

Housing for the Elderly

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ABSTRACT

“India is aging with very high speed than before thought and is anticipated to have nearly 20% population of the world's 60 years and more than 60 by 2050 with the largest number of older adults in the world,” Prasun Chatterjee, Department of Geriatrics, All India Institute of Medical Sciences (AIIMS) stated. One of the most talks over global phenomena in the current century is Population aging. Countries that are more populated such as India have many people now aged 60 years or more. This paper is focusing on the literature review of the physiological characteristics & challenges of the elderly, principles of design, standards and norms of elderly housing in India and case studies across the world.

KEYWORDS

Elderly Housing, ageing population, Insecurity, Safety, Healthcare, House Design, Public-private partnership, Ageing in place, Public Housing, Social Enterprise, Gerontology, Activities of Daily Living (ADLs), Adult Day Care, Assisted Living, Continuing Care Retirement Communities (CCRs), Hospice Care, Independent Living, Nursing Home, Universal Design

BACKGROUND

Older people were 7.7% of the total population, on the census 2001 report, in census 2011 which rose to 8.14%. The estimate for population in 60 years in next upcoming four censuses is: 133.32 million (2021), 178.59 (2031), 236.01 million (2041) and 300.96 million (2051). The rise in number of the elderly population are the outcome of changing fertility and mortality regimes over the last 40-50 years (Ministry of Health and Family Welfare, 2011) & (Central Statistics Office, New Delhi, 2011).

INDEX	2001	2011	2021	2031	2041	2051
60 and above						
Number (in millions)	77	96	133	179	236	301
Percentage to the total population	7.5	8.2	9.9	11.9	14.5	17.3
Sex ratio (male per 1000 females)	1028	1034	1004	964	1008	1007
70 and above						
Number (in millions)	29	36	51	73	98	132
Percentage to the total population	2.9	3.1	3.8	4.8	6	7.6
Sex ratio (male per 1000 females)	991	966	970	930	891	954
80 and above						
Number (in millions)	8	9	11	16	23	32
Percentage to the total population	0.5	0.7	0.8	1	1.4	1.8
Sex ratio (male per 1000 females)	1051	884	866	843	774	732

Table 1- Number, Population and sex ratio of the elderly, 2001-2051

“(Source- The Centre for Enquiry into Health and Allied Themes (CEHAT), Mumbai)”

The number of India's elderly population of age 60 and above the age of 60 is expected to increase from 77 million in 2001 to 179 million in 2031 and 301 million in year 2051. This estimated ratio is likely to reach 12 percent in 2031 and 17 percent in 2051. The sex ratio among senior citizens favours males. The number of persons above 70 years of age (old-old) is likely to increase more rapidly than those 60 years and above, the numbers of elderly are projected to rise five-fold between 2001-2051 from 29 million in 2001 to 132 million in 2051. Proportion is supposed to increase from 2.9 to 7.6 percent. Even though we have found more males in the age group of 60 and above, the old-old sex ratio is advantageous to females. The oldest-old people 80+ among the elderly in India are supposed to grow faster in number than any other age group. In very outright terms, it is likely to increase from 8 million in 2001 and exceed to 32 million in 2051.

INTRODUCTION

Accordingly, there is a growing consciousness that we suppose to plan for the old age population and, crucially, give proper environments and housing which could cater to varied needs. This type of housing comes up with the elderly with independence and privacy additionally giving them a holistic environment where they can interact with people of their age group and stay busy with various activities that promote their psychological as well as physiological health. Designers and Architects need to subsume different ways to encourage relaxation and release stress into their conceptualization of a given built environment, mainly when it comes to creating living spaces for the elderly. Different factors like basophilic design, lighting, and colour theory all need to be included when thoughtfully shaping and designing the interior and exterior environment for the elderly.

The Indian government deserves recognition for its foresight in drafting a National Policy on Older Persons (NPOP) in 1999, for being a signatory to the Madrid International Plan of Action on Ageing. MOSJE the Ministry of Social Justice and Empowerment coordinates the NPOP and it is implemented through the respective mandates of several ministries. The amended National Policy for Senior Citizens (NPSC) suggests several areas of intervention, which are income security in old age, safety, health care and security, housing, productive aging, multigenerational bonding, welfare, and enhancing participation and involvement of media on this very important aging issues.

Economists said that that the rapid population aging will have very serious upshots for the giving resources, that include land and housing. This is very considering that, as people age, they have to spend so much of their time at home. Properly designed communities and Suitable housing are known as most important factors to reduce the health risks for the old people, promote well-being and independence, with the potential to minimise social and health-care expenditures, while improper housing could be the gain of multiple costs and problems.

LITERATURE REVIEW

The reviewed paper is more than 100 including research papers and thesis etc. whereas the below mentioned paper focused more, which has been categorised in the different categories of Function, Form and Financing. Some more papers focused on COVID-19 and digital era.

S.No	Name of the Paper	Year of the Paper	Name of the Author	Focus Area
1	Indoor environmental quality in social housing with elderly occupants in Spain: Measurement results and retrofit opportunities	2020	Antonio Serrano-Jimenez a, , Jesús Lizana a , Marta Molina-Huelva b , Angela Barrios-Padura	Function
2	Social Enterprise for Elderly Housing: Policy for Accountability and Public-Private Responsible Financing	2018	Artie W. Ng ¹ & Tiffany C. H. Leung ¹ & A. Ka Tat Tsang	Financing & Governance
3	Elderly Care: Designing Based on Occupant Perceptions	2018	Lilly McDougall ² , Nilesh Bakshi ^{1,2} , Andre Brown ¹ , Michael Donn ¹ and Stephen McDougall ² ¹ Victoria University of Wellington {nilesh.bakshi, andre.brown, michael.donn}@vuw.ac.nz ² Studio of Pacific Architecture lily.mcdougall1@gmail.com, stephenmcdougall@studiopacific.co.nz	Form
4	Convergence Research Directions in Cognitive Sensor Networks for Elderly Housing Design	2015	Shinil Suh, ¹ Byung-Seo Kim, ² and Jae Hee Chung	Form
5	Mismatch between the quality of dwelling units and residents' health condition in elderly housing with supportive services	2019	Mismatch between the quality of dwelling units and residents' health condition in elderly housing with supportive services	Function
6	The Elderly-Friendly Housing Design Features Preferences by Generations in Malaysia	2020	Hafiszah Ismail ¹ , Muhamad Saiful Alizan Nordin ² , Aida Wati Zainan Abidin ³	Form
7	Intergenerational Housing: The Case of	2019	Marlous Elisabeth Arentshorst, Roy Reinier Kloet & Alexander Peine	Function

	Humanitas Netherlands			
8	Intergenerational Housing	2018	Joost van Hoof 1,2,* ID and Peter Boerenfijn	Function
9	Housing conditions and risk of physical function limitations: a prospective study of community- dwelling older adults	2018	Bibiana Pérez-Hernández1 , Esther Lopez-García1,2, Auxiliadora Graciani1 , José Luis Ayuso-Mateos3 , Fernando Rodríguez-Artalejo1,2, Esther García-Esquinas	Function
10	Housing for the Elderly: Addressing Gaps in Knowledge Through the Lens of Age-Friendly Communities	2017	Stephen Frochen& Jon Pynoos	Function
11	What determines the supply of housing for the elderly, and how is it related to the spread of Covid-19 and future demographic changes?	Workin g Paper 2020:18	Maria Kulander and Mats Wilhelmsson	Function (related to COVID 19)
12	Merging current health care trends: innovativeperspectiv e in aging care	2018	Miguel Ángel Gandarillas1 Nandu Goswami2	Function (related to COVID 19)
13	Modern Senicide in the Face of a Pandemic: An Examination of Public Discourse and Sentiment About Older Adults COVID-19 Using Machine Learning	2020	Xiaoling Xiang, PhD, MSW,1, *, Xuan Lu, PhD,2 Alex Halavanau, PhD,3 JiaXue, PhD,4 Yihang Sun, MSW,1 Patrick Ho Lam Lai, MSW,1, and Zhenke Wu, PhD	Function (related to COVID 19)
14	Changes in Everyday and Digital Health Technology Use Among Seniors in Declining Health	2017	David M. Levine, MD, MPH, MA,1 Stuart R. Lipsitz, ScD,1 and Jeffrey A. Linder, MD, MPH	Function (Digital +Health)
15	Aging in Place in Gentrifying Neighborhoods: Implications for Physical and Mental	2018	Richard J. Smith, MSW, PhD, 1 Amanda J. Lehning, MSW, PhD,2, * and Kyeongmo Kim, MSW, PhD,3	Function (related to Health)

	Health			
16	Demand for community-based care services and its influencing factors among the elderly in affordable housing communities: a case study in Nanjing City	2020	Tiantian Gu ¹ , Jingfeng Yuan ^{1*} , Lingzhi Li ² , Qiuhu Shao ¹ and Chuanjun Zheng ¹	Function
17	How Is the Neighborhood Environment Related to the Health of Seniors Living in Hong Kong, Singapore, and Tokyo? Some Insights for Promoting Aging in Place	2017	Becky P. Y. Loo, Winnie W. Y. Lam, Rathi Mahendran & Keiko Katagiri	Function (related to Health)
18	Housing affordability, preferences and expectations of elderly with government intervention	2014	Eddie C.M. Hui ^{a,*} , Francis K.W. Wong ^a , K.W. Chung ^b , K.Y. Lau ^c	Financing & Governance
19	Circulation analysis of design alternatives for elderly housing unit allocation using building information modelling-enabled indoor walkability index	2018	Jin-Kook Lee ¹ , Jaeyoung Shin ² and Yeunsook Lee ¹	Form
20	The study of a space configuration using space syntax analysis Case study: an elderly housing	2017	Yosica Mariana, Arindra J. Triwardhani, Michael Isnaeni Djimantoro	Form
21	Moving House and Housing Preferences in Older Age in Slovenia	2018	Maša Filipovič Hrast, Richard Sendi, Valentina Hlebec & Boštjan Kerbler	Form
22	The Future of Housing for the	2018	Jon Pynoos, MCP, PhD	Form

	Elderly: Four Strategies that Can Make a Difference			
23	The Relationship between Socio-Spatial and Elderly Cultural Values Towards a Sustainable Senior Retirement Housing	2020	Alice Sabrina Ismail*, Muhammad Nor HaziqZamry	Function
24	Assessment of and Improvement Strategies for the Housing of Healthy Elderly: Improving Quality of Life	2018	I-Ming Feng 1 , Jun-Hong Chen 1 , Bo-Wei Zhu 2,3,* and Lei Xiong 1	Function
25	State of Elderly Housing in Singapore	2017	B. Yuen and E. Soh,	Form
26	Housing for Older People in Singapore: An Annotated Bibliography	2017	Belinda Yuen • Emily Soh	Form
27	SUSTAINABLE DESIGN FOR THE ELDERLY: SENIOR HOUSING DESIGN GUIDELINES	2017	Kezhen Chen	Form
28	Elderly Housing Design in Charlton, Massachusetts	2010	Andrew Abderrazzaq Christopher Lacagnina Derek Snow	Form
29	Social Architecture: aging in community	2016	Orhan Hassan	Function
30	Reasons for Living of Elderly to In Old Age Homes: An Exploratory Study	2014	S.C.Tiwari, Rakesh Kumar Tripathi, Ambrish Kumar, Nisha Mani Pandey	Function
31	Research on Residential Building Design for the Elderly in the Aging Society	2020	Hui Zhang (Thesis)	Form

Table 2- Reviewed paper with different focus areas
(Source- Collected and reviewed by Author)

PHYSIOLOGICAL CHARACTERISTICS & CHALLENGES OF THE ELDERLY

Owing to the reduction of brain physiological functions, the elderly shows a reduction in mental energy, and also show a passive, shrinking, and slow impression in life. It is not negative, even so, active self-protection. Using life's energy in the most productive survival activities is an adaptive change. Due to reduced physiological function and the high occurrence of chronic diseases, older people often experience physical discomfort, and so they are prone to loneliness and depression. The intensity of the negative emotional experience does not decline with age the emotions of the elderly are inherent, strong, and long-lasting. Owing to their rationality, the elderly often weaken their emotional responses with cognitive regulation. However, the emotional experience of older people caused by negative stress events is much enduring than younger and middle-aged people.

A lot of elderly households are in housing environments that are not according to their abilities and requirements. The housing units are either physically improper, have physical and structural problems or the elderly pay a lot of amount of their income on housing. In real support systems such as family, home health care, and other facilities and services, they seem to be available only to those who can afford them. Nishita et al. (2008) note that nursing facility residents wish to change out of the nursing facilities and into community living; yet stay in the facilities since there is no alternative present to facilitate leaving the nursing care facility. They also recorded that the essential goal for planned housing for the seniors must be enriched social opportunities. The deed of transforming out of a nursing facility and into a community setting is a very important decision as Nishita et al. note: "transition is a very tough decision in which the person weighs the capacity and the desire to relocate, as well as the community support available to meet anticipated care needs" (Nishita 2008, p.6).

Chen et al. (2001) state that famishment in the elderly can stem from depression due to living alone and becoming dependent on others: "When the supports the elderly have dependent upon are lost or diminished in their old age, the elderly may have difficulty in forming new attachments, in coping, and in caring about life" (Chen 2001, p.137).

Birnholtz and Jones-Rounds (2010, p.143) stated that: "During aging in place allows elderly people to maintain and balance a sense of independence and to stay in a known environment, both are often desirable, it is necessary that they should able to interact with others because communication, serves as a foundation for social relationships and can help seniors avoid the sense of isolation that often leads to loneliness and possible depression."

As we know that the human body passes through several changes of life and old age turns more apparent, mobility restrictions and day-to-day life activities such as moving around to changing clothes become tough or impossible to do by them. Alternatives range from shifting into new ranch-style accommodation in order to decrease stairs, to moving into an elderly care facility. Bhushan (2010, p.20) notes, "the move can still be traumatic...this transition is also devastating to one's feelings of well-being, security, and orientation." The choices in aging care facilities are as varied as the people that live there. Some Identification of problems in old people that they face is mentioned in the following table:

Sr. no	Issues	Parameters
01.	Safety Issues	Requirements for safety in the residential indoor and outdoor areas at the time of using rooms, kitchen, toilets, stairs, etc. Outdoor areas in terms of the materials and their use.
02.	Mobility Issues	Requirement of the mobility support and device of environment for mobility of elderly.
03.	Dexterity issues	Requirement of environmental support for the difficulties of the slow movement of old people.
04.	Vision related issues	Requirement of transformation in the environment for good vision for example improvement in the environment in terms of glare, colour, light, and depth perception, clear vision and such things.
05.	Hearing related issues	Requirement for transformation in environment for sound clarity and better hearing of elderly.
06.	Health issues	Requirement of transformation in environment for good support for the health Issues because of several diseases for example Blood pressure, Asthma, Diabetes, Cardiac problems etc.
07.	Memory issues	Requirement of the environmental support to improve the situations of memory loss in elderly.
08.	Light Ventilation issues	Requirement of provision of sufficient amount of light and ventilation in the elements of residential design for the elderly.

Table 3- Identification of issues in elderly face*(Source- Collected by Author)***HOUSING TYPOLOGY OF THE ELDERLY**

The surge in the evolution of the long-term care industry in current years has been assigned to several factors, which include: the growing population over the age of 65 advances in medical technology, and the changing attitudes of society to the institutionalized care of the elderly. Now a day's long-term care facilities provide a variety of services. Long-term care facilities provide one or more of the following:

Typology	Explanation	Examples
Independent Living Apartments	Independent living apartments are perfect for the elderly who do not need medical or personal care but who would like to live with other seniors who share similar interests. In most independent living facilities seniors can take advantage of well-organized community events, shopping excursions field trips, and on-premise projects. These types of apartments are not licensed or regulated.	Singapore
Adult Homes	Adult homes are licensed and governed for short-term or long-term residence by senior citizens unable to live independently. Adult homes usually include housekeeping; supervision, personal care, and it include meals also	Retirement residence, Domat Ems

Enriched Housing	Enriched housing is the same as adult homes, with the exception that the elderly live in independent housing units. They are licensed by the State Department of Health and offer a minimum of one meal per day.	
Family-Type Homes	Family-type homes provide long-term residential care, supervision, and housekeeping, for four or fewer adults which are not related to the operator. The Social Services department of look after their operations.	Adult Foster Homes
Assisted Living Program (ALP)	Assisted living program is a very good substitute to nursing homes for seniors who requires help with their daily routines, but don't need 24-hour care. Room, board, case management, and skilled nursing services all provided by an outside agency. ALP program provides Medicaid, Supplemental Security Income (SSI), with home relief beneficiaries.	
Continuing Care Retirement Communities (Life care Communities)	Continuing care retirement communities provide many types of facilities, from assisted living to nursing homes, all on one campus. They assure aging in place, that is, the resident can move from one level of care to the next level as needs change. As we know for residents, the transformation to a nursing home is easier, because they are able to be in familiar surroundings. They may require an up-front annuity purchase with monthly payments which includes services, amenities, and required medical care.	Clyde E. Lassen State Veterans' Nursing Home
Nursing Home (Skilled Nursing Facility)	Nursing homes are the best place for those who can no longer live independently they offer 24-hour-a-day care. In nursing homes, there are trained medical professionals who provide specialized care to the elderly with severe illnesses or injuries. Nursing homes have Specially trained staff to assists residents with daily activities such as bathing, eating, housekeeping, and laundry. They may very good in acute nursing care, intermediate care, or long-term skilled nursing care.	Armstrong Place Senior Housing San Francisco

Table 4- Types of Elderly Care Facilities
“(Source- Collected by Author)”



Retirement residence, Domat Ems



Armstrong Place Senior Housing San Francisco

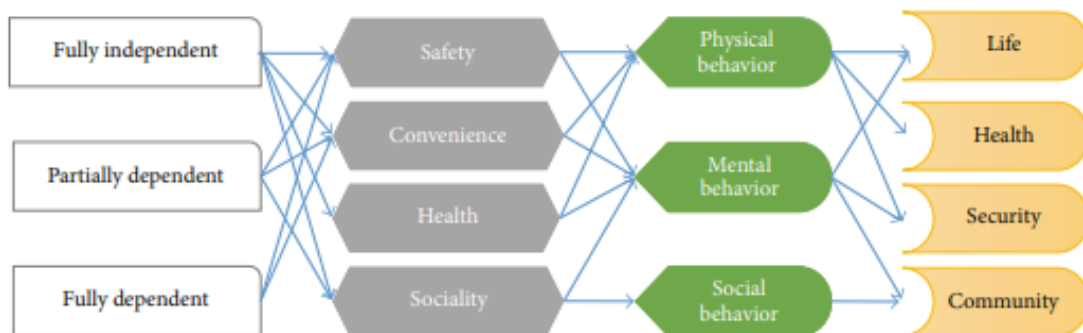


Figure 1: Correlation between types of the elderly and architectural factors
 “(Source - *Involving the elderly in the design process: A Participatory design model for instability, safety and attractiveness*)”

DESIGN MODELS

Several ways of elucidate the design procedure of an environment or product is called design models. “Design models are representations of philosophies or strategies proposed to show how design is and may be carried out” (Sivaloganathan et al., 1995: 456). Each and every model contains its own phases.

Model 1: A Model for Usability: The User-Based Design and Development Model

Model 2: The Consumer Idealised Design Model

Model 3: Lawton and Nahemow’s Ecological Model

Model 4: Eckert and Murray’s Ecological Housing Model

Model 5: The Person-Environment Transaction Model

Model 6: The Supportive Environment and the Environmental Competence Concept

Model	Design Elements	Name of the Author	Flow chart
<p>Model 1</p>	<p>A Model for Usability: The User-Based Design and Development Model</p>	<p>Marking et al., 1997: http://valley.interact.nl/DAN/NEWSLETTER/NEWS97/user.html, 7. 1.1998</p>	
<p>Model 2</p>	<p>The Consumer Idealised Design Model</p>	<p>Consumer idealised design model involving end-users early on in the product development process (Ciccantelli and Magidson, 1993. 343)</p>	
<p>Model 3</p>	<p>Lawton and Nahemow's Ecological Model</p>	<p>modified from Lawton and Nahemow, 1973</p>	

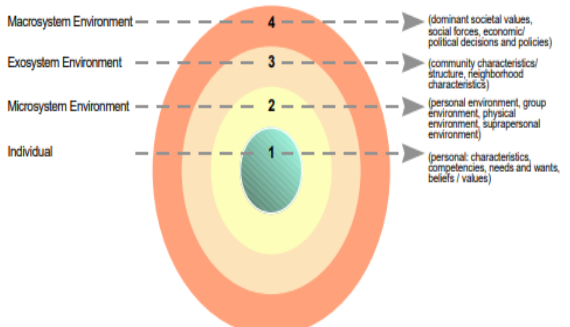
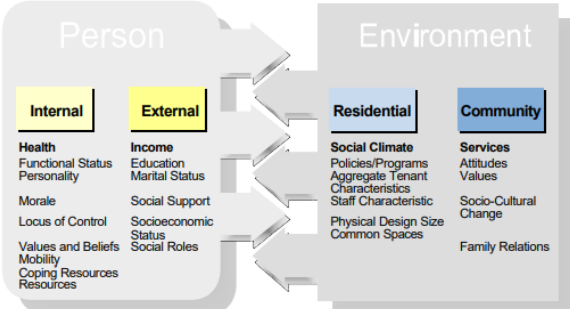
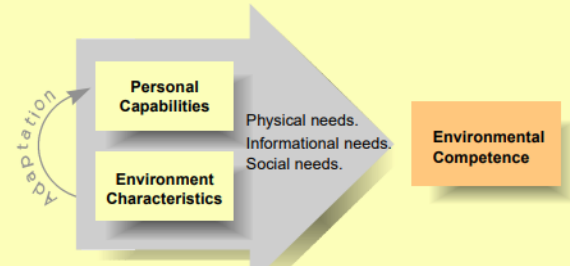
<p>Model 4</p>	<p>Eckert and Murray's Ecological Housing Model</p>	<p>modified from Eckert and Murray, 1984</p>	
<p>Model 5</p>	<p>The Person-Environment Transaction Model</p>	<p>modified from Sheehan, 1992</p>	
<p>Model 6</p>	<p>The Supportive Environment and the Environmental Competence Concept</p>	<p>modified from Hunt, 1992</p>	

Table 5- Design models
 (Source- Collected by Author)

PRINCIPLES OF DESIGN OF THE ELDERLY

Sr. no	Principles	Perspectives
01.	Independence;	The physical environment creation authorizes residents through supporting a person's lifestyle choices and independence. The physical environment for the old people should be purpose-designed to address an individual's evolving needs that are going to live there through the provision of a physical fabric that provides positive support and choice.
02.	Social and lifestyle;	The physical environment should be designed to permit residents to make lifestyle and social choices and brace them to fulfil these expectations. It should provide appropriate physical access, spaces, and amenity that encourage residents to maintain an active and fulfilling life.
03.	Connectedness and	The formation of a community that holdup residents

	linkages	maintaining a meaningful social connection with their friends, family, and the broader community by providing linkages with those who live on and off-site.
04.	Sustainability	The main indicator in calculating the health of a community is determining how it absorbs sustainable practices into its everyday activities, including sustainable design. Sustainable design is intrinsically linked to affordability and can incorporate everything from home insulation to windows or appliances. In a senior's community setting, affordability is as important as it is at any other stage in life, if not more so, considering the high percentage of village residents who receive an age pension.
05.	Enabling and evolving;	Enabled environments consider the impact and benefit that technology, design development, and physical and psychological research advancement can have on residents' day-to-day lives and the quality of experience within their home and community. Through a considered design approach, flexibility can be established to enable dwellings to be modified or customized to fit a resident's personal requirements, which will be varied and change as they continue to age in place.
06.	Affordability.	When designing the physical environment, a designer must acknowledge prospective residents' need to meet the cost of entry. Typically this will be determined by the value of housing in the area and further their level of homeownership. This is primarily the case as most people prefer to live near their current home, which enables them to maintain community connections with family, friends, and local services.

Table 6- Principles Design of the elderly
(Source- Collected by Author)

GUIDELINES & GOVERNANCE

According to UNFPA, a sensitive 'segmented approach' to the diversity within the senior citizen population is recommended. While Old-Age Homes cater to the dependent and destitute senior citizens, there is an increase in the number of elderly adults from the 'middle income and urban upper' group who rely on an undeveloped and uncontrolled market for living and services, as demonstrated by a facility type known as a 'Retirement Home.' While this group has the financial means to pay for services and facilities, it is not properly secured against fraud, abuse, and other types of harassment.

ROLE OF MOHUA (Ministry of Housing and Urban Affairs) AND THE NEED FOR GUIDELINES FOR RETIREMENT HOMES

PLANNING NORMS “[Source - Model guidelines for development and regulation of retirement homes (Ministry of Housing and Urban Affairs)]”

States/UTs should develop and recommend proper planning guidelines, including the types of retirement homes and their requirements. The following provisions should be included in the planning norms:

- i.** First, the inclusion of "Retirement Home" as a permitted building type under "Residential" land use in relevant city/planning areas, notably in Master/Zonal/Local Area Plans, is required.
- ii.** The city's population determines the need for land in the "Retirement Homes" category, and a demand study will be performed in this respect by the planning authority/agency.
- iii.** These types of projects are very different from real estate projects and have very specific design requirements. The allocation of additional FAR as an incentive to encourage developers/promoters to establish such Retirement Home projects may be beneficial. This will incentivize developers and promoters to build Retirement Home Projects, as well as urge financial institutions to finance such projects.

As a result, child day-care/orphanage centres and Retirement Homes could be co-built with proper green space division to promote social relations between these two age groups that require assistance. Residents may be able to work part-time at this facility in exchange for their active participation in other social organisations.

iv. Average size of dwelling units*

Area	Number of rooms	Dwelling unit size (sq.mts.)
Plains	1 BHK	40-60
	2 BHK	50-80
Hilly	1 BHK	30-45
	2 BHK	40-60

Table 7: Average size of dwelling units

“(Source - Model guidelines for development and regulation of retirement homes (Ministry of Housing and Urban Affairs), Page no.-9, 2017)”

v. Indicative norms for Retirement Homes as Group Housing*

SI No.	Plot size (sq.mts.)	Ground Coverage (%)	FAR	Dwelling density (DUs/Acre)	Height excluding stilts (mts.)
Plains					
1.	3000	35	2.00 (In the case of high demand, higher FAR may be considered by the state Government based on relevant studies)	150	18
Hill towns					

2.	1500	45	1.2 (For higher FAR, State government may conduct relevant studies)	100	12
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Table 8: Indicative norms for Retirement Homes as Group Housing

“(Source - Model guidelines for development and regulation of retirement homes (Ministry of Housing and Urban Affairs), Page no.-10, 2017)”

*The above-mentioned norms are indicative in nature, and may differ from state to state and region to region due to factors such as topography, affordability, local demand, and other parameters.

vi. Specification for community facilities and open spaces

Area	Medical Room	Community Space	Convenience store	Total open space
Plan	Minimum 15 sq.m/25 DUs or part thereof	2 sqm / person or 500 Sqm whichever is lesser	2% of built-up Area (BUA) or 30 sq.m whichever is lesser.	65% of site area
Hilly	Minimum 15 sq.m/25 DUs or part thereof	2 sq.m / person or 300 Sq.m whichever is lesser	2% of BUA or 20 sq.m whichever is lesser.	55 % of site area

Table 9: Specification for community facilities and open spaces

“(Source - Model guidelines for development and regulation of retirement homes (Ministry of Housing and Urban Affairs), Page no.-11, 2017)”

vii. Attendants/staff accommodation

Should be available on-site as needed; Within the bounds of allowable coverage and FAR, one attendant per apartment is permitted.

PHYSICAL STANDARDS AND NORMS

The old age home should be built in accordance with the guidelines/standards/principles outlined in the ‘National Building Code,’ ‘Model Building Bye Laws,’ and ‘Harmonized Standards and Space Standards for Barrier-Free Built Environment for Persons with any Disability and Elderly Persons as modified from time to time.’ States and UTs shall guarantee that Retirement Homes are constructed in compliance with the NBC, MBBL, Harmonized Rules, and other applicable guidelines. The states/territories have the authority to oversee the implementation of physical standards and specifications for building construction. While sanctioning plans and conducting audits of such projects/apartments/buildings, they may put in place additional processes to ensure that these standards/norms are handled and implemented on a regular basis.

Sr. no.	Elements	Explanation
01.	Building Design	<p>Provisions in addition to the NBC norms that should be followed are given below: the building that has more than one floor must be provided with lifts that are suitably equipped to accommodate the users who need help and using wheelchairs and such equipment/mobility tools.</p> <ul style="list-style-type: none"> • All the external and internal design of the building spaces should consider the free movement of wheelchairs for proper mobility of the elderly. • The Door opening should not be less than 900 mm in width. • Sliding windows should be used in old age homes. • Doorknobs and lever handles should be of large size which will be easy to grip. • Ergonomic design of furniture specific should be according to the needs of senior citizens.
02.	Green Building principles	To lessen the exposure of the senior citizens to the fumes and exhaust arising from the combustion of fossil fuels, there should be maximum use of non-polluting and renewable energy sources in old age Homes. Norms which are mentioned in chapter 10 and 14 of Model Building Bye-laws, 2016, should be complied with fully.
03.	Lifts and Ramps:	All elevators should have audio and visual signage and signalling systems and to accommodate the users needing assistance and using wheelchairs and similar mobility tools. Mandatory ramp to be constructed throughout the building to provide for wheelchair access for elderly.
04.	Kitchen	The kitchen design of the old age home should be as per NBC with natural lighting and ventilation. Mandatory fire safety, gas leak detection system shall be installed in all kitchen and rooms which have attached kitchen.
05.	Lighting and ventilation:	Power backup facilities are very important to be given in each apartment of old age Home and with mandatory connection in kitchen and bathroom. Ventilation and lighting for all building components to be in compliance to MBBL and National building code. Sufficient lighting should be provided in common area including corridors, lobby and lifts to be supplied uninterrupted electricity with facility of power backup.

Table 10: Physical standards and norms“(Source - Model guidelines for development and regulation of retirement homes (Ministry of Housing and Urban Affairs), Page no.-12, 13, 2017)”

CASE STUDIES

1. Dwellings for Senior Citizens - Domat, Switzerland

Year: 1st Phase / 2nd Phase 2004 / 2015

Name of the Architect/firm/Planner: Dietrich Schwarz



Figure: 1 Front view



Figure: 2 back view



Figure: 3 Side view

“(Source - <https://inspiration.detail.de/dwellings-for-senior-citizens-in-domatems-103281.html#:~:text=The%2020%20two%2Droom%20dwellings,634>.)”

The project location is in Domat, Switzerland and it has 20 two-room dwelling units, which are organized over 4 floors and all the units are designed by keeping the disabled in mind, and each floor of the building has 5 units. Each and every apartment units are approx 615 ft² in dimension. Each unit contains two bedrooms, one living room, one kitchen, and one bathroom. These units have access to private additional storage space also. A very unique and new aspect of this design solution is the installation of high-tech glass, and the southern wall is fully included in this glass. The glass used in the building is very unique because it is triply

glazed which can control the type of light which is entering the building. The first cavity of this glass contains a series of prisms that allow the light from low angles to penetrate while not letting the light from higher angles penetrate. The glazing system is installed to let winter light enter the spaces but it reflects away the hot direct summer sunlight. The second glass cavity contains a salt hydrate due to which it acts as a thermal storage mass, maintaining its heat the whole day and releases it in the evening time when it is cool outside according to temperature.

The structure of the building responds very properly to its surroundings, also it is quite responsive to the local climate. This technology is utilized by building, for example, a very special and effective glazing system to work with the environment passively. The form of the building is open to the south and closed off to the north because of which with the internal space layout the organization works properly and the natural light is utilized very well in the building. The dwelling units are open to very amazing views of the mountain landscape and a lot of natural light in the building, as it faces towards the south. The borrowed northern light is used for the kitchens in every unit. Through the wide circulation spaces, the north light diffuses and travels, and that works as a northern buffer. The form of the building is monolithic and quite simple. It does not consist of any subtractive elements and is rectilinear. The section which is shown below describes a simple 1:3 connection with the plan. The skin of the building responds to the orientation of the building, in the south, is glazed and open, while the north side is totally clad in brick and closed off.



Figure4: Living unit



Figure5: Circulation

(Source - [https://inspiration.detail.de/dwellings-for-senior-citizens-in-domatems-103281.html#:~:text=The%2020%20two%2Droom%20dwellings,634\).](https://inspiration.detail.de/dwellings-for-senior-citizens-in-domatems-103281.html#:~:text=The%2020%20two%2Droom%20dwellings,634).))”

The structure of the building is very durable. The floors are made from concrete slabs and the walls are formed of sand-lime bricks. The massive materials which are used provide thermal mass that is helpful in the cold climate of Switzerland. The building structure has exterior insulation of 8 inches. A passive energy standard is required in the local culture of Switzerland to which this building exceeds. The building is a great example of a simple building form and is responsive to the environment very well and utilizes technology in a very good and successful way.

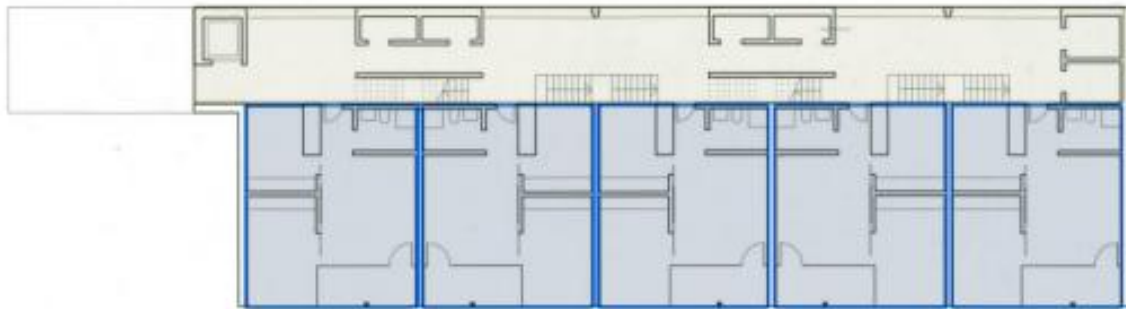


Figure 6: Circulation: Linear along north
Repetitive pattern: Dwelling units of the building along the south

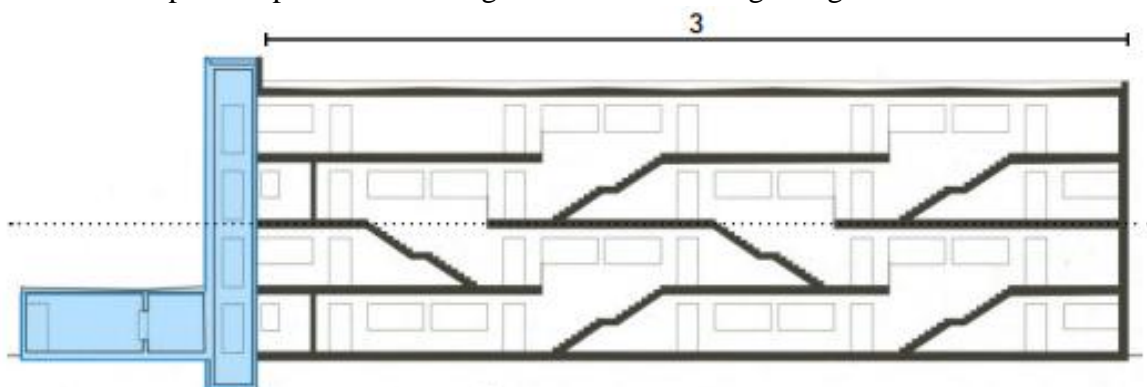


Figure 7: Proportion: Width = Height = 1/3 length
Uniqueness: Elevator core and service spaces are an unique language

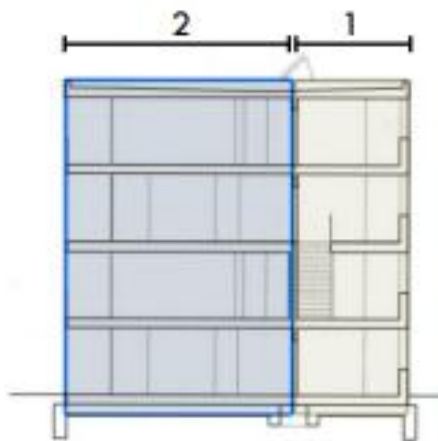


Figure 8: Southelevation, Circulation ratio - 1:2
Height



Figure 9: Proportion: Width = Height

2. Armstrong Place Senior Housing San Francisco

Year: 2011

Name of the Architect/firm/Planner: David Baker + Partner



Figure: 10 Front Elevation



Figure: 11 Front Elevation

Figure: 12 Walking corridor“(Source - <https://www.archdaily.com/153359/armstrong-place-senior-housing-david-baker-partners>)”



Figure: 13 Connectivity

“(Source - <https://www.archdaily.com/153359/armstrong-place-senior-housing-david-baker-partners>)”

David Baker & Partners designed Armstrong Place Senior Housing and this senior old age housing is in San Francisco, CA, United States. To prevent seniors from living in isolation this senior apartment complex is adjacent to family housing. In this housing for seniors, there are several designs involved with sustainable consciousness and the building also achieved LEED Gold Certification in 2011.

The housing gives the elderly ability to take care of them and the interesting part is that it is situated in a formerly industrial city. The place where senior citizen lives should be rich with the present communities, infrastructures, and all ages' people, public parks, and public transport convenient for them. The site selection for the Senior Housing avoided improper sites and channelled development to urban areas having existing infrastructure. This project is

described as an innovative housing mix by the architect David: “Affordable urban town homes to keep growing families in the city and family housing adjacent to senior apartments to prevent seniors from living in isolation.” In this housing 116 apartments for the elderly in economical rental units and the important project development gives the public area retail space and community services. In Armstrong Place for Senior Housing Vegetated open space is given by the central courtyard, side garden, and roof which cover over 25% of the property area, which has 2 benefits, preparing miniature wetlands and adding green areas to the surrounding. With these features and design aspects, a social and ecologically sustainable site was built.



Figure 14: Armstrong Place Senior Housing and Family Housing Plan



Figure 15: Armstrong place senior housing ground floor plan

Special Features:

Some green strategies for the indoor environment are featured in this project of elderly. Armstrong Place Senior Housing provided a plan for managing indoor air quality (IAQ) during the construction and pre-occupancy stages (U.S. Green Building Council, 2017) for providing good air quality to the elderly. To reduce odorous, irritating, and harmful air contaminants all adhesives, paints, coatings, sealants, composite woods, and carpet systems that are used are very low-emitting materials. The design of the project allows daylight in. A

connection between indoor spaces and the outdoors is provided by high sunshine and pleasant vistas which are essential for the physical and emotional wellbeing of elders.



Figure 16:Armstrong place senior housing standard floor plan and section

The Armstrong Place Senior Housing put towards a way to keep the elderly population in this formerly industrial block in the city which is affordable and very easy access to urban townhouses for economic sustainability. Government subsidies for the elderly provide a very good living environment and surroundings. Sustainable products are of higher cost, but due to their sustainability, they can save money in the long-term use of this project.

By this project many complementary green strategies are featured, which include stormwater management, solar arrays, alternative transportation, and water-efficient landscaping. In this, it thinks about alternative transportation which are low-emitting vehicles, LRT system, and carpool parking capacity. The project manages onsite infiltration and stormwater runoff which limits the disruption of natural water hydrology. Solar panels on the roof meet 13% of energy requirements by heating household water and illuminating communal spaces. The energy performance rating of the building is excellent; it is 28% lower than the standard building performance rating. The majority of the performance is provided by solar arrays and LED lighting. The irrigation landscape decreases potable water use by 50% with a courtyard rain garden, which saves 30% water by employing dual-flush toilets and water-saving faucets throughout the structure.

3. Clyde E. Lassen State Veterans' Nursing Home

Year:2010

Name of the Architect/firm/Planner:Harvard Jolly Architecture



Figure: 16 Front views (entrance)
(entrance)



Figure: 17 sitting space

“(Source - <https://www.staugustine.com/article/20100319/NEWS/303199977>)”

The Clyde E. Lassen State Veterans' Nursing Home is designed by Harvard Jolly Architecture and it is situated in St. Augustine, Florida. The Clyde E. Lassen State Veterans' Nursing Home is the first nursing home to achieve LEED Gold Certification in Florida. The Harvard Jolly Architecture generally comes up with sustainable design decisions at the beginning of the design and put efforts to use them throughout the building process. In this case, the study offers an analysis that how The Clyde E. Lassen State Veterans' Nursing Home complies with the basic principles of social, economic, and ecological sustainability.

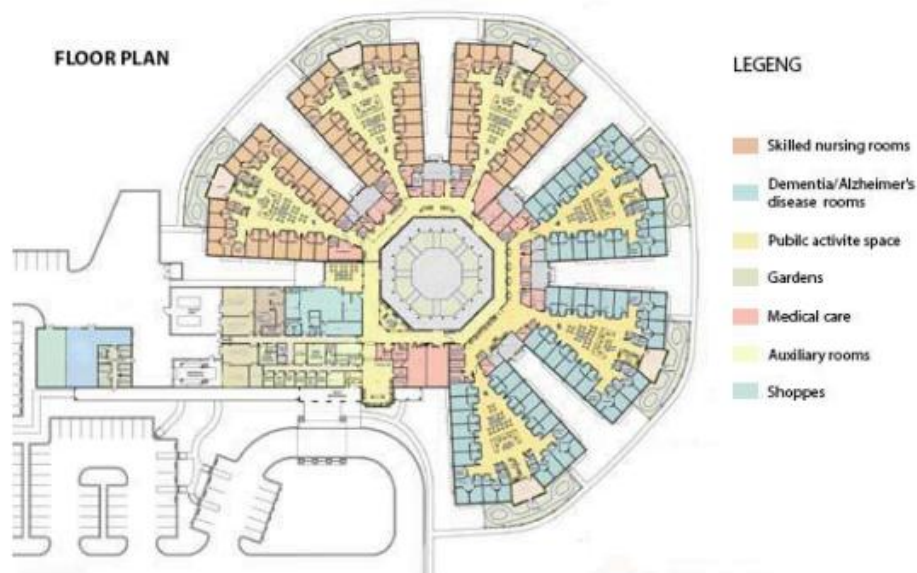


Figure: 18 Floor plan Clyde E. Lassen State Veterans' Nursing Home

“(Source - *SUSTAINABLE DESIGN FOR THE ELDERLY: SENIOR HOUSING DESIGN GUIDELINES*)”

The Clyde E. Lassen State Veterans' Nursing Home has 96 patient rooms with a total occupancy of 120 beds in one pinwheel layout building, and the residents are long-term living veterans. One of the most important influencing elements on the physical health of the elderly is the indoor environmental quality. The indoor environmental quality score (11 of 13) is the highest for this project's rates. This suggests that ensuring a high level of interior

environmental quality is a major concern in nursing home design. All of the information provided was obtained from the LEED and Harvard Jolly websites. First, for construction and pre-occupancy, an Indoor Air Quality (IAQ) Management Plan was developed and implemented as part of this project (U.S. Green Building Council, 2017). Second, all adhesives, sealants, paints, varnishes, composite woods, and carpet systems have minimal emissions that help to eliminate odours, irritants, and hazardous air pollutants. Third, thermal comfort is provided by high-performance heating, ventilation, and air conditioning (HVAC) systems as well as improved ventilation. The climate in the area where the building is located is humid subtropical. Maintaining a comfortable level of temperature and humidity is essential. There is also monitoring of outside air distribution and management of lighting and thermal comfort systems. Some rooms may suffer from a lack of natural light and views.

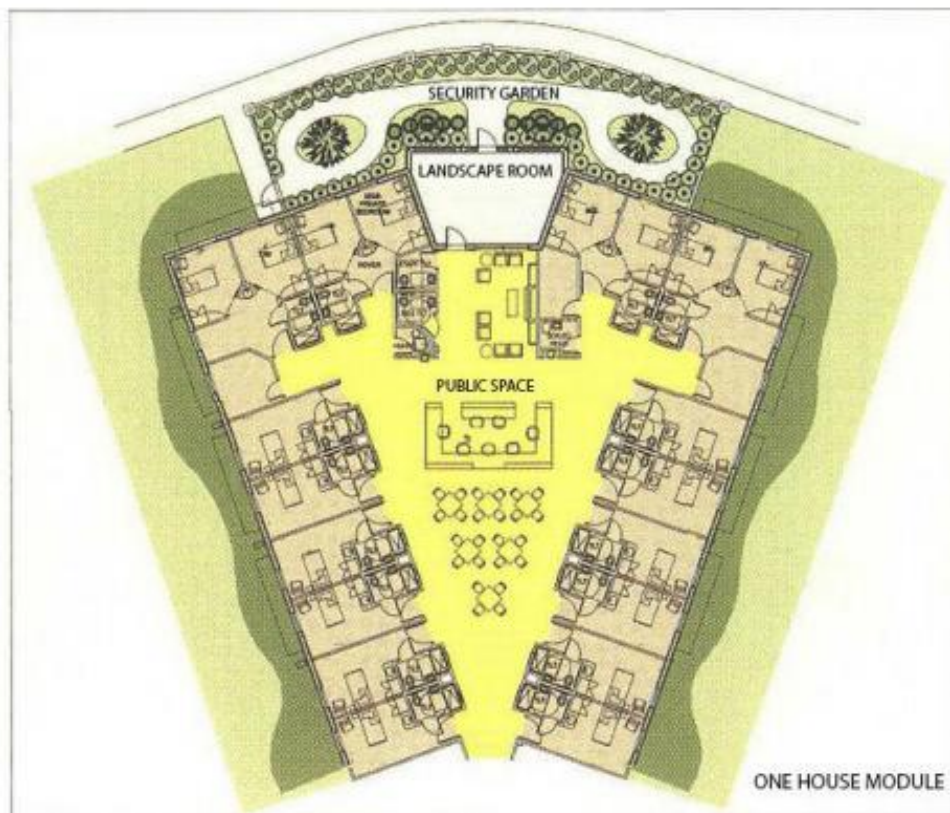


Figure: 19 one house module Clyde E. Lassen State Veterans' Nursing Home
 "(Source - *SUSTAINABLE DESIGN FOR THE ELDERLY: SENIOR HOUSING DESIGN GUIDELINES*)"

It was said by Harvard Jolly Architecture: "Communication is encouraged within a therapeutic and safe environment." (Harvard, 2012) The pinwheel arrangement split rooms into six houses: three homes for 60 skilled nursing residents and three houses for 60 dementia/disease Alzheimer's patients, and each house model is very functional and homelike. In each, a central living room is provided so that residents can converse and visit one another. Every house model includes a private walking garden with natural and native flora that provide a welcoming atmosphere for individuals, their families, guests, and employees. To begin with, the project's pinwheel structure increases worker efficiency by lowering daily travel lengths, which contributes to economic sustainability. High-quality, low-impact building approaches need extra financing, but Gustafson (2011) discovered in this

project that “purchasing more expensive sustainable items can save money in the long term.” High-efficiency HVAC systems also have a lower long-term economic impact. In June 2012, the construction cost was estimated to be \$227.21 per square foot. On Facebook, this project received a high rating and numerous recommendations. Although good service played a role in the outcome, design has the potential to improve and sustain business.



Figure: 19: Sitting space



Figure: 20: Activity zone

“(Source - *SUSTAINABLE DESIGN FOR THE ELDERLY: SENIOR HOUSING DESIGN GUIDELINES*)”

The Clyde E. Lassen State Veterans' Nursing Home project contributes significantly to environmental sustainability. It considered alternative transportation options such as bicycles, low-emission vehicles, fuel-efficient vehicles, and carpool parking. To reduce the disruption of natural water, the nursing home manages storm water runoff and on-site infiltration. The nursing home's landscaping method used 50 percent potable water for irrigation while saving 30 percent on total water usage by installing dual-flush toilets and water-saving faucets throughout the facility. The planned building performance rating is 21% lower than the baseline grade for building performance. The high-performance HVAC systems and LED lighting played the most important roles in this performance. To reduce energy consumption during transportation, regional building materials were used in construction. The project made use of rapidly renewable materials and certified wood products. From the attention to detail, this subject demonstrates a very high level of long-term sense. The pinwheel layout is ideal for indoor transfer and service because it is compact. Designers set the objective of LEED certification from the starting so that building development could adhere to the majority of guidelines. They were especially concerned with improving the quality of the indoor environment while using less energy. High-performance HVAC systems, IAQ management, LED lighting, low-emitting materials, renewable materials, non-portable irrigation, dual-flush water closets, and water-saving faucets are the main sustainable designs. Residents are most concerned with their indoor environment, gardens, and public areas. These spaces were the most frequently mentioned topics in posted feedback. On the contrary, due to the high cost and poor overall effect, on-site renewable energy and building reuse were not considerations of this project. The pinwheel design, high-performance HVAC systems, low-emitting materials, IAQ management, and renewable materials are the important sustainable aspects.

4. Convergence of Wireless Sensor Network Technology according to a Modular Construction Technology in housing

Year:2018

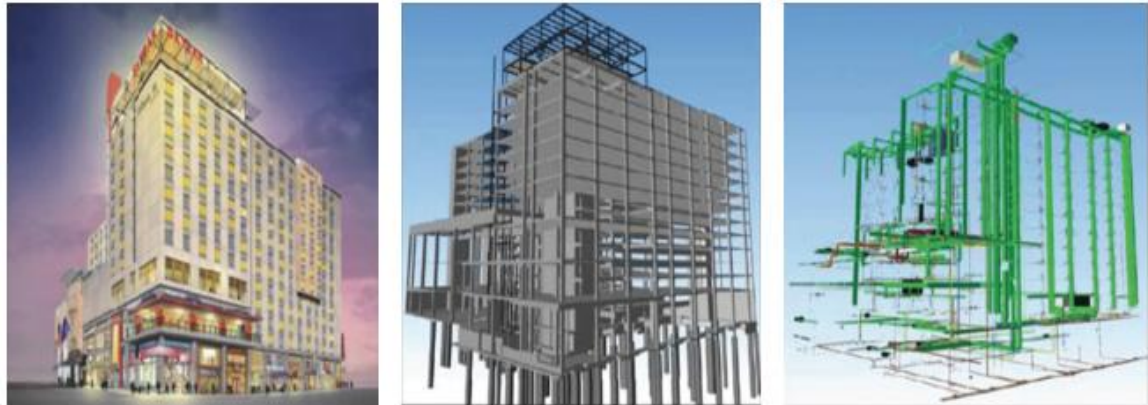


Figure 1: Architectural (a), structural (b), and plumbing (c) models of BIM for Hilton Aquarium at Atlanta, Georgia, USA

Now a day's modular-based architecture and construction technology are being researched actively as an alternative residential area for the elderly. Modular architecture technology is industrialized building construction systems in which modular units are made in the factory offsite are moved to the construction site and the building is constructed by assembling them on the site. It increases efficiency through the modularization of building materials minimizes construction processes at the site and provides more secured works in the construction processes. Basically, it could be reusable moved and technology after installation also. There are several advantages of modular construction. For the elderly, this modular design technology would be expected to apply residential designs a lot. The reason behind this is the number of the old people who live alone will increase in the future according to survey, and for them the residential area will be smaller. These smaller houses are needed for the old people due to its small house works. As mentioned above, types of the elderly are changed as time goes by, and accordingly, area for them would also possible to change. Atkinson et al. insist that the modular type (prefabricated) houses is suitable for the elderly housing due to its low cost and its reusability. In conclusion, prefabrication construction technology is certainly used for the housing for elderly. That's why, the sensor network technology on the basis to this modular architecture should be developed to operate and install properly within the modular residential environment. Although, the environment is created to various shapes by another resident, the sensor network technologies enabling to give always reliable and efficient services are important to be studied. The wireless-based sensor networks are suitable for modular transformative residential areas instead of using wired sensor networks. Basically, the use of the wireless sensor networks could resolve the trouble occurred by wires for changing areas freely, also the considerations of the line arrangement could be less in the modular area implementation. For one more example, there could be the link and detection technology of dynamic and automatic connection devices into the central management panel. The wireless sensors as stated above would record data and deliver control commands through the central management system. By changing areas in various ways, the type and location of the communication device will be changed, and this will be automatically

detected, and then the technology is important to be removed and integrated for devices and sensors in the central management system without user's additional behaviour.

5. The Elderly-Friendly Housing Design Features Preferences by Generations in Malaysia Year:2019

A case study The Preferences for Elderly-Friendly Housing Design Features by Generations in Malaysia are based on three (3) factors: physiology, psychology, and sociology. The physiological and psychological components, which largely address the physiological and psychological difficulties of old age—sociology focuses mostly on the social behaviour problems associated with old age. The prior hierarchical model of senior demands projected a model of older service requirements from a user-centered perspective. (Yuqi&Ryoichib, 2019).

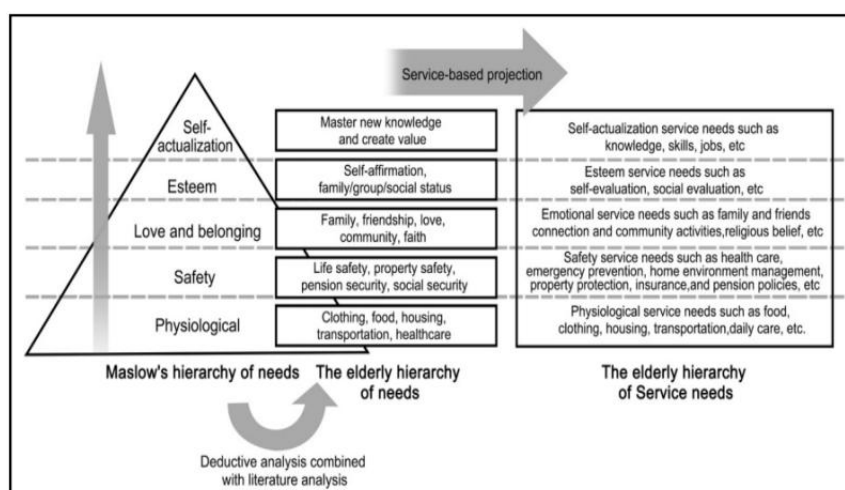


Figure 1: Analysis process of the elderly service needs model (Yuqi&Ryoichib, 2019)

A residence can suit the needs of its occupants (Demirbilek and Demirkan 2004). The elderly like to live independently in their homes and communities for as long as feasible. Aging in place refers to the tendency to stay in the same area indefinitely. The current meanings associate ageing in one's flat or house during the course of one's life or in older years (Weil, 2015). The concept of aging-in-place emerged from study on persons who wish to age-in-place as well as the reasons why older people opt to remain in their current settings. Gerontologists use the term "ageing in place" to describe the situation in which a senior stays and continues to live within the community with some level of freedom as opposed to living in residential care. To better explain this, Raymond et al. (2010) developed a Three-Pole Model of Place Attachment. In this paradigm, place attachment is associated with three (3) basic forms: place identity and dependence, social bonding, and bonding nature. The first type is known as the personal element, which is associated with situated identity and dependence, as well as rootedness, and this form is accompanied by the second form of social bonding associated with community context, which includes neighbourhood attachment, familiarity,

and belongingness. Nature bonding is the final and third form, which is related to closeness to nature, environmental identity, and affinity to nature.

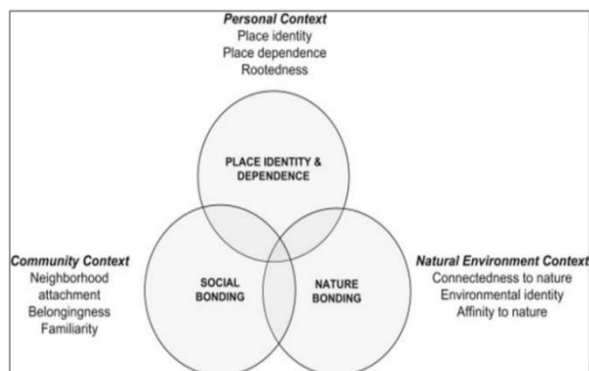


Figure 2: Three-Pole Model of Place Attachment Source: Raymond et al. (2010)

“(Source: Raymond et al. (2010))”

6. Housing Design Guidance in Malaysia - MS118 and the Universal Design Concept

Year: 2014/2018

Currently, there is a lack of adequate Rules and Regulations for the design and building of Elderly-Friendly Housing in Malaysia. However, the architects have selected two (2) main guidelines and design concepts for the building design for the Person with Disability (PWDA). The instruction refers to MS1184 and the Universal Design Concept adaptation. MS1184 is intended to benefit all people, including: 1) people with vision impairments; 2) people with mobility impairments; 3) people with hearing impairments; 4) persons with hidden (such as stamina, strength, mental, allergy, and dexterity); and 5) people with age and structure differences.

Principle	Description
Equitable Use	The design is useful and marketable to people with diverse abilities
Simple and Intuitive Use	The design accommodates a wide range of individual preferences and abilities
Perceptible Information	The use of the design is easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level
Tolerance for Error	The design provides necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities
Low Physical Effort	The design can be used effectively, comfortably and minimises fatigue.
Size and Space for Approach and Use	Appropriate size and space is provided for approach, reach, manipulation and use regardless of user's body size, posture or mobility.

Table 1: The Key Principles of Universal Design (UD)

“(Source - Kamarudin et al. (2014))”

Variable	Category	Frequency	%
	Ageing in place	177	52.4
Housing choice preferred most for the age of 60	Move to other location and live on your own	35	10.4
	Move to other location & live with family members	106	31.4
	Move to other types of housing especially for the elderly	15	4.4
	Others	5	1.5

Table 2: Housing Choice Preferred Most for the Age of 60

These findings suggest that Malaysian generations (Baby Boomers, Gen-X, and Gen-Y) prefer to age in place and live independently, but are willing to relocate if necessary.

FAMILIARITY		
Housing Design Features	Index	Order of Familiarity
Elderly-Friendly BATHROOM Design	74.5	1
Elderly-Friendly BEDROOM Design	70.7	2
Elderly-Friendly KITCHEN Design	69.0	3
Elderly-Friendly LIVING ROOM Design	67.6	4
Elderly-Friendly FLOOR Design	67.3	5
Elderly-Friendly STAIRCASE Design	66.6	6

Table 3: Index of Familiarity for Features of Elderly-Friendly Housing Design

In terms of familiarity, as in precise location and local customs of recognised personal objects in building or creating old age dwelling features, the bathroom design was reported to be the most familiar; it is measured by the panels' scores. These were followed by bedroom design (70.7), kitchen design (69.0), living room design (67.6), and floor design (67.3). And, according to the panels, the staircase feature (66.6) for building old age residences had the least familiarity. The distinction between desires and familiarity with regards to elderly home design reveals that Malaysians were conscious of the importance of designing elderly-friendly homes for each individual dwelling unit.

The age-related problem affects the elderly's usual regular behaviours and hence we need the inclusion of design considerations for the old. The study's findings show that Malaysians prefer to age in place and live independently throughout their retirement years. Nonetheless, generations opt to migrate to a new area to be closer to family members. Essentially, the elderly mobility housing decision is made due to health problems, or late-life moves due to the elderly's need for assistance in completing daily living chores. Family members and partners or wives are regarded to have the most influence on senior citizen dwelling selection decisions. According to the study, the two (2) most desired types of elderly-friendly housing are (a) existing housing units and (b) new housing units built by the developer. The survey provides limited input from Malaysian generations on the ideal elderly-friendly dwelling design characteristics. More research could be conducted in Malaysia to determine the design aspects in specific for landed and stratified dwellings.

LESSONS LEARNT FROM CASE STUDIES

Sr. no	Case study	Aim of the Study	Design Parameters	What you learnt from case study
01.	Dwellings for Senior Citizens - Domat, Switzerland	To study about the designing strategy For Independent living Apartment for senior citizen and techniques or material used according to need of residents and climatic condition.	Horizontal window openings frame the views to the north, while the south facade is an open glass and metal construction. The central topic of the building is focused on the needs of its residents. Spacious wheelchair accessible apartments with the best facilities give every resident the opportunity to furnish his private space individually. All apartments are south-facing. The interiors are clad in wood and the bright walls all over ensure maximum flow of daylight.	In conclusion, this is a great example of a simple building form which responds very well to the environment and utilizes technology in a successful way. Simplicity in this case reveals a beautiful responsive building that creates great interior spaces for the elderly residents. FUNCTION
02.	Armstrong Place Senior Housing San Francisco	This case study offers analysis of how this nursing home complies with the principles of social, economic, and ecological sustainability and fits into the centre part of city with and also maintains the environment required for elderly.	To reflect the historically African-American population of the neighbourhood, design details were drawn from traditional African textiles and symbols. Textile-inspired paint and window arrangements combine to wrap the public face of the building in an interlocking “quilt” of colour and pattern. The courtyard is ringed by a wall inset with Ashanti tribal symbols representing security, wisdom,	The key sustainable features of this design are solar arrays, storm water management, and water-saving landscape and healthy interiors and materials. Physical and Social infrastructure plays a vital role. FUNCTION

			power, love, unity, and hope.	
03.	Clyde E. Lassen State Veterans' Nursing Home	The principles of social, economic, and ecological sustainability. priority of offering high indoor environmental quality in nursing home design	This nursing home made and implemented very important feature (IAQ)Indoor Air Quality Management Plan for construction and pre-occupancy. Second, all adhesives, sealants, paints, coatings, composite woods, and carpet systems are low-emitting materials to decreaseodor, frustration, and injurious air contaminants.	A good paper taught that how to achieve sustainability in the housing. FUNCTION
04.	Convergence of Wireless Sensor Network Technology according to a Modular Construction Technology.	Architectural (a), structural (b), and plumbing (c) models of BIM for Hilton Aquarium at Atlanta, Georgia, USA	This modular design technology would be expected to apply residential designs for the elderly a lot. The reason is that number of the elderly who live alone will increase in the future, and the residential area for them will be smaller.	Types of the elderly are changed as time goes; design has a good correlation with time. FORM
05.	The Elderly-Friendly Housing Design Features Preferences by Generations in Malaysia	This case study is basically depends upon three factors angles; physiology, psychology, and sociology.	The physiological and psychological aspects basically concentrates at the old age physiological and psychological problems—the sociology always emphasizes upon the social behaviour difficulties of aging.	Relation between physiology, psychology, and sociology. FUNCTION
06.	Housing Design Guidance in Malaysia - MS118 and the Universal Design	a) people who is suffering from hearing problem; b) people having visual problems; c) People having mobility problem;	The comparison between familiarity and preferences on the Elderly-Friendly housing design shows the Malaysian generation were aware	Elderly Housing need special attention as per the various health issues. Design has a relation with health parameters.

Concept	d) people having cognitive/learning impairments; e) People with diversities in age and structure.	of the importance of elderly-friendly housing design for each specific dwelling unit.	FORM
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Table 11: Summary table
“(Source: Collected by Author)”

TABLE OF PAPERS (FOR LITERATURE STUDY):

Sl#	TITLE OF PAPER	AUTHOR(s)	JOURNAL OF PUBLICATION	PUBLISHER	PAGE #	ISSN/DOI #	DATE/YEAR	SUBJECT OF RESEARCH PAPER	COMMENTS ON RESEARCH PAPER
1	Social Enterprise for Elderly Housing Policy for Accountability and Public-Private Responsible Financing	Arlie Yi, Ng1 & Tiffany C. H. Leung1 & A. Ka Tat Tsang2	Journal of Population Ageing	Springer Nature B.V. 2019		https://doi.org/10.1007/s12062-018-9235-5	4-Dec-18	Elderly housing Responsible Financing	1. It deepens the understanding & importance of governance for social enterprises & highlights the significance of a contemporary performance measurement system that combines the functions of compliance and quality performance on a continuous basis. 2. Using this system, the government as public-funding provider will be making more effective decisions about resource allocation, and identifying operators who aren't compliant and be reprimanded, or deprived of resources where necessary. 3. The social-enterprise model for the formation of elderly housing needs to be a mission-driven operation. The social enterprises would need to seek multiple sources of funding to support their operations and should be transparent enough for quality assurance and an external accreditation process.
2	Convergence Research Directions in Cognitive Sensor Networks for Elderly Housing Design	Shinil Suh, 1 Byung-Seo Kim,2 and Jae Hee Chung3	International Journal of Distributed Sensor Networks	Hindawi Publishing Corporation	11	http://dx.doi.org/10.1155/2015/196280	6-Sep-15	Cognitive Sensor Networks - Elderly Housing Design	1. The IT services/systems represented by sensor networks for smart homes are mainly focused on universal purpose, not specialized for the elderly. 2. For sensor networks-based elderly housing, there are 3 perspectives explained: - One is adopting CR-based sensor network technologies to cope with dense sensors environment. - Heterogeneous network environment, customizing sensors/networks classification correlated with the elderly types. - Converting sensor network technologies with architectural technologies.
3	Housing for the Elderly: Addressing Gaps in Knowledge Through the Lens of Age-Friendly Communities	Stephen Frochen & Jon Pynoos	Journal of Housing For the Elderly	Routledge Taylor & Francis Group	18	10.1080/02763893.2017.1309936	25-May-17	Addressing Gaps in Knowledge - help of views from Age-Friendly Communities	1. Aging is as much a community effort as a household undertaking, more housing options may help older adults find their homes in an era of unprecedented migration. 2. Conducting research on political interests and competing agendas at local, state, and national levels may help us understand why elderly housing programming is underfunded and how to increase it. 3. As the population of older adults continues to grow across the nation and the world, housing will become an ever-important area of interest.
4	Housing affordability, preferences and expectations of elderly with government intervention	Eddie C.M. Hui a,* Francis K.W. Wong a, K.W. Chung b, K.Y. Lau c	Habitat International		21	www.elsevier.com/locate/habitatint	2014	Elderly Housing affordability with Government Intervention	1. In this paper, they have included living time in current housing as a factor while conducting research, which was often overlooked in previous studies. 2. As elderly people have been living in their communities for a long time, they develop a strong sense of belonging & built a social network. They can't move not only because of their physical disabilities, but also because their long-built social network and community would be lost. 3. The government's housing policy should help the elderly people to age in place more conveniently so that they can live with dignity in a familiar environment.
5	Circulation analysis of design alternatives for elderly housing unit allocation using building information modelling-enabled indoor walkability index	Jin-Kook Lee1, Jaeyoung Shin2 and Yeunsook Lee1	Indoor and Built Environment	SagePublications, UK	17	DOI: 10.1177/1420326X18763892	17-Jan-18	Analysis of building circulation using a BIM-enabled calculation method	1. This paper reports an approach to analyze building circulation using a BIM-enabled calculation method (the IWI) and demonstrates by design cases the effectiveness of the index tool to support an elderly housing unit's spatial allocation issue and circulation. 2. The major contribution of the approach is not the fact that the calculated numbers of the IWI provide almost every problem-solving approach to design, but that it can provide a carefully and quantitatively measured decision-support mechanism, especially among design alternatives in the relatively early phase of design in BIM environment. 3. The demonstration result shown in this paper proved that the IWI approach to analyze design has a significant and positive impact on early phase design decisions.
6	Assessment of and Improvement Strategies for the Housing of Healthy Elderly: Improving Quality of Life	H-Ming Fang 1, Jun-Hong Chen 1, Bo-Wei Zhu 2,3,* and Lei Xiong 1	Sustainability	MDPI	32	creativecommons.org/licenses/by/4.0/	8-Mar-18	Improving quality of life of the elderly	1. It is evident that factors affecting the impacts of housing improvement on old-age health are complicated, with non-linear cause-effect interrelations among themselves. A single factor in the system may influence changes in another part of the system. 2. The results show that the elderly have the most concern for their physical and psychological sensory comfort in their living environment. 3. The only drawback of this research is it is a cross-sectional study focusing on examining the improvement of the housing environment for the elderly for a specific housing setting. Its data and outcome cannot be used for the assessment and the improvement of other elderly housing environments. 4. Issues related to the health of the elderly, such as community environment, social welfare, and medical and health care, can still be studied further.
7	Mismatch between the quality of dwelling units and residents' health condition in elderly housing with supportive services	Motohiro Sannomiya,1 Byung Joon Hwang2 and Yoshihiro Suzuki3	Japan Architectural Review	Architectural Institute of Japan	12	https://doi.org/10.1002/2475-8876.12065	2019	Mismatch - quality of dwelling units and residents' health condition - elderly housing	1. The lack of choice encourages the elderly to attempt to remain in their homes until care is necessary, even though care is not the only reported reason for moving into EHS. Development of EHS for self-supporting residents or those needing mild care is a necessity. 2. Considering lifestyle continuity, prevention of unnecessary care, and couple's needs, improving the quality of dwelling units may make daily living easier. It is recommended to examine whether the daily living space standard is revised or a standard that excludes floor area dedicated to a kitchen, toilet, or bathroom included. 3. A general-purpose floor plan, similar to FR-housing, is suggested to allow residents to move within housing based on the level of necessary care. 4. The lives of residents may be affected by the design of the communal area and how supportive services are used. Further research should be conducted to obtain knowledge about the quality of the living environment to ensure additional improvements.
8	Housing conditions and risk of physical function limitations: a prospective study of community-dwelling older adults	Bibiana Perez-Hernandez1, Esther Lopez-Garcia1,2, Auxiliadora Graciani1, José Luis Ayuso-Mateos3, Fernando Rodriguez-Artalejo 1,2, Esther Garcia-Baquintas1	Journal of Public Health	Advance Access Publication	8	doi:10.1093/pubmed/kqy004	17-Jan-18	Risk - physical function limitations - community-dwelling ofg elders	1. The results support the role of poor housing conditions in the development of frailty. Prevention programs targeting functional limitations and disability in older people should ensure that older adults live in homes that are accessible to the street and have adequate temperature systems. 2. Prevention programs targeting functional limitations in older adults should ensure that they live in suitable housing conditions.
9	Merging current health care trends: innovative perspective in aging care	Miguel Angel Gandarillas, Nandu Goswami	Clinical Interventions in Aging	Dove Publications	13	https://www.dovepress.com/terms.php	2018	Health trends & ageing care	1. It highlights the great potential that can be realized by merging the mentioned trends and incorporating the best evidence-based tools and practices into an integrated health care system focused on prediction, prevention, and promotion of health within the patients' ecosystem. 2. Description of a feasible system that may overcome current limitations in e-health, by guaranteeing that each stakeholder has access only to the information needed by their tasks. 3. The potential misuse of predicting devices (for instance, raising alarms in the patient) could be reduced by the closer face-to-face relationship of that health community managers and teams with the patient. 4. The governance approach used here allows territory-based, overarching health care planning, simplifying the structure of services and bringing a more cost-efficient and effective health care value chain with the participation of all stakeholders, patients, and communities.

10	Modern Senicide in the Face of a Pandemic: An Examination of Public Discourse and Sentiment About Older Adults and COVID-19 Using Machine Learning	Xiaoling Xiang, PhD, MSW, I, Yan Lu, PhD, Alex Halavanau, PhD, Jia Xue, PhD, Yitang Sun, MSW, Patrick Ho Lam Lai, MSW, I, and Zhenke Wu, PhD	Journals of Gerontology	The Gerontological Society of America	11	doi:10.1093/geronb/gbaa128	12-Aug-20	Public Sentiments about Older Adults using Machine Learning with perspective of Covid 19	1. This research suggests a relatively high level of 'trust' expressed in tweets and that information about COVID-19 on Twitter likely influenced public perceptions of risk and acceptable ways of controlling the pandemic relevant to the treatment of older adults. 2. The proportion of tweets that implied the life of older adults is less valuable or downplayed the pandemic rose as quickly as 1 day after each increase in informative tweets related to COVID-19 risk factors. These findings provided evidence that more directly implicating social media as an online platform that reproduces and reinforces existing ageism in society than descriptive findings from previous studies. 3. There were tweets that demonstrated intergenerational solidarity and a keen awareness of ageism in the pandemic. 4. While social media such as Twitter has reproduced ageism, its speed and influence can be leveraged to combat ageism for improved health equality and reduced societal cost. 5. Older adults continue to contribute to society in many ways and represent a powerful force that drives economic growth and value. We must recognize their value, learn from past mistakes, and prevent the return of senicide to the modern world.
11	Changes in Everyday and Digital Health Technology Use Among Seniors in Declining Health	David M. Levine, MD, MPH, MA, Stuart R. Lipsitz, ScD, and Jeffrey A. Linder, MD, MPH	Journals of Gerontology: Medical Sciences	The Gerontological Society of America	8	doi:10.1093/gerona/glx116	12-Jun-17	Changes in Tech use among seniors in worsening health	1. The type of health decline a senior experiences predicts technology use, which may allow better targeting of digital health to specific seniors. Seniors with new dementia, relocation to a nursing home, and declining physical performance seem especially poor candidates for technology interventions. 2. Future health technology innovations need to improve if we expect seniors to use them, and keep using them, at reasonable rates when their health declines. Only then might digital health have broad reach in improving quality, cost, safety, and health outcomes for seniors.
12	Aging in Place in Gentrifying Neighborhoods: Implications for Physical and Mental Health	Richard J. Smith, MSW, PhD, Amanda J. Lehning, MSW, PhD, and Kyeongmo Kim,	The Gerontologist	The Gerontological Society of America	10	doi:10.1093/geront/glx105	27-Jul-17	Effects of ageing amongst neighbourhoods - physical & mental health	1. Economically vulnerable older adults in gentrifying neighborhoods reported higher self-rated health than economically vulnerable older adults in low-income neighborhoods. 2. Both economically vulnerable and higher-income older adults in gentrifying neighborhoods had more depression and anxiety symptoms than those living in more affluent areas. 3. Higher-income older adults in gentrifying neighborhoods had poorer mental health than their counterparts in low-income neighborhoods. 4. Needs attention to the complexity of gentrification, and for more research examining how the intersection of neighborhood and individual characteristics influences older adults' health.
13	The study of a space configuration using space syntax analysis Case study: an elderly housing	Yosica Mariana, Arindra J. Trivardhani, Michael Isnanti Djimantoro	The International Conference on Eco Engineering Development 2017 (ICEED 2017)	IOP Publishing	7	doi:10.1088/1755-1315/1091/012048	2017	Elderly housing: Space configuration in this elderly residential building. Integration, control value, choice and entropy are the basic dimensions in space syntax that can be used as a fairly effective and efficient tool for explaining relationship patterns in spatial configurations.	
14	The Future of Housing for the Elderly: Four Strategies that Can Make a Difference	Jon Pynoos, MCP, PhD	Public Policy & Aging Report	The Gerontological Society of America	4	doi:10.1093/ppar/pry006	29-Mar-18	Strategies - future housing for the elderly	1. There is a shortage of affordable, accessible, and supportive housing for older persons. 2. We need to expand programs such as home modification that have been proven to work and directly impact the ability of older persons to age in place. 3. We also need to increase the supply of subsidized supportive housing by building new complexes and adding services to those that already exist. Such housing is urgently needed, especially for homeless older adults, including veterans. 4. We need to lay the groundwork for the future by building new housing based on the principles of universal design that will meet the needs of residents over their lifetime.
15	The Relationship between Socio-Spatial and Elderly Cultural Values Towards a Sustainable Senior Retirement Housing	Alice Sabrina Ismail, Muhammad Nor Hazzi Zamry	International Journal of Psychosocial Rehabilitation	Researchgate	20	DOI: 10.37200/IJPR/V24I6/PR261056	May-20	Socio-spatial & seniors cultural values - sustainable senior retiring home	1. In Malaysia, while designing elderly homes, six cultural values can be the basis of reference and determinants: - Preserving dignity - Manners - Community spirit - Compliance - Spiritual wellbeing - Harmony 2. The Malaysian government including developers and housing authorities should consider these cultural values and considers it in building design so that a much better living environment that elevates the household quality of elderly (life namely) in urban areas can be produced.
16	Housing for Older People in Singapore: An Annotated Bibliography	Beinda Yuen - Emily Soh	SpringerBriefs in Aging	Springer	114	DOI 10.1007/978-3-319-44754-4	2017	Bibliography - elderly housing in Singapore	1. The annotated bibliography is a product of the literature scan on the subject of housing for the older population in Singapore. It focuses on housing for the elderly, examining where they live, how they live and how they cope with the experiences they encounter. 2. As per the book, we require a new awareness of the deployment of resources, rethinking health care and new skills of re-designing and retrofitting a city and housing for this important and growing population. Cities and authorities have to think of new innovative solutions to meet these needs.
17	How Is the Neighborhood Environment Related to the Health of Seniors Living in Hong Kong, Singapore, and Tokyo? Some Insights for Promoting Aging in Place	Becky P. Y. Loo, Winnie W. Y. Lam, Rathi Mahendran S Keiko Katagiri	Annals of the American Association of Geographers	Taylor & Francis Group	18	DOI: 10.1080/24694452.2016.1271306	16 Mar 2017.	Neighbourhood Environment - Health of Seniors - specific to HK, Singapore & Tokyo	1. To policymakers, the urban infrastructure, not just within homes but also the neighborhood, needs to be modified to compensate for the functional limitations and disabilities among the geriatric population in cities. 2. Without turning cities into 'the land of old age' with nursing homes and institutionalizing the elderly population, there needs to be an extra support in the urban living environment to facilitate community-dwelling seniors to have an active old-age life with good mental and physical functioning. 3. The results of this article echo previous works that suggest that social capital is closely linked to health outcomes (Cannuscio, Block, and Kawachi 2003; Polack and von dem Knesebeck 2004). When planning for local communities, facilities and activities that help to promote social capital should be provided to support healthy aging in place. 4. We need to promote an objectively walkable neighborhood (NOW) with smooth surfaces by enhancing the comfort, convenience, and safety of pedestrians (including those using walking aids or wheelchairs) on pedestrian walkways should be a priority policy area for governments aiming to support or promote healthy aging in place.

CONCLUSION

In recognising and addressing knowledge gaps in the elderly housing literature, we have implemented the age-friendly housing paradigm, which involves its principles: Access, support services and socialization to analyse the missing components and to evolve various design parameters. The findings of this study suggest that in place of aging: A domestic endeavour is as much a community effort; more accommodation options could help older adults to find their homes in an unprecedented era; Migration; facilitating and organizing home. Elements of elderly housing relate with environmental gerontology theories. Extensive frameworks for example the ecological theory of aging; and knowing about political interests and competitive agendas in local, state, and can help us understand elderly housing better. Investigators, medical professionals, and Policy makers are different stakeholders to show areas of elderly housing research. The physiological, psychological and the sociology prominence mostly on the problems of social behaviour of aging which plays a

very important role to set various principles of design, the case in which function and form both follow each other. Housing has become an important area of interest to grow in the country and around the world. Age-friendly efforts will continue to inform the field of elderly housing in recent era of unprecedented population growth.

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