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# A Review of Facilities Management Guidelines for the Living Environment of the Elderly

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## Abstract

The population of elderly people is significantly increasing across different parts of the world. In fact, it is estimated that the number of elderly people in the world will exceed the number of children in 2022. Due to the increasing number of cases of decline in the health of the elderly, there will be increased demand for special additional facilities to enable them to maintain their independence in the living environment. To understand the needs of the elderly, there is the need to identify the basic and special facilities required by the elderly in their living environment. Therefore, this study seeks to identify the facilities management (FM) needs of the elderly and the corresponding guidelines for different countries across the world. A comprehensive literature search was conducted to identify the FM guidelines for residential apartments of the elderly in different countries of the world. The FM guidelines were assessed to understand the basic and special needs for the comfort of the elderly in their living environment, while content analysis of the guidelines was conducted and presented under three different categories identified in literature namely space management, building services and supporting facilities. The studyreveals that many of the suggested FM components in the guidelines were general needs of disabled individuals without adequate consideration of the specific health needs of the elderly. The study recommends that a comprehensive anthropometric measurement of different elderly groups is conducted in order to provide detailed FM guidelines for meeting both the basic and special needs of the elderly in the living environment.

## Keywords

Elderly; Facilities Management; Living Environment; Sustainability

## 1. Introduction

Increasing life expectancy, declining fertility and improved healthcare is responsible for the significant rise in the elderly population around the world (Hui and Yu 2009; United Nations 2013). The number of elderly persons is expected to outnumber the population of children aged 0-14 for the first time in human history within the next few years (United Nations 2006). According to the United Nations, the number of people aged 65 and above living in the world is 727 million, which is about 9.3% of the population in 2020. The percentage of elderly people in around the world is expected to reach 1.5 billion (i.e. 16.0% in 2050 (United Nations 2020). This means that the number of elderly people will be doubled within the next 2.8 decades. Therefore, it is urgent to investigate issues affecting the comfortability of the elderly in their living environment (Murphy et al. 2006).

Housing is a basic need, and its quality is one of the best indicators of a person's standard of living (Alagbe 2011; OECD 2011). To meet the diverse needs of the ageing population, the government of different countries have formulated different policies to guide in the provision of comfortable housing for the elderly. For instance, the principle of ageing-in-place to enable elderly people live in their home environment with minimum disruption was adopted by the Hong Kong government (Hong Kong Policy Address 2016), the United States government provides rental assistance for those on low incomes and promotes home-ownership through interventions in mortgage markets (Olsen and Zabel 2015); and the Chinese government advocates home- ownership for middle and high income families and social housing for low-income families (Zenou 2011).

Ageing-in-place is facilitated by ensuring adherence to Universal Design standards for interior facilities of new residential apartments to meet seniors' needs (Wai 2006), and provision of diverse housing choices and schemes (Cheng 1999). However, most elderly residents reside in old residential apartments which may be over 50 years and lacking facilities required for meeting their daily needs. Hence, practical steps are required to improve old apartments and, when necessary, provide new flats with facilities that will meet the needs of the teeming elderly population.

Facilities refer to the space, living environment, support and services enabling the achievement of key business objectives, and integrating development, operation and needs of the business (Alexander 1999). Management, on the other hand, involves the process of planning, leading, organizing and controlling the resources of an organization to meet its objectives through the commitment of employees (Weihrich and Koontz 1993). It incorporates the people (referring to the elderly in this study), place (the residential apartment) and processes (the facilities) to provide an enabling environment (Springer 2004).

The provision of quality facilities management (FM) components becomes very important for the elderly because they largely depend upon the facilities to make up for the inherent disabilities and deficiencies associated with old age. In fact, the elderly becomes more susceptible to various health challenges requiring the provision of appropriate facilities to enhance their livelihood. Hence, the design of the building must be aligned to address the age-related functionality and supportive role required to improve their quality of life (QoL). The current study thus seeks to identify the current guidelines for the living environment of the elderly which will serve as a basis for comprehensive design requirements for aligning and meeting elderly needs.

## 2. Research Methodology

To understand the FM needs of the elderly in the living environment, a content analysis of international guidelines across different countries was conducted, including United States, United Kingdom, Canada, Hong Kong, Ireland, New Zealand, Nepal and India. These countries were chosen because they had a comprehensive FM guideline and requirements specifically prepared for the elderly. The content of the guidelines considered in this study consists of the following sections: (1) identification of the FM needs of the elderly under the three major categories, including space management, building services and supporting facilities; and (2) the requirements of the guidelines as it affects the comfortability of the elderly in the living environment.

A systematic procedure was followed in the review of guidelines for this study as follows: firstly, a thorough literature review was conducted to ascertain some of the FM needs in the residential apartment of the elderly. Secondly, an electronic search of relevant guidelines for the living environment of elderly people was conducted using the housing department website of different countries, and references in different published articles indicating housing requirements of different countries. In addition, google scholar was also used in the search for the guidelines using words such as “facilities”, “accessibility design standards”, “living environment requirements”, “universal design requirements”, “housing standards”, etc. The guideline for 13 countries were identified from the electronic search conducted.

A total of 19 FM needs were identified from literature for the residential apartment of the elderly, including 3 space management components, 7 building services components and 9 supporting facilities components (Famakin 2018; Leung et al. 2019). The key words as identified from literature for the FM components were searched in the guidelines to explore the minimum requirements from each identified country. For inclusion in the study, countries with guidelines for at least five (5) of the FM needs for the elderly outlined from literature were considered. Each of the FM needs have been introduced, findings presented under the three major categories and outcomes from the different guidelines have been outlined in Table 1.

## 3. Results and Discussion

The outcome of the comprehensive study of the guidelines of different countries have been outlined in Table 1. The FM needs of the elderly in their living environment have been grouped under three components, namely space management, building services and supporting facilities. For the space management components, the study focuses on turning spaces, clear spaces and sizes of different spaces available in a typical residential apartment. On the other hand, building services considers the lighting, ventilation, temperature (i.e. room and water temperatures), electrical fittings, safety and security gadgets, lift service (if any) and fire service. Lastly, supporting facilities takes a look at the colour, furniture, floor finish, signage, doors, windows, acoustics, handrails and grab bars.

### 3.1 Space Management

Space management focuses on the building design and layout (Cotts 1999). It includes sizes of rooms, distance between rooms as well as turning and clear spaces within the apartment. Turning spaces and clear spaces are essential housing design requirements for facilitating elderly’s essential activities within the interior spatial areas. It supports their independent movement and manoeuvring for the elderly within the home. It is particularly important because some elderly may require a walking assistance or support (e.g., a walking frame or wheelchair) for movement within the home to engage in daily activities. Therefore, a sufficient turning and clear space is necessary in the different spaces within the home.

Turning spaces as provided in the requirement of different countries reveal that spaces made available allow for a $360^0$ turning of a walking assistant such as wheelchairs, scooters for the easy manoeuvring of the

elderly within the living environment. The spaces provided (e.g., 1500mm circular space for UK elderly; Lifetime Homes 2010) are dependent on the average size of the walking assistant used by the elderly in the country. Some other countries e.g., Ireland and Nepal (i.e. 675mm for able bodied elderly, and 750-900mm for those using walking frame/crutches) also made provision for elderly people with mild changes in walking conditions.

A few countries have specific guidelines for the provision of clear spaces for the elderly in the living environment. For instance, in the United States, a 305mm clear space parallel to at least one side of the bed is required to ensure easy mobility for the elderly in their residential apartment; this may not accommodate those using a walking assistant (United States Department of Justice 2010). On the other hand, Canada stipulates the provision of a minimum of 760 x 1370mm clear space to accommodate a wheel chair (City of London 2007). The provision of adequate clear space for the elderly will help ensure their independent movement within the home (able-bodied and mild changes in walking) and for easy transfer from wheelchair to the bed (wheelchair users).

**3.2 Building Services**

Building services refer to services that aid the effective functioning and fulfilment of the elderly's basic needs and consists of lighting, ventilation, temperature, electricity fittings, safety and security, lift and fire service within the residential apartment of the elderly (Bitner 1995; Leung et al. 2019). Lighting is a powerful design tool for visual perception effectiveness (Zhang and Ma 2010); ventilation removes contaminated and stale air, and creates optimal conditions for air quality and comfort (Dimitroupoulou 2012); temperature influences the thermal comfort of elderly residents; electricity fittings are pivotal to communication efficiency, cooking, comfort and many otheractivities in the living environment; lift services are useful for vertical movement in a high-rise environment, while fire services is a significant facility for ensuring safety of elderly people during a fire.

The specific requirements for building services were very scanty in many of the guidelines for different countries (refer to Table 1). Lighting is a measure of the illuminance (i.e. luminous flux per unit area) with the lux as the international system of units. It is a measure of the intensity as perceived by the human eye. A suggestion of fluorescent tubes with uniform illumination measuring 300 lux and 1000 lux for ambient and task light respectively were found appropriate for US elderly (Figueiro 2001); while a lighting intensity of 108 lux was suggested for sleeping which should be measured at 760mm above ground level was also provided (IES 2001). For Hong Kong guidelines, it is required that residential apartments for the elderly provide a minimum uniform illumination of 85 lux and a maximum of 120 lux internally (Hong Kong Buildings Department 2008).

For the ventilation of the residential apartment, a percentage of the floor area in the rooms was required as available for inflow of air into the room for natural ventilation, while the air changes per hour was provided for mechanical ventilation for the elderly (refer to Table 1 for details). On the other hand, the guidelines also made provisions for room temperature as well as the water temperature in the bathroom of the elderly. Similar range of temperature for the room temperature and water temperature was found in the different guidelines, including 21.6-27.2$^0$C in the United States and 21-26$^0$C in Toronto for room temperature, while 43$^0$C in the United States and Ireland for the water temperature.

Electrical fittings as an instrumental building service in the home was not given adequate consideration in many of the guidelines observed. The requirements provided by few countries have focused on height for lighting switches and electrical sockets within the home. For instance, lighting switches are required to be positioned between 900-1200mm high in Canada and India (City of London 2007; Central Public Works Department 2014), 750-1000mm high in Ireland (International Wheelchair Association 2009) and 610-1200mm high in Toronto; while electrical sockets are expected to be positioned 400mm high in Canada, 400-1000mm high in Ireland, and 400-500mm high in India.

The safety and security is crucial to the health and protection of the elderly from injury, theft, vandalism and personal attack (Kratcoski and Edelbacher 2016). However, only three of the nine countries in this study have at least a guideline for the safety and/or security of the elderly in the residential apartment. For the United Kingdom, the walls and furniture were to be rounded off, while gas leak detection with alarm was to be installed (LIN 2007); Hong and India provides for a 13mm grating or walking surface unparalleled with the direction of travel path (Hong Kong Housing Society 2005; Central Public Works Department 2014); and Ireland ensures thata call system with accessible alarm facility is provided for each bed unit for the safety of the elderly (InternationalWheelchair Association 2009).

Lift service for vertical transportation of the elderly focussed on the space size of the lift, height of lift control/button panel, opening time of lift at landing and door closing speed of the lift. Many of these lift requirements do not align with the turning space requirement for the wheelchair within the lift, which may be necessary during usage. For instance, lifts in the UK are to be within 1100x1400mm, where a turning space of 1500mm circular or 1700x1400mm turning eclipse was the requirement (Lifetime Homes 2010). For fire service, only two out of the 9 countries for consideration have a guideline (refer to Table 1). In the United States, provision is made for fire alarm systems with smoke detectors in all sleeping rooms and outside of a separate dwelling unit within 6400mm of any door to a sleeping room with unobstructed escape route (NFPA 2013). On the other hand,

audible and visible components of fire alarms 1200mm high which should alert elderly with sensory limitations is required in Tornto (Healthy City Office 2004).

**Table 1: International Guidelines for FM Component Needs of Elderly People in Residential Apartments**

| FM Components | United States | UK | Canada | Hong Kong | Ireland | New Zealand | Toronto | Nepal | India |
|---|---|---|---|---|---|---|---|---|---|
| **Space Management** | | | | | | | | | |
| Turning spaces | 1525mm (T-shaped) with arms and base 915mm[1] | 1500mm circular or turning eclipse of 1700x1400mm[2, 28] | 2440mm circular[3] | | 675-1800mm[6] | 1500-1950mm[7] | | 550-950mm[9] | 1500-2000mm[10] |
| Clear spaces | 305mm parallel to at least one side of bed[1] | 750mm width for essential circulation[2] | 760 x 1370mm[3] | 900mm on side of one side of bed[4] | | | | | |
| Size | | | | 800x1500mm bathroom size; 2900-3400 x 3000mm bedroom size[4] | 2500x2500mm bathroom and/or toilet size[6] | | 1500x1675mm toilet size[8] | 2000x2000mm bathroom and/or toilet size[9] | |
| **Building Services** | | | | | | | | | |
| Lighting | 108-1000 lux[11,12] | | 100-200 lux; evenly distributed light for non-glare illumination[3] | 75-300 lux[4,5] | 150-250 lux[6] | 100 lux minimum[27] | 100 lux, fixtures mounted to ensure headroom of 2030mm[8] | | |
| Ventilation | 4-8% of floor area; 0.35 air changes per hour[13,14] | | | 1.5-5 air changes per hour; glazing area, 10-20% of floor area[27] | | | | | |
| Temperature | 21.6-27.2$^0$C room temp.[16] | 43$^0$C water temp.[18] | 20-25$^0$C; 40-70% humidity room temp.[19] | | 60$^0$C storage, 50$^0$C distribute, 43$^0$C supply, water temp.[17] | 55$^0$C water temp; adequate controlled interior temperature[7] | 21-26$^0$C; 30-40% humidity room temp.; 49$^0$C supply max. water temp.[8] | | |
| Electricity fittings | | | Lighting switch, 900-1200mm high; electrical sockets, 400mm high[3] | | Electrical sockets, 400-1000mm high; lighting switch, 750-1000mm high[6] | Lighting switch aligned with door handles, 900-1200mm high; electrical socket, 500-1200mm high[7] | Lighting switch, 610-1200mm high[8] | | Electrical sockets, 400-500mm high; lighting switch, 900-1200mm high[10] |
| Safety and security | | Round off corners of walls and furniture; install gas leak detection with alarm[21] | | 13mm grating or walking surface unparalleled with direction of travel path[5] | Call system with accessible alarm facility for each bed unit[6] | | | | 13mm grating or walking surface unparalleled with direction of travel path[20] |

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|---|---|---|---|---|---|---|---|---|---|
| Lift service | | 1100x1400mm; lift control 900-1200mm high[2] | | 1200x1100mm; lift button, 20mm size and 900mm high; 3s, lift opening time at landing[5] | 1800x1800mm/ 1400x2000mm; lift control /button panel, 900-1100mm high; 20s, lift opening time at landing[6] | 1400x1400mm; car button, 20mm width/ diameter; lift control, 900-1350mm high; door, 900mm width[7] | 1065x1370mm for normal; 1725x2285mm for serving seniors and disabled persons | | 1100x2000mm, lift control /button panel, 900-1100mm high; 20mm lettering size; 0.25m/s, lift door closing speed[10] |
| Fire service | Fire alarm system with smoke detectors and notification appliances within 6400mm of any door[22] | | | | | | Audible and visible fire alarm signals, 1200mm high[8] | | |
| **Supporting Facilities** | | | | | | | | | |
| Colour | 3:1 light reflection ratio within space[23] | | Careful selection of pattern to avoid visual confusion[3] | | | Luminance contrast of 30%[27] | 70% contrast from background colour; 40% contrast for industrial yellow[8] | Use of distinguishing colours between doors and surrounding walls[9] | |
| Furniture | | Bed surface, 400-450mm high; wardrobe drawers and shelves, 600mm high; wardrobe rails, 1400mm high | | 900x2000mm bed size for single elderly[4] | | | | | |
| Floor finish | Carpet securely attached to have firm cushion[1] | | | | | | Careful selection to avoid unduly amplified noise, reflected glare[8] | | |
| Signage | 15-51mm character height; San Serif font; upper case[1] 16-51mm lettering height for 1830-6400mm distance at 1015-3050mm height[24] | | | | 25mm, information signage size; 37mm, directional signage size; 1400-1700mm high[6] | Signage should be clear and legible as well as informative, directional and locational, positioned at 1400-1700mm high[7] | | Clear signage in large letters and at eye level[9] | 600-200mm plain and legible lettering using international symbols; 900-1500mm high[20] |

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|---|---|---|---|---|---|---|---|---|---|
| Doors | 815-915mm; 1980mm high for door closers and door stops; 22.2N force[1] | | 850-950mm width; handle, 900-1000mm high; 22-38N force[3] | 800mm width; handle, 950-1050mm high; 20mm threshold; 22-30N force[5] | 900-1000mm width; lever handle, 900-1000mm high; 20N force[6] | 760mm width; handle with lever action positioned at 900-1200mm high; 22-38N force[7] | 915mm width; 75-100mm D-type handle, 760-1065mm high[8] | 900mm width; lever handle, 800-1000mm high[9] | 900mm width; handle, 950-1050mm high; 20mm threshold; 22-30N force[20] |
| Windows | | | Window sill, 760mm high; handle, 400-1200mm from floor[3] | Window sill, 1000mm high[26] | Lever handle, 800-900mm high; transom, 1200mm high; sill, 850mm high[6] | Operating locks and latches should have lever action, positioned 900-1200mm high[7] | Lever handle, 1065mm high; transom, 1200mm high; sill, 760mm high[8] | | Handle, 900-1200mm high; Sill, 800mm high[20] |
| Acoustics | 47dB(A)[25] | | | | | | | | |
| Handrails | 32-51mm ϕ or 57x100-160mm non-circular; 38mm minimum clearance; 865-965mm high from floor[1] | | 30-40mm ϕ or 45x100-125mm non circular; 50-60mm space between handrail and wall; 865-920mm high from floor; 0.9kN load resistance[3] | 32-50mm ϕ tubular; 30-50mm clear of wall, 300mm beyond surface of facility; 850-950mm high; 1.3kN load resistance[5] | 32-45mm ϕ or 50mm oval; 60-75mm space between handrail surface and wall; 300mm projection beyond edge of wall; 600-900mm high[6] | 32-45mm ϕ; 50-60mm clear space between handrail and wall surface; 840-1000mm high; 1.1kN load resistance[7] | 30-50mm ϕ; 40-65mm space between handrail and wall surface; 300mm projection beyond edge of wall; 865-965mm high[8] | 35-45mm round; lower handrail, 700-750mm; top handrail, 860-920mm; 300mm extension beyond top and bottom of wall/ stair/ramp[9] | 32-50mm ϕ; 30-50mm clearance between handrail surface and wall; 850-950mm high; 1.3kN load resistance[20] |
| Grab bars | 32-51mm ϕ or 51x100-120mm non-circular; 38mm spacing; 840-915mm high from floor; 1065mm length for side wall grab bar[1] | | | 32-50mm ϕ; lower bar, 700-800mm high; upper bar 850-950mm high[4] | | 30-40mm ϕ; 50-60mm clearance between grab bar and wall; 840-1000mm high; 1.1kN load resistance[7] | | | |

**Note:** [1]United States Department of Justice (2010); [2]Lifetime Homes (2010); [3]City of London (2007); [4]Hong Kong Housing Society (2005); [5]Hong Kong Buildings Department (2008); [6]Irish Wheelchair Association (2009); [7]New Zealand Standard (2001); [8]Healthy City Office (2004); [9]Handicap International Nepal (2009); [10]Central Public Works Department (1998); [11]Figueiro (2001); [12]Illumination Engineering Society (2001); [13]International Code Council (2007); [14]State Virginia Mechanical Code (2006); [15]Hong Kong Buildings Department (2015); [16]Woronchak (2004); [17]Health Information and Quality Authority (2008); [18]Department of Health (2003); [19]Hong Kong Department of Health (2012); [20]Central Public Works Department (2014); [21]LIN Housing (2007); [22]National Fire Protection Association (2013); [23]Mahnke (2012); [24]International Code Council (2010); [25]National Joint Committee for the Communicative Needs of Persons with Severe Disabilities (1992); [26]Hong Kong Buildings Department (2012); Barrier Free NZ Trust (2013).

### 3.3 Supporting Facilities

These are facilities that enhances the indoor environment of the elderly, including color, furniture, floor finish, signage, doors, windows, acoustics, handrails and grab bars (Duncan-Myers and Huebner 2000). For furniture, only one (i.e. Hong Kong) of the nine countries considered provided the bed size for a single elderly (Hong Kong Housing Society 2005). Specific colour requirements are not available in the guidelines, but generic information including careful selection of pattern to avoid visual confusion for Canada (City of London 2007); use of distinguishing colours between doors and surrounding walls as in Nepal (Handicap International Nepal 2009), etc. (refer to Table 1).

Similarly, floor finish for the elderly was generic in description with suggestions for secure attachment for firm cushion in the United States (United States Department of Justice 2010) and careful selection to avoid amplified noise and reflected glare in Toronto (Healthy City Office 2004). The concept of signage as reflected in different guidelines focuses on the size and height of lettering in all three countries (i.e. United States, Ireland and India); font size as in the United States and use of symbols as in India (refer to Table 1). On the other hand, doors and windows centers on width of doors ranging between 815-915mm for all countries, type and height of door or window handle, maximum force required for opening the door, transom and sill height of the windows amongst others.

Lastly, similar features were considered for handrails and grab bars in the residential apartment of the elderly. The following are the requirements: the diameter and/or perimeter of the handrail and grab bar in all seven countries involved in the study, minimum space and/or clearance between the handrail/grab bar and wall surface, minimum and maximum height of the handrail and/or grab bar from the floor surface, and minimum load resistance of the handrail and grab bar (United States Department of Justice 2010; Hong Kong Buildings Department 2008).

## 4. Conclusion

The study has explored the FM needs of the elderly and the corresponding guideline requirements in selected countries around the world. This will provide designers and facilities managers with a thorough understanding of the needs of the elderly for ensuring their comfortability in the living environment. It will also ensure that the various requirements for consideration in the design and management of facilities for the elderly in their living environment is adequately understood and catered for. However, many of the FM requirements in the guidelines were not directly provided for the elderly but for disabled persons within the living environment. To ensure that the needs of the elderly are adequately met, it is essential to conduct a quantitative study for assessing the importance of the identified facilities in this study and their current satisfaction with the facilities available in their residential apartment. In addition, further studies using anthropological measurement of the elderly and the physical measurement of facilities needed to ensure that the requirements will directly meet their specific demand should be carried out. This will ensure a more objective approach in ensuring that facilities provided in the apartment of the elderly meet their specific needs in the living environment.

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