of the elderly residents in general in PRHs (Chui, 2001). It is therefore essential to study how effective those design features installed and facilities provided in terms of achieving AIP. The present study fills this gap. As the government is planning (due to pressure arising from society) to develop more PRH estates in the immediate future, the outcome of the present will provide clear insights into what design features and facilities should be provided in those future PRH estates for achieving successful aging in place in Hong Kong.

2.4. Theoretical framework

Most of the existing research work in the area of AIP and the wellbeing of the elderly has been based on the theoretical approaches borrowed from environmental gerontologists. Rowles (1978) was one of the first environmental gerontologists who developed the theory of *insideness*, which emphasizes that as people age the tendency of their attachment to the place they live becomes high, and they also become more concern and sensitive to the physical and social environments. He further conceptualized the elderly attachment to places in three dimensions: i) physical insideness (stresses sense of belonging to a certain physical environment); ii) social insideness (stresses the social relationships that an elderly develops with others); and iii) autobiographical insideness (stresses the memories of an elderly on shaping their self-identity) (Iecovich, 2014). In examining the living experiences of the elderly in line with AIP, some previous studies have also adopted the Atchley's (1999) 'continuity theory of aging' (Dante, 2015). Continuity theory consists of internal and external patterns. Internal patterns comprise idea patterns (e.g., attitudes and beliefs) and personal objectives, whereas the external patterns consist of lifestyle (e.g., social roles and relationships) and adaptive capacity. The theory presumes that the elderly tend to increase their adaptability to their environment under those patterns, and remain consistent in their behavior patterns as they age (e.g., leisure activities).

The ecological theory of aging, developed by Lawton (1982), has a long history. The ecological theory is very rich and has the ability to embrace almost all the elements relating to the elderly behavior and their physical and social environment, because this theory has borrowed ingredients from a wide variety of disciplines including public health, sociology, and psychology, and hence form a rich framework to understand human health, well-being as well as the elderly behavior (Ring, Glicksman, Kleban, & Norstrand, 2017; Menec, Means, Keating, Parkhurst, & Eales, 2011). The framework is used to effectively understand the mutual relationships and interactions between individual competences and the physical and social environments at various levels, including micro-, exo-, mezzo-, macro-, and chronosystems (Emlet & Moceri, 2012). The authors emphasize the need for a perfect balance between the personal capabilities and the environments that can result

in positive consequences, whereas a mismatch would lead to a feeble adaptation. Also, the theory assumes that the demographic background, such as gender, age, ethnicity, race, socioeconomic differences, would directly and indirectly shape and intervene well-being, function, and health of the elderly people (Smedley & Syme, 2001).

Ecological theory is particularly relevant to the concept of aging in place. The theory suggests that an elderly person interacts with various outdoor as well as indoor environments on a daily basis. In other words, they interact with microenvironment environments (e.g., homes and family), and also with a broader external environments (e.g., social capitals, networks, and sociocultural factors). Both micro and macro environments influence various abilities of the elderly affecting aging in place (Lavery, 2015; Emlet & Moceri, 2012). The availability and accessibility of physical, emotional, and social resources an elderly person has, and the layout and structures of the environments influences their ability to maintain and function in the present living conditions. The likelihood of an elderly person to age in place would be reduced when his/her needs in both physical and social environments exceed their resources (Greenfield, 2011).

Among all theoretical concepts, the ecological theory seems to be the most appropriate framework for the present study for a number of reasons. First, the ecological theory greatly emphasizes the dynamic interrelations between abilities and the needs of the elderly and various physical and social environmental elements in accomplishing successful aging in place. This is exactly what we aim to investigate in the present study. The study aims to investigate whether the design features installed and facilities provided in redeveloped PRH schemes are adequate and in line with the age in place concept. Second, the ecological theory provides an important framework to explore and understand how well and to what extent the elderly people are satisfied with various specific facilities and amenities at different scales. While the ecology theory mentions about different scales (representing various physical and behavioral environments) that affect people at varying degrees, the current study adopts a similar method to classify and measure the physical and behavioral environments under three measurement stages, i.e. micro, meso, and macro. Thus, we believe the ecological concept is the relatively more suitable for the present study.

2.4.1. Relationship among the three measures: micro, meso and macro scales

Elderly's perception is measured on three scales in the built environment: micro, meso, and macro. The first measure – (micro scale measure)- aimed to obtain elderly perceptions on the internal physical design of the house. In the ecological model, the micro-level is commonly defined as the smallest level of the environment that yields immediate and direct effects on a person's life (ARCC, 2011; Duncan, Bowman, Naidoo, Pillay, & Roos, 2007). As explained by many existing studies, 'home' is described as an ongoing negotiation with the dynamic landscapes of social, individual, and cultural changes (Andrews, Cutchin, McCracken, Phillips, & Wiles, 2007). For the elderly, particularly for those with health problems that limit their mobility, 'home' is more than a physical level entity, which is closely connected with the social and symbolic level entities. Given such strong interconnection between the levels, this 'smallest' level of environment influences the elderly most significantly. Therefore, in the present study, questions were formulated to obtain the seniors' opinion on (i) sense of home, (ii) privacy and comfort, and (iii) independence and dignity. These measures reflect features of house design, as seen in Fig. 1. The element of 'housing design' has a special and very important place in 'aging-in-place' as the elderly spend most of their time in their homes. Hwang, Cummings, Sixsmith, and Sixsmith (2011) explained that physical home environment has a direct impact on the quality of life and their daily activities. They further mentioned that home environment also improves their psychological wellbeing and personal competencies. As elderly people often experience and encounter barriers in their physical home environment (Gitlin et al., 2008), the built environment should

be improved in such a way for the elderly people to enhance functional competence (Hwang et al., 2011).

Since aging-in-place is a process, not a static phenomenon, the physical home environment is connected to the surrounding physical environment. In the ecological model, the meso-level represents the middle ground that deals with the linkage between the micro-scale (Homes) and the surrounding environment they interact, such as the neighborhood and community (ARCC, 2011; Duncan et al., 2007). A number of previous studies have investigated the meaning of neighborhood to the elderly. Rious and Werner (2011) emphasized that a dwelling should not be isolated and separated from the surrounding physical and social community, although the internal design of the house is certainly significant for the elderly people. In fact, community and neighborhood may have a significant influence on health conditions of the elderly (Glass & Balfour, 2003). Through long years of residency in the neighborhood, elderly tend to be 'structurally linked' with the physical and social fabrics, which is reflected through 'estate design' in the present case. Despite the importance of physical community environments and individual functional capabilities, subjective feelings about the neighborhood and social exchange between friends and relatives are an inevitable factor for elderly' satisfaction (Gory, Ward, & Sherman, 1985). Thus, for aging-in-place to take place successfully, the elderly' perceptions towards the neighborhood environment should be considered (Oswald, Jopp, Rott, & Wahl, 2011).

In the study, therefore, the elderly' perceptions of the community, in term of estate design and the common areas and facilities was considered as the second measure – at meso scale. The elderly were asked to express their opinions on four features at meso-scale: barrier free access routes, signage, route connection to major estate facilities, and floor level changes & continuity and convenience (Fig. 1).

The last measure – (macro scale) – represents the elderly' perceptions towards community care support. In the ecological model, macroscale represents the largest level of the environments that have an impact on the people's lives. It involves primarily with the supports of institutions and policies, such as community supporting services (ARCC, 2011; Duncan et al., 2007). Previous studies have established that the community-based services and supportive health care facilities are essential for the dream of aging-in-place to become a reality (e.g., Rantz, Skubic, Miller, & Krampe, 2008). Appropriate community support services allow the elderly to remain active in their homes and familiar neighborhood while receiving appropriate supports in their daily lives (Davey, 2006). Community support services can also deaccelerate the deterioration of the physical functioning of the elderly and hence delay the institutionalization. To satisfy the changing needs of the elderly and further promote "aging in place", there are two types of services: in-home services (e.g., home health services) and community-based services (e.g., elderly care day center) (Tang & Pickard, 2008). In the present study, community care support includes personal care and health/prevention care services, as seen in Fig. 1. These three measures: micro, meso and macro scale measures are inter-connected and should be addressed simultaneously for a successful aging-in-place to take place.

3. Methodology

The aged population is unevenly distributed in Hong Kong. In 2011, Wong Tai Sin and Sham Shui Po districts had the largest proportion of the elderly population, 17.6% and 17.0%, respectively (HKSAR Census and Statistics Department, 2015). Sham Shui Po was selected as the study area, and the Un Chau Housing Estate of the largest public rental housing estates, as the case study. Sham Shui Po is the second largest, regarding the elderly aged 65 years and above. The Un Chau Estate was selected for two reasons: (1) nearly 30% of the total population in this estate are elderly people (HKSAR Census and Statistics Department, 2011); (2), the Un Chau Estate has undergone redevelopment three times, in 1998, 2008 and 2012, in order to incorporate various age-
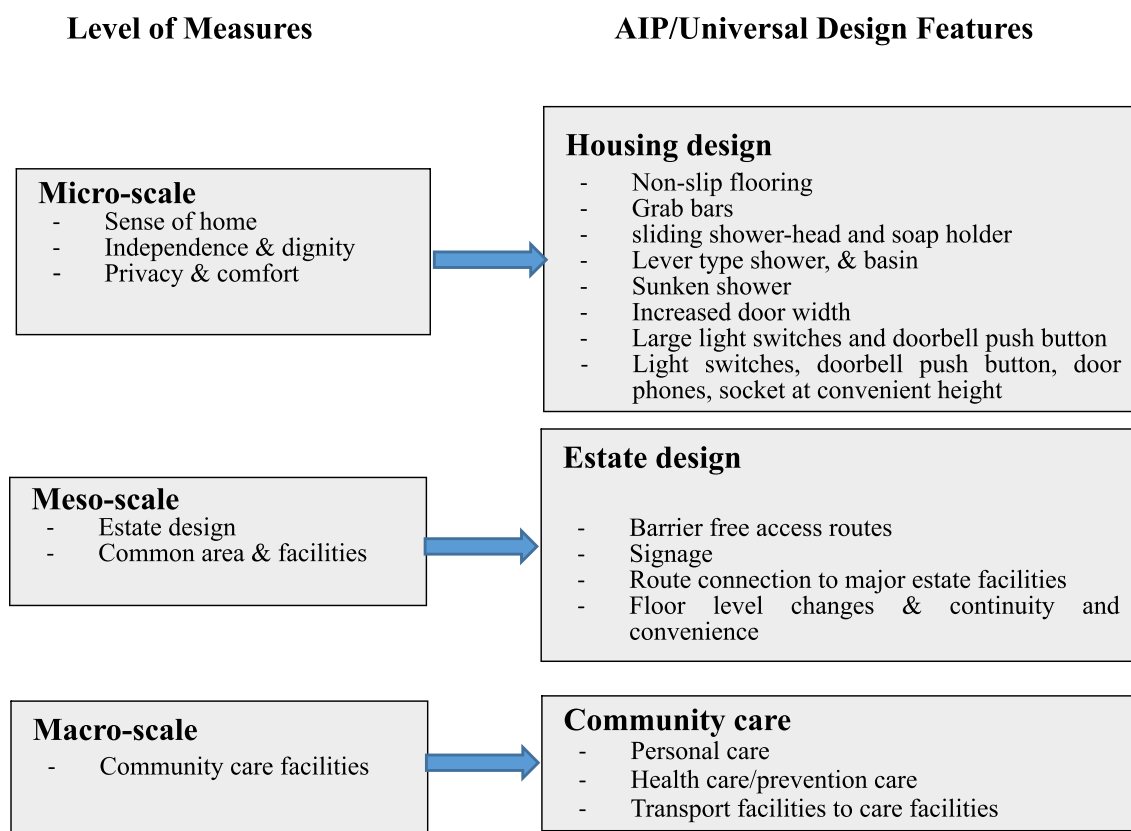
Level of Measures

AIP/Universal Design Features

Micro-scale
- Sense of home
- Independence & dignity
- Privacy & comfort

Housing design
- Non-slip flooring
- Grab bars
- sliding shower-head and soap holder
- Lever type shower, & basin
- Sunken shower
- Increased door width
- Large light switches and doorbell push button
- Light switches, doorbell push button, door phones, socket at convenient height

Meso-scale
- Estate design
- Common area & facilities

Estate design
- Barrier free access routes
- Signage
- Route connection to major estate facilities
- Floor level changes & continuity and convenience

Macro-scale
- Community care facilities

Community care
- Personal care
- Health care/prevention care
- Transport facilities to care facilities

Fig. 1. Connection between measurement indicators and AIP.

friendly facilities and services (HKSAR Housing Authority, 2015). The Un Chau Estate consists of 11 residential blocks/ towers (see Fig. 2): Un Fung House, Un Wo House, Un Him House, Un Shing House, Un Tai House, Un Hei House, Un Chi House, Un Kin House, Un Moon House, Un Yat House, and Un Wai House.

The methodology adopted to address the main objective of the study constituted (a) a questionnaire survey and face-to-face discussions with the seniors, and (b) an in-depth interview with professionals.

(a) *Questionnaire survey and face-to-face group discussion*

A questionnaire survey was administered to understand the perceptions of the elderly residents in the Un Chau Estate about their re-developed dwellings and the facilities available. The questionnaire related to aspects of design elements, and the support and community services, necessary for aging in place to occur. The aim of the questionnaire was to obtain opinions/perceptions of the elderly, particularly with respect to the following three built environment aspects:

 (i) Micro-scale – internal/interior design of housing
 (ii) Meso-scale (mezzo-scale) – common areas, facilities and social network
(iii) Macro-scale – community care support

These three practice categories (micro, meso and macro scales) are particularly used in the social study analysis. Micro-scale work is the most common and deals with an individual or a family. In this study, micro-scale covers asking an elderly person his/her perceptions about the housing unit on a sense of home, independence and dignity, privacy, comfort and health, and safety. The mesoscale normally covers small-to-medium size groups/works such as neighborhoods and institutions. This study, at mesoscale, aimed to analyze the opinions of

the elderly about common facilities, designs of the housing estate, and the transportation facilities in the estate. The macro-scale covers large scale interventions that would affect the entire community. This study, at macro-scale, covers community care services in the housing estate. These three categories often overlap and sometimes influence each other. Satisfaction with all three categories is essential for aging in place to be successful.

For a better understanding of the perceptions of elderly people, respondents were divided into the two categories: Solitary Elderly and Non-Solitary Elderly. Those living alone are Solitary Elderly, while those living with others (spouse or/and children) Non-Solitary Elderly. This differentiation, is important as those who live alone may have different emotions and requirements than those who live with others. They may have different opinions towards the built environment and the facilities. Such information would be very useful in formulating appropriate planning and design guidelines towards an appropriate housing system for the future elderly community.

The questionnaire consisted of 34 questions, with a 5-point Likert scale (1 = strongly disagree/dissatisfied to 5 = strongly agree/satisfied). The elderly people were asked to express their degree of agreement to questions/statements on a 1 to 5 scale. The elderly have been invited to assess the perceived importance and the satisfaction level for each element in question. To test internal consistency, Cronbach's alpha test was performed. This test shows a measure of scale reliability of the items.

The questionnaire was administered to the elderly in the housing estate. Being face-to-face with the elderly, the research team explained the main aim of the survey as well as the benefits that the study may bring to the elderly community. Once the elderly had gained a clear understanding of the purposes and benefits of the survey, they were enthusiastic, and hence, the response rate was very high at 92%. Approximately 240 questionnaires were distributed, and 221 completed
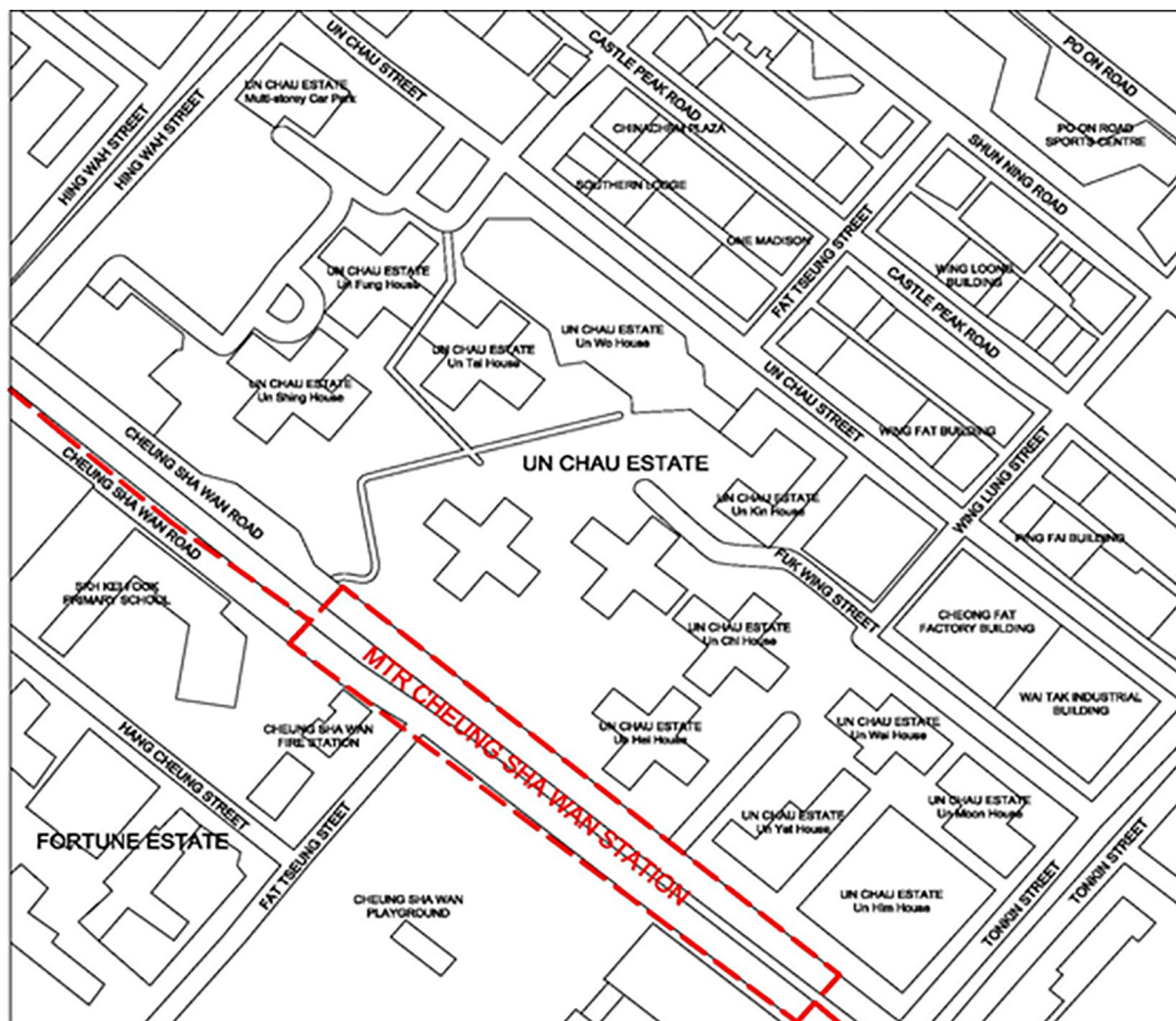
Source: Google Maps

Fig. 2. The study location.
Source: Google Maps.

questionnaires were collected. In the study sample, 74% of the respondents were female, and the remaining 26% were male. Since this study is not gendered sensitive, this imbalance would not affect the results of the study. The majority of the respondents (78%) were 75 years and above and, nearly half of them (49%) lived alone. The majority of the respondents (87%) had no major health issues.

Seniors' opinions were evaluated regarding means of responses about the satisfaction and perceived importance levels for each element studied in the built environment. Their opinions were analyzed in three aspects: (i) *micro-scale* – interior design of housing; (ii) *mesoscale* – common areas, facilities and social network; and (iii) *macro-scale* –community care support. Before the analysis, a reliability test (Cronbach statistic) on the 8 variables used in the analysis was carried out. A Cronbach statistic of 0.814 was obtained for the level of satisfaction. Reliability is established if the Cronbach statistic is greater than 0.6 (Malhotra, 1993). Hence, we consider all the variables in our study data meets the necessary criteria of reliability.

Results of the questionnaire survey were analyzed using (a) descriptive statistics and (b) correlation analysis. Descriptive statistics, in terms of mean scores and standard deviation, were primarily used to identify the general patterns of the respondents' perceptions

(satisfaction and perceived importance) (Trochim, 2006). To further determine 'age-friendliness' of the living environment, a correlation analysis was conducted to identify the relationship between the satisfaction and importance levels.

Face-to-face group discussions with the elderly were also conducted to cross-check the responses received from the questionnaire survey. Six group discussions (pre-arranged) (6–10 seniors in a group) were held in their housing estate. They were specially asked to express their opinions on their levels of satisfaction and their expectation levels of the facilities in their homes and the built environment.

(b) *In-depth Interviews with Professionals*

To obtain in-depth insights on the effectiveness of the facilities and the care services provided in their dwellings and the estate, five professionals, from various governmental and quasi-governmental organizations, were interviewed (see Table 4). They were asked to express their opinions and insights mainly on the following themes.

(1) Design elements incorporated into homes to facilitate the changing needs of the elderly.

Table 4
Profile of the interviewees.

Name	Organization/capacity	Expertise/experience
Two senior architects	Housing Authority	Current design consideration of the PRHs
Two professionals	Housing Authority	Design considerations including barrier free access and planning standards and guidelines
A senior nurse	A government elderly age home	Experience in taking care/dealing with elderly; a very good experience towards aging-in-place

(2) Expectations of elderly people for the built environment in the aging process.

(3) Applicability and effectiveness of the facilities installed in homes for the elderly achieve aging in place.

(4) Opinions or recommendations for promoting an aged friendly built environment.

3.1. Method of sampling

The stratified sampling method was used to select the elderly for the questionnaire survey. The elderly respondents in the housing estate were divided into two distinct demographic groups: Solitary Elderly (SE) and Non-Solitary Elderly (NSE). In each group, the random sampling method was then employed to locate the respondents. With the use of this sampling method, it was not only helped to minimize the potential bias in the sample but also ensured that the sample size in each group is well represented. The random sampling is ideal for this type of a study as it ensures that all elements of the population of interest are representatively sampled (Lim & Thompson, 2016), in this case, for example, proportionally including adults who are isolated.

As for the interviews with professionals, the expert sampling technique was adopted to select qualified interviewees. Instead of randomly selecting professionals for interviews, this method involved assembling of a sample of individuals with demonstrable experience and extensive knowledge in the area of elderly care policies and "aging-in-place" in Hong Kong. This did not only help to collect in-depth insights on the effectiveness of facilities and care services, but also validated the findings obtained from the questionnaire survey.

4. Findings

4.1. Questionnaire survey results

The results reveal that the levels of satisfaction on all elements within the three categories (micro, meso, and macro) are relatively low (Table 5). The levels of satisfaction have a lower mean score for all

Table 5
Results of means of satisfaction.

Assessment criteria/elements	SE (n = 109)	NSE (n = 112)	Overall (n = 221)	SD Overall
1. Micro-scale				
Satisfaction on sense of home	3.56	3.46	3.51	0.66
Satisfaction on independence & dignity	3.83	3.75	3.79	0.43
Satisfaction on privacy	3.47	3.29	3.38	0.67
Satisfaction on comfort & health	3.62	3.57	3.60	0.61
Satisfaction on safety	3.76	3.87	3.82	0.51
2. Meso-scale				
Satisfaction on common area and facilities	2.75	2.65	2.70	0.62
Satisfaction on estate design	3.19	3.16	3.17	0.42
Satisfaction on transportation	4.52	4.57	3.45	0.63
3. Marco-scale				
Satisfaction on community care support	3.41	3.49	3.45	0.73

elements, which suggests that performances of all these elements are below those required by the elderly. Nevertheless, no significant differences, between SE and NSE categories, were found regarding levels of satisfaction for all the elements.

There are significant differences in the means of the responses across the three categories. Particularly, for the mesoscale, the means of responses show great disparity. The highest mean score was 4.5 (for transportation), and the lowest was 2.7 (for common area and facilities in the estate). This clearly shows that the elderly people in the Un Chau Estate are not satisfied with the common areas and the facilities provided (this will be further discussed below).

The means of responses, for the micro-scale category (internal home designs), do not show significant differences across elements. However, the elderly satisfaction levels for the sense of home and privacy are quite low, with mean scores of 3.51 and 3.38, respectively. A sense of home and privacy are very important elements if aging in place is to be achieved. These two elements, in fact, are complementary - no sense of home means no privacy and vice versa. They are closely related. Results also indicate that the elderly people in the estate are only moderately satisfied with the residential unit about safety (3.82) and independency and dignity (3.79). This implies that the elderly people appreciate independence and dignity and safety very much. They are also quite unhappy with the common areas and the facilities in the estate, which is reflected by the low mean score of 2.7.

4.2. Perceived importance and satisfaction level with the built environment

While a comparison between the importance and the satisfaction levels can be used to adjust the weight of the measurement scale, it also provides an indication of the level of age-in-place features. Perceived importance level is an indicator, which reflects what features are valued most by the elderly residents in the estate. This clearly reflects what aspects of house and estate design are important for them to have a safer and independent living environment. Satisfaction level on the other hand, reflects whether or not the incorporated design elements into redeveloped housing have fulfilled the needs of the elderly in terms of quality of life. This comparison approach is therefore appropriate as features and attributes of aging-in-place vary from context to context. The measurement of elderly perception through a correlation analysis is not new to the fields of environmental gerontology and psychology to examine the environmental impacts (e.g., home and neighborhood) and other physical elements and facilities on elderly's health-related psychological wellbeing (e.g., Oswald et al., 2010; Wahl, Fänge, Oswald, Gitlin, & Iwarsson, 2009). Elderly satisfaction on their residences often serves as an important measure of the elderly's personal and environment experiences with their physical and psychological wellbeing to aging in place. The authors presume that the elderly are active users of their homes and environments, and the critical basis of the elderly satisfaction is dependent on whether the environment supports their needs and goals. Especially for those with health problems (e.g., mobility impairments), the skills and abilities of residents may limit their engagement with the socio-physical environments, which will reflect through their opinions on residential satisfaction. Thus, obtaining an elderly perception on socio-physical environments where they live will help us to understand and establish relationships between their residential needs and the facilities/services provided to them in their living spaces and the outside environment. As described by many

Table 6
Perceived importance & satisfaction in different assessing criteria.

Assessing criteria/ elements	Perceived importance (PI)		Satisfaction (S)		Correlation between PI & S
	Mean	S.D.	Mean	S.D.	Coefficient
Micro-scale					
Sense of home	4.81	0.39	3.51	0.66	0.150
Independence & dignity	4.43	0.56	3.79	0.43	0.209**
Privacy	4.64	0.50	3.38	0.67	− 0.158
Comfort & health	4.44	0.50	3.60	0.61	− 0.198*
Safety	4.60	0.49	3.82	0.51	0.169
Meso-scale					
Common area & facilities	4.06	0.53	2.70	0.62	0.129
Estate design	4.05	0.46	3.17	0.42	0.198*
Macro-scale					
Community care support	4.31	0.52	3.45	0.73	0.129

Note: *,** Correlation is significant at 1% and 5% level, respectively.

scholars (e.g., Choi, 2014; Perez, Fernandez, Rivera, & Abuin, 2001), the most important aim of 'aging in place' is to enhance the quality of life for the elderly residents. Thus, a comparison between, through a correlation analysis, satisfaction level and importance level is an effective way measure whether the elderly are satisfied with those facilities available to them, which can enhance their quality of life. The results of such a comparative analysis can further provide some insights on areas where further improvement needed to achieve successful AIP.

This section examines the relationship between the perceived importance of and the satisfaction with various elements of the built environment. The means and standard deviations of the perceived importance and the satisfaction level for each item under three sub-categories are shown in Table 6. The Cronbach statistic of 0.764 for the variables of the levels of importance, implies the data is reliable.

As seen in Table 6 and Fig. 3, the levels of satisfaction show lower means than the levels of importance (for all the elements). Only three elements out of eight are statistically significant in the correlation analysis (last column of Table 6) between the elements of importance and satisfaction. Interestingly, two out of those three elements, where the levels of satisfaction were relatively close to the levels of importance, are in the micro-scale (related to home design) category. These two are independence and dignity, and comfort and health. It is also important to note that the elderly people have ranked safety (3.82), independence & dignity (3.79) and comfort & health (3.6) high (highest mean scores) regarding their relative satisfaction. This shows that the elderly are moderately satisfied with the design of safety measures
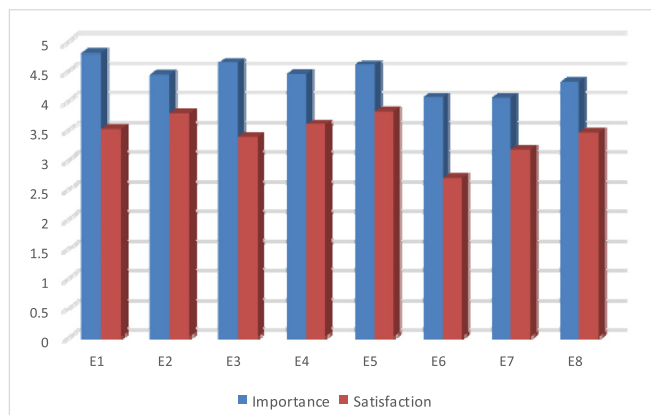

Fig. 3. Comparison of means of importance and satisfaction.

within the home environment and feelings towards independence, compared to the other elements. However, some important elements such as a sense of home and privacy are statistically insignificant. There are significant differences between the perceived importance and the level of satisfaction for those elements. The elderly ranked these two elements top (first, 4.81 and second, 4.64) regarding their relative importance. This suggests that the elderly community is not satisfied with these two elements. In fact, these two elements record the weakest correlations (next to common area facilities) between importance and satisfaction levels. The sense of home and privacy are crucial to achieving successful aging in place for the elderly.

It is also important to note that the micro-scale elements (home design and internal facilities in the house) were ranked above the meso and the macro scale elements regarding importance and satisfaction. The elderly also recognize that community care support (macro-scale) is more important than the facilities in common areas (mesoscale). The lowest mean score of satisfaction (below the average) towards the common area and facilities, which is, shows that the design of common areas and facilities do not satisfy the needs of the elderly.

4.3. Analysis of face-to-face group discussion

Six group discussions with the elderly on the estate were held to validate the findings of the questionnaire survey. Following are the key points highlighted:

(a) All the seniors emphasized in one voice that they want to age in their homes, and in a familiar environment rather than to move into institutional shelters (elderly care centers, nursing homes). Most of them were only moderately happy with their accommodation.
(b) They are unable to adapt to a new environment, and therefore it is their high priority to live in their familiar environment. That is the main reason why the elderly do not wish to move into institutional care centers.
(c) The feeling of the sense of own territory (feeling of home) was emphasized in one voice by all the participants. Approximately half of the respondents were only moderately happy with 'sense of home' in their present dwelling.
(d) A quieter living environment along with the sense of privacy within their residence is another important factor they emphasized. Nearly half of the participants were not satisfied with the present situation.
(e) A sense of safety in the living environment is another significant element. Most of the elderly are happy with this element in their living place.

5. Discussion

(i) *Micro-scale* – interior design of housing

Senior respondents, in the questionnaire survey, rank sense of home, privacy and safety high regarding the importance, while independence and dignity, and comfort and health were ranked slightly lower. Even though they ranked sense of home and the privacy the top regarding importance (ranked 1st and 2nd), their satisfaction level on these two elements is the lowest among the five elements. The result implies that an appropriate elderly friendly dwelling design is very crucial to them. As bodies physically and mentally deteriorate with age, mobility is restricted, requiring a user-friendly internal design layout for the dwelling. Nevertheless, independence and dignity and comfort and health were found to be statistically significant implying that seniors were relatively satisfied with those facilities in their residences. An interviewed senior professional mentioned that Barrier Free Access facilities had been incorporated into the redeveloped public rental housing estates. The expert further mentioned that BEA is now widely applied in newly built public rental housing. Some of those facilities include increased door width at the flat entrance and shallowing the

entrance door threshold with beveled edges. He further mentioned that barrier-free access facilities in dwellings (in line with principles of universal design) would help to create a home atmosphere in which the elderly can easily engage in their day to day activities minimizing outside intervention.

The results reveal that, under the micro-scale category, the elderly's satisfaction level on the sense of home, privacy and safety was not up to their expectations. By ranking sense of home 1st, privacy 2nd and safety 3rd, regarding perceived importance, the elderly strongly echoed that these three elements in their residences are crucial to achieve successful aging in place. The result implies that dwellings should be designed in such a way that the elderly feel a sense of home and have privacy and safety. Nevertheless, independence and dignity and comfort and health elements were found to be statistically significant implying that seniors were moderately satisfied with those facilities in their residences. It suggests that the design of safety measures provided within the home environment and feelings towards independence are acceptable to the elderly. It is important to understand the influence of the physical environment on the sense of security and independence and well-being of the elderly.

(ii) *Mesoscale* – common areas, facilities and social network.

The elderly were, however, less satisfied with meso-scale elements in the studied estate. Their main concerns about the provision of common facilities are two-fold: (a) sense of oppression and (b) cleanliness in common areas. They emphasized that common facilities such as gathering areas and seating are surrounded by congested high-rise buildings which impose a sense of oppression. Bad location and improper design of these facilities were mainly emphasized by them. These poor designs are unable to meet the functional needs of the elderly. These facilities should be designed in such a way as to enable them to participate actively in the community. In addition, the elderly also emphasized the inadequacy of public seating in the estate. Common facilities in housing estates are particularly crucial if aging in place is to occur successfully. Overall, the findings reveal that significant improvement or development works are needed to bring up the public housing estates to meet the elderly's special needs.

The lowest mean score clearly indicates the dissatisfaction of the elderly with the standard facilities in the housing estate, which was further reaffirmed by the group discussion with the elderly. Their concerns about the provision of common facilities are two-fold: (a) sense of oppression and (b) cleanliness in common areas. They emphasized that common facilities such as gathering areas and seating are surrounded by congested high-rise buildings which impose a sense of oppression. Bad location and improper design of these facilities were questioned by them. For example, they were puzzled about the location of benches in the estate. The majority of the benches were located near the main street, with some facing a children's playground (Fig. 4). These unsuitable designs are unable to meet the functional needs of the elderly. These facilities should be designed in such a way enabling them to interact with their peers actively in the community. These poor designs make the elderly uncomfortable about using these facilities.

In addition, the elderly also emphasized the inadequacy of public seating in the estate. This caused many elderly to use the kerb as their resting and gathering place (Fig. 5). The seniors also mentioned that discontinuous seating arrangements and the limited number of seats cause a great inconvenience to them due to their limited physical mobility. The professionals interviewed also echoed the lack of common facilities in public rental housing estates. They mentioned that the design and provision of these public amenities should be improved to cater to the specific needs of the elderly. They further mentioned that the common facilities in housing estates are particularly crucial if aging in place is to occur successfully.

(iii) *Macro-scale* – community care support

Seating facing the main pedestrian path

Fig. 4. Improper seating design.

Seniors' impressions on the community care services in the housing estate are generally positive. This is reflected by the relatively large mean score regarding satisfaction (though not statistically significant), which was also reaffirmed through the group discussion with the elderly. They appreciated the various types of social and health services provided by the government and the non-governmental organizations. There are few care center services carrying out their duties within the estate and in the neighborhood. The senior health professional interviewed emphasized the importance of providing quality medical and social services to the elderly. The expert mentioned that these services could easily avoid the need to move the elderly to outside health care institutions. The benefit of this is not only cost effective but is also convenient for the elderly. They were also moderately happy with accessibility to those facilities. During the group discussion, they also expressed their satisfaction with the house maintenance and modification services arranged by the estate management authorities. A repair and maintenance service for the specially designed and installed facilities in their homes is essential to have a risk free life at home.

6. Conclusions

Elderly housing surveys and research work consistently claim that the elderly prefer living in their homes as far as they are physically able. The study examined whether the elderly living in their housing estate are satisfied with their (internal design) homes and facilities provided under the redevelopment programme, from micro, meso and macro scales based on ecological theory. The findings suggest that all the seniors opined in one voice that they want to live in their familiar environment rather than to move into institutional centers, which is in line with the Government's policy of 'Aging in Place'. The authorities recommended to review the existing housing designs and practice, and the provision of common facilities and community care services in public housing estates to design an improved housing system enabling the seniors to age comfortably.

One challenge for the government is to deal with the current old public housing stock that is waiting for redevelopment. They are considerably aged, but physical design structure of most of the estates is flexible enough to be upgraded to the needs of the elderly in accordance with aging in place concept. As the government is planning to expedite the redevelopment process of public housing in the next 10 years, it is advisable that the government incorporate specific elements and facilities (micro, meso and macro levels), in line with aging in place. The authorities should allocate sufficient resources to provide and promote

Sitting on the kerb   Discontinuous seating arrangement

Fig. 5. Improper and insufficient design facilities.

the aging in place concept as a much-preferred alternative to residential care centers or nursing homes.

By investigating the case study of Hong Kong as a showcase, the study findings will help to improve awareness and knowledge among professionals and policymakers about the benefits and importance of aging in place in enhancing life satisfaction of elderly tenants in the studied estate, with the objectives to carry out further improvement works and future policy and estate planning in optimizing the benefits of aging in place in redeveloped public rental housing estates. The findings will also be a valuable addition to the present academic studies on the ecological model with a new perspective of unique design needs in the built environments for successful aging in place.

All in all, while progress has been made in addressing certain aspects in achieving aging in place, there are many aspects of room for improvement if aging in place is to be fully and successfully implemented. Creating an age-friendly environment in the city requires the close engagement of the elderly, and those approaching old age. Thus, it is essential for the elderly as well as experts to be involved in the planning and development stages of such an attempt. Findings would also promote and enhance the public awareness of the severity of the aging issue within society in Hong Kong.

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