# Green buildings for greying people: A case study of a retirement village in Australia

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*Published in:*
Facilities

*DOI:*
10.1108/F-08-2011-0060

# Green buildings for greying people: a case study of a retirement village in Australia

**Abstract**

**Purpose** - With an increasingly ageing population and widespread acceptance of the need for sustainable development in Australia, the demand for green retirement villages is increasing. This paper aims to identify the critical issues to be considered by developers and practitioners when embarking on their first green residential retirement project in Australia.

**Design/methodology/approach -** In view of the lack of adequate historical data for quantitative analysis, a case study approach is employed to examine the successful delivery of green retirement villages. Face-to-face interviews and document analysis were conducted for data collection.

**Findings -** The findings of the study indicate that one of the major obstacles to the provision of affordable green retirement villages is the higher initial costs involved. However, positive aspects were identified, the most significant of which relate to: the innovative design of site and floor plans; adoption of thermally efficient building materials; orientation of windows; installation of water harvesting and recycling systems, water conservation fittings and appliances; and waste management during the construction stage. With the adoption of these measures, it is believed that sustainable retirement development can be achieved without significant additional capital costs.

**Practical implications** - The research findings serve as a guide for developers in decision making throughout the project life-cycle when introducing green features into the provision of affordable retirement accommodation.

**Originality/value-** This paper provides insights into the means by which affordable green residential retirement projects for aged people can be successfully completed.

**Key words:**

Green building; retirement village; aging population, case study, Australia

**Paper type**:

Case study

## INTRODUCTION

The construction of sustainable buildings[1] in Australia has increased due to the fact of depletion of natural resources and an increasingly level of awareness of sustainability issues. There is a growing demand from various stakeholders such as owners, developers, consultants, contract and public that sustainable design and construction practices are incorporated into the project with the aim to alleviate the negative environmental impacts of buildings and to improve health and productivity of occupants(Korkmaz *et al*., 2010; Green Building Council of Australia,2011).

Meanwhile, with an ageing population in Australia, the demand for retirement villages is growing. As a viable accommodation option, the retirement village has been widely accepted to promote and enhance independence, choice and quality of life for older people (Gardner *et al*., 2005; Croucher, 2006; Bernard *et al*., 2007). The past decade has witnessed an increasing number of people moving into retirement villages in which to spend their retired life (Stimson, 2002; Retirement Village Association, 2011). Meanwhile, along with the larger number of the older people living in retirement villages, the impact on the environment of the buildings involved is also increasing. Recent research by Barker (2010) indicates that current and potential residents of retirement villages are generally very conscious of unsustainable resource consumption and would like their residences to be more environmentally friendly. Additionally, older people in general consume more energy as they spend more time in-house, making it even more important for their housing to be energy efficient in order to mitigate the impact on environment. According to the Victoria

[1] The terms ‘sustainable’ and ‘green’ are taken to be synonymous in this paper

Department of Planning and Community Development (2008), the housing for older people needs to "go green" and is an existing issue which needs addressing. With the first Australian baby boomers now beginning to retire (Humpel *et al*., 2009) along with the widespread acceptance of the green building philosophy, retirement villages are becoming a fast-growing market for green building.

Although there is an imminent need to build and increasingly populate retirement villages, providing sustainable buildings for older people poses challenges for most developers. There are several reasons for this. Firstly, older people have unique requirements, i.e., easy access, companionship, sense of belonging, healthcare support, easy operation, security, etc, which increases the difficulties involved in senior housing design. Although there is ample research literature in relation to sustainable planning, design, construction, management, and operating in the construction industry (e.g. O'Sullivan, 1988; Turrent, 2000; Loosemore, 2001; Rajendran *et al*., 2009; Korkmaz *et al*., 2010; Wu and Low, 2010), very little research has been aimed specifically at the provision of green residential retirement projects for older people. Secondly, older people generally have a reduced financial capability after their retirement, so the affordability of the sustainable building is always a concern to developers, as the cost of sustainable buildings is normally higher than the traditional ones. Thirdly, according to Bernard et al. (2007), although housing developments for older people share certain characteristics, no single model prevails. In view of this, facility planners and managers need to carefully consider project solutions that are specially tailored to older residents when delivering affordable green retirement facilities.

The research reported in this paper therefore aimed to identify critical issues to be considered by developers and practitioners when embarking on their first green residential retirement project in Australia. This involved a case study of the project development of a retirement village in South Australia which incorporated green designs for the site and floor plans, adoption of thermal efficient building materials, special window orientations, water harvesting and recycle systems, water saving fittings and appliances, and waste management during construction. Significantly, the developer managed to make the development more environmentally friendly while still being affordable and it appears that all the technologies and techniques used can be easily and affordably adapted to most new developments. Moreover, it was found that some of the environmentally friendly practices used, such as water fitting and appliances and rainwater tanks, could be even incorporated into existing developments.

## RETIREMENT VILLAGES IN AUSTRALIA AND INTERNATIONALLY

In Australia, the proportion of the population aged 65 years and over increased from 11.1% in 1990 to 13.5% in 2010 (Australia Bureau of Statistics, 2010). This is expected to increase steadily (ABS, 2010), with the population in this age group projected to be 5,093,000 in year 2026, 8,122,000 in year 2056 and more than 11,186,000 by the year 2101 (ABS, 2010). The result has been termed a "looming crisis" for Australia in how to house and care for older people (Retirement Village Association, 2011).

**Please insert Figure <1> here**

A number of housing options are available for older people, ranging from independent-living alternatives through to high-level care. Retirement villages have been widely accepted as a viable accommodation option, and are seen by a small but increasing number of retirees as a desirable and appropriate place for retired life (Stimson, 2002). According to Simpson and Cheney (2007), the development of retirement villages in western countries is a result of three social trends: the medicalization of aging, the development of positive-aging institutions, and the improved lifestyle of the contemporary customer society. This development course has involved a clear shift from healthcare-emphasized services to life-style-focused services.

Currently, approximately 5% of Australians aged 65 years and over live in retirement villages, indicating that over 150,000 Australians have chosen to live in village communities. Some Australian States already have significantly higher rates, with Western Australia and South Australia being approximately 7% and 8% respectively (Retirement Village Association and Aged and Community Services Association of NSW and ACT, 2010). According to the Retirement Village Association (RVA) statistics, more than 160,000 older Australians live in some 1850 retirement villages nationwide. This represents a significant investment – valued at $50 billion in construction costs - in addition to a significant number of resulting associated employment opportunities (RVA, 2011).

The New Zealand situation is similar to Australia. In 2004 it was estimated that approximately 5% of the population aged 65 years and over were living independent

lives in retirement villages (Grant, 2006). In the United Kingdom, although the retirement village is a comparative new form of senior housing, policy makers and providers have been enthusiastically promoting retirement villages as appropriate for older people (Office of the Deputy Prime Minister, 2003). In the USA, where the first retirement communities appeared in the 1950s (McHugh, 2003), around 7% of Americans aged 65 years and over live in retirement villages (Omoto and Aldrich, 2006). Undoubtedly, there has been an increasing acceptance of retirement villages around the world in the recent decades.

According to Lucas (2002), current retirement villages are usually situated within or on the periphery of an urban area. Stimson and McCrea (2004) also pointed out that the location of retirement villages (which enables easy access to public transportation, social activities, recreational facilities, and family etc.) is one of the reasons for older people moving into retirement villages. In addition, retirement villages provide "valuable infrastructure to local communities [so that] seniors can have effective social support, improved lifestyle, enhanced health and care along with security of tenure at no cost to government" (RVA and Aged Care Queensland, 2010, p.5).

Retirement villages can substantially enhance the quality of life for older people. Recent research (Croucher *et al*., 2003; Bernard *et al*., 2004; Gardner *et al*., 2005) has demonstrated high levels of satisfaction among residents. According to Buys (2000), older people decided to move into retirement villages mainly due to (p. 150):

1. healthcare and support,
2. low maintenance needs,
3. personal security and security of tenure,
4. the company of other older people,

5. lower costs, and
6. proximity to family (see also Stimson *et al*. 1997).

Older people generally highly "value the combination of independence and security, with the additional benefits of the support and companionship of their fellow residents" (Croucher, 2006, p.19). As a result, older people "often develop strong friendships and a sense of belonging to the retirement village community" (Cheek et al., 2007, p.9).

However, the affordability of retirement villages is the major concern of potential residents. According to Croucher (2006), a key issue for retirement villages is how to make them accessible to people with different financial circumstances. Gardner (1994) also pointed out that, for non-home owners, affordability is the primary issue preventing them from moving to a retirement village. Additionally, residents in retirement villages may have to pay higher recurring fees, which raises the issue of property and facility management involved (Earl, 2004).

All in all, therefore, retirement villages appear to have great potential in improving the quality of living for older people although the issue of affordability does need to be addressed. With the combination of an ageing population and wider acceptance of living in a retirement village, it is estimated that there will be around 7–8% Australians aged 65 years and over living in retirement villages in the next 10 years, which implies an associated significant rise in demand for the construction of new retirement communities.

## RESEARCH METHODOLOGY

Although there is a substantial demand for retirement villages in Australia, very few studies have investigated the provision of green facilities. In view of the lack of adequate historical data for quantitative analysis, a case study approach was employed to examine the successful delivery of green retirement villages. In order to identify the best practices in green retirement village development, the case study placed special emphasis on the following questions:

1. What options are available for reducing the use of natural resources in retirement villages?
2. How can green features be introduced in retirement village developments without causing cost escalation?
3. How can green retirement villages that address the unique requirements of older people (e.g. open access, security, companionship, convenience) be provided?

According to Yin (2003), a case study focuses on something unique, and the unit of analysis can be individuals, organizations, institutions, or neighbourhoods. Neale *et al*. (2006) pointed out that the case study approach helps to highlight the success or challenges presented to a project. Therefore, case studies are generally preferred for explanatory research to deal with actions traced over time rather than the statistical frequency of events (Yin, 2003). In addition, as Molenaar *et al.* (2004) point out, case studies are especially apposite in the construction management field, where researchers usually lack control over the events being studied. In short, the case study

method is eminently suitable to investigate the development of affordable green retirement villages.

This case study focused on identifying the critical issues to be considered for affordable green retirement village development. The selected project is developed by ECH Incorporated (ECH), one of largest not-for-profit providers of affordable retirement housing in South Australia. In order to ensure the validity of the results, all the interviews were conducted with senior management staff of ECH. These include: the Chief Executive Officer and the General Manager Independent Living and 3 senior project managers. They have an average of more than 20 years of experience related to retirement village development and management. These interviewees have in-depth knowledge of residential retirement developments and are responsible for the design of future ECH developments. As a result, it was expected that the developer's commitment and concerns relating to the introduction of green features into retirement villages would be fully explicated. These interviews were semi-structured, which allows the same set of questions to be used for all interviewees while facilitating interactive discussions (Waara, 2008). All questions are open-ended and each interview took around 1.5 hours. Each interview started with a brief introduction of the background of the study followed by a set of main questions such as:

- What are drivers for sustainable retirement village developments?
- What are constraints to sustainable retirement village development?
- What practices in each project phase may help to improve the sustainability and affordability of retirement village development with the consideration of unique requirements of older people?

Prompting questions were also designed to obtain the interviewees' further insights on the above main questions. Additionally, ECH provided detailed information concerning the project site, design documentation, construction materials and methods, and green technologies and appliances applied. The collected data, therefore, represent a comprehensive picture of an affordable green retirement village development. Content analysis was employed to analyse the qualitative data collected from the various sources, e.g. semi-structured interviews and project documentation review. As a typical method to identify emerging themes from the collected data, content analysis is a common approach for qualitative data analysis in built environment related studies (e.g. Singh et al., 2011; Price et al., 2011).

## CASE STUDY

### Background and context

The ECH head office is located at 174 Greenhill Road, Parkside, South Australia. It is a not-for-profit organisation providing affordable retirement living with 96 retirement villages and 1630 independent living units throughout South Australia. The number of residents in these developments varies considerably, with the smallest villages having only four residents to the largest accommodating 160 residents. Due to the diversity in the size of their projects they have a broad knowledge of retirement living. Despite being not-for-profit, ECH's stated purpose is to provide quality affordable homes and support to enrich the lives of older people. To meet its purpose, and be sustainable, ECH aims to produce villages and homes that satisfy resident demands while at the same time recovering the capital costs of the development

through sales income. Any additional income generated is invested in developing villages, improving facilities or providing additional services.

To respond to research concerning the housing aspirations and expectations of older South Australians, ECH has become interested in introducing environmentally sustainable features into its developments. When considering the provision of green retirement villages, however, the ECH senior management has received mixed messages from potential residents. These indicate that, in general, affordability is of the highest importance to residents. On the other hand, residents also indicate they would prefer to live in a more sustainable environment. Therefore, the immediate problem is to find ways to provide sustainable facilities without escalating their costs.

A site owned by ECH was planned for a retirement village with 15 units. The site has a total area of 6,754m$^2$ and is located at 180 Fosters Rd, Oakden, South Australia, with frontage to both Fosters Rd (west side) and Brookside St (Fig 2). All the existing buildings could be removed, although there were some significant obstructions in the form of three significant trees and an electrical transformer. Due to the size of the proposed site, there was plenty of flexibility from a design point of view. Throughout the entire design process, the key focus was to develop an environmentally friendly, socially conscious and affordable development which sacrificed density in order to provide amenity for the residents. The project design had been finalised and submitted to the local council for development assessment.

**Please insert Figure <2> here**

**Green commitment and concern - the developer's perspectives**

ECH was very keen to incorporate green features in the project for a variety of reasons, including environmental concern. Communications with senior management indicated clearly that the company was committed to reducing the on-going costs for residents on fixed incomes (i.e. pensions) and reducing the impact of the development on the environment. In particular, ECH were concerned about the energy consumed by their developments in general. Thus, they made efforts to reduce this in developments where they are solely responsible for the cost of energy consumption. Alternatively, they tried to ensure that the appliances which they supply for the developments are as energy efficient as possible for the independent living sites where the residents are responsible for their own energy costs. ECH was also committed to minimizing energy consumption without inflating construction costs. In particular, it was interested in learning more about solar power generation, water harvesting and the use of energy efficient appliances, in order to reduce energy costs.

A particular concern for ECH, however, was the cost of providing green facilities, with ECH senior management indicating this to be the biggest challenge involved. According to previous joint research between ECH and the University of South Australia (Barker, 2010), although nearly all the residents in retirement villages would like to have their facilities more environmentally friendly, most are concerned about the costs involved, and are reluctant to pay a higher price for an environmentally friendly home. ECH, on the other hand, were also concerned that their sales income might not be sufficient to recover their capital investment if the construction work was too costly.

A further issue is that, although ECH found a number of existing residents to be concerned with the amount of energy consumption and water re-use, the company also recognised that it is very difficult for existing residents to recycle waste or adopt significant energy saving measures simply due to the lack of provision of facilities to recycle and lack of financial capacity to pay for more energy efficient technologies. According to previous research conducted by ECH in the general community, environmental factors are of high importance to potential residents when they are considering the benefits of retirement living. As residents of retirement villages spend more hours at home, it is thought that they may be prepared to pay a higher initial cost in some cases to incorporate environmentally sustainable features in return for the future benefit of a reduced cost of energy use.

## Design

### *Design objectives*

The site was predominantly surrounded by a residential community with a large shopping centre and public transport immediately to the west of the site. According to ECH, this was ideal for a retirement village as it is important for the residents to be connected with the local community instead of potentially being isolated in large villages with everything provided on site and not near enough to public transport or other community facilities. After obtaining a better understanding of the site, the key objectives of project planning and design were determined by ECH to be to:

- provide housing specifically for older people and that meets the Federal Government's Liveable Housing Design Guidelines to a 'Platinum' level, thereby ensuring appropriate accessibility and mobility throughout all units as well as throughout the surrounding grounds;
- deliver a sustainable and environmentally friendly development to reduce the on-going costs of residents;
- provide quality heating and cooling throughout the units, including not only reverse cycle air-conditioning but also adequate orientation of the units, shading, and the use of appropriate construction materials;
- deliver an attractive external appearance that utilises low maintenance materials and incorporates drought and heat tolerant gardens;
- ensure that the residents feel safe in their units and the surrounding grounds;
- provide a quiet and peaceful environment for the residents;
- provide a community feel for the residents and help them develop friendships and a sense of belonging in the community.

A design brief was provided to the architect for a better understanding of the older people's requirements. For instance, the general description of the units of the village was that they: (1) are designed to support affordable independent living for older people to age in place; (2) are of a simple style to minimise initial costs and the costs associated with ongoing maintenance; and (3) are to meet the Federal Government's Liveable Housing Design Guidelines, preferably to a Platinum level. In terms of style, the design of the units aimed to offer a range of styles to provide the look and feel of a typical community streetscape with a diverse range of facades. It would provide

safety (injury prevention/minimisation) and a sense of security. There were generally open plan layouts to eliminate passageways but still provide privacy to bedrooms.

*Site planning*

The project was located next to Fosters Road (Figure 2), which is a major arterial road and not appropriate for a driveway access/egress (AS/NZS 2890.1.2004 Standard Parking Facilities Part 1). AS/NZ 2890.1.2004 Table 3.1 'Selection of Access Facility Category' defines access as a category 1 to 1.1 Parking Facility (residential car park of less than 25 cars). This is of a low order and, as one point of entry, was not 'excessive' or likely to 'cause grave safety issues'. The number of traffic movements to and from the site would not be increased significantly or to the level generated by the adjoining dwelling townhouses/unit developments. Furthermore, considering that older people generally have declining physical capabilities, it was not appropriate to set the driveway entrance along a major road with heavy traffic. The driveway entrance of the retirement village was therefore from Brookside Street with the entry dimensions designed to accord with the requirement to provide access for emergency vehicles. The speed limits within the residential development would be limited to 10kph as it is a shared zone and exit speeds from the site would be low, allowing the residents more than an adequate response time, as the sight lines at the entry point to the site were in excess of those prescribed in the Sight Distance Requirements at Access Driveways for a category 1 driveway providing access to a 1.1 category Parking Facility (residential car park of less than 25 cars) as defined by AS/NZ 2890.1.2004.

The design team was confronted with conflicts of density and amenity. In order to maximize the amenity for the residents, ECH limited the number of units to 15 (see Figure 3). The saved spaces were designed to be open green space for the enjoyment of residents. All the 15 units were located along the driveway, which allowed easy access to all the residents. At the centre of the retirement village, a large grassed community space was provided, which comprised a common gazebo area with a path from the centre to the edge walkway. These features helped to provide a quiet and convenient environment with a strong community feel.

**Please insert Figure <3> here**

*Unit design*

After the site planning, floor plans for individual units were developed to achieve the ultimate layout. Design changes were made (typically in relation to the orientation of windows, the size of living areas and the location of internal walls) in order to achieve a solution which minimised the amount of energy needed for heating and cooling. Each unit was positioned to take full advantage of the natural sunlight, maximise the use of north-facing windows and minimise the number of east, west and south windows. Of course, the benefit of northern windows in the Southern Hemisphere is that they receive winter sun, therefore helping to heat the unit during the winter cold weather, while most windows facing east, west or south receive little winter sun. It was also important to have south facing windows in order to provide a cool breeze in the summer. Anticipated reductions in heating and cooling costs were achieved, therefore, by optimising the orientation of windows throughout the unit.

The final floor plan was relatively open, with wide doorways and large open bathrooms – allowing easy access for residents to all areas and making heating and cooling more efficient. The floor areas of these units ranged from 118 to 126m$^2$ with larger bedrooms (16m$^2$ minimum) to allow for aged care and other services.

Much consideration was also given to what was needed to be incorporated into the yards of each unit. Most of the features were included to allow easy access for residents and deliver an environment which is aesthetically pleasing, safe, comfortable and of low maintenance demands. In the end, the following features were incorporated:

(1) Paved areas of at least 1200mm around the units to allow easy access for elderly residents;

(2) Sensor lights to light the front of each dwelling if someone approaches;

(3) An undercover veranda at the rear of each unit to provide shading and shelter for the residents;

(4) Wide doorway access;

(5) A passage width that allows for aged mobility access – a minimum of 1m;

(6) No steps between the laundry and clothesline/service area;

(7) Rain water tanks to collect roof water running off the units;

(8) A Gopher® charge station for easy and convenient charging;

(9) Day time living areas to maintain a passive view over common areas; and

(10) Wet areas to be close together.

**Construction materials and methods**

Once the design was developed, most of the materials and construction methods were selected. The first main decision to be made was in relation to the style of wall construction. Several different types of wall construction were considered, including brick veneer, reverse brick veneer and double brick. Although these wall styles have their advantages and disadvantages, ECH had considered using the double brick (DB) method for all external walls due their being cooler in summer, warmer in winter, quieter, termite resistant, and low maintenance even though the final decision had not yet been made. The main disadvantage of DB walls relates to the fact that they have the highest embodied energy of all the options available. However, the advantages in this case were taken to out-weigh the disadvantages involved.

For the internal walls, it was decided to use steel partitions. These were clad with plasterboard except in wet areas where fibre cement sheeting was used. All internal partition walls were insulated to reduce the rate of heat transfer and the intensity of sound, which should produce an energy efficient and quiet environment. Although all units used the same core materials, individual appearances were achieved through the use of feature brickwork, rendering as well as different colour schemes.

With the establishment of external and internal walling methods it was then decided that a steel framed Colorbond® roof would be used, primarily because it is both easy to construct and virtually maintenance free. Sisalation® with high R value (in terms of thermal consistence) insulation was added in order to deliver a more thermally

efficient roof. Large eaves would be used to provide shading for windows and walls and in order to reduce heat gain.

As a complement to the DB wall, double glazed windows (DGW) were used to minimise heat loss in the winter and heat gain in the summer. They also offer an excellent sound barrier that significantly reduces the ingress of external noise. These complement the DB walls to provide an extremely efficient external wall. Although these windows are more expensive than traditional single plane windows, they reduce heating and cooling costs. UPVC window frames were also used due to their excellent thermal efficiency and low maintenance cost.

All windows were fitted with locks to ensure adequate security. In addition to the locks, all windows were to be fitted with roller shutters for both security and the increased thermal performance. All units also had a garage fitted with an automatic roller door for simplicity and security. It was also proposed that each unit would have a storage area and a work bench within the garage.

**Hot water system**

Solar, gas and electric options were all considered for the hot water system. Electric hot water was not seriously considered as it produces the most $CO_2$ omissions and is therefore regarded as unsuitable for the environment. Another option was to select an instantaneous gas hot water system as it has a good life span and emits the second lowest amount of $CO_2$ emission after the solar option. However ECH did not intend to have gas supply to the site due to the cost of supplying gas to the site and each unit.

Finally, ECH was intending to use solar hot water systems and solar energy systems, which are excellent from an environmental point of view but still financially acceptable.

**Water saving approaches**

In order to reduce water consumption, water saving fixtures, including tap ware, toilets and showerheads were adopted in all the units. These fixtures are simple-to-use, making them ideal for older people and large savings could be made by using them. For example, most traditional toilets use 13 litres of water to flush, while the new water saving versions use 4.5 litres for a full flush and 3 litres for a half flush. Additionally, large holding tanks were installed in the underground space of the community to harvest the overflow from the rain water tanks and storm water running off from the development. The water collected could be used for watering the common park area and associated gardens. As one of the simplest but best environmentally friendly techniques, this system drastically reduced the water usage of the development. Figure 4 illustrates how the system operates.

**Please insert Figure <4> here**

**Construction waste management**

In addition to the green design, building materials, construction methods, appliances and fittings, special consideration was given to the waste generated during the construction stage. Multiple bins were provided for both waste and recycling. It was

also considered to be important that subcontractors were educated on the use of the recycling bins on site to ensure their proper utilisation. When choosing subcontractors, only those that could provide environment impact and management plans were contracted.

## DISCUSSION

According to developer's estimate, the green features discussed above account for 5.7% of total cost, including building cost, land cost and infrastructure cost. This estimate, provided by the Real Estate Institute of South Australia (REISA) (www.reisa.com.au), was made based on the median house price of the surrounding suburbs. As a peak professional body for real estate professionals in South Australia, REISA publishes a quarterly market update which includes the median price, number of houses sold, median changes, etc. However, the expected market price for each unit was still comparatively lower than the median house price of the local suburbs. This was partially due to the not-for-profit nature of the developer where a lower margin is built into the development and the capital costs are recovered over a longer period of time. This helps to enhance the affordability of retirement villages as the residents of ECH are most likely relying on their pensions for living expenses.

This retirement village design adopted an abundance of technology, materials, and environmentally sustainable practices that can be effectively applied to housing developments. During the site planning and design stage in particular, the practices of green infrastructure have been adopted to address the ecological and social impacts of the development of retirement villages. Green infrastructure is "an interconnected

network of green space that conserves natural ecosystem values and functions and provides associated benefits to human populations" (Randolph 2004, p. 98). According to Kim and Kaplan (2004), the natural features and open spaces affect the residents' perception of the community and how they interact with other local residents. More importantly, green infrastructure provides physical and psychological health benefits to surrounding residents (Tzoulas et al., 2007). For the site planning and unit design of the project, green infrastructure practices, i.e. traffic control, open green spaces, rainwater collection etc., will help improve the health conditions of both the ecosystem and residents.

It is interesting to find that the environmentally sustainable technologies and solutions adopted did not result in significant escalated costs for the developers or residents. Furthermore, from the developer's point of view, it should also be possible for the energy saving potential in the long-term to be used to obtain a higher sales price for the units.

The green features that have been incorporated into the development not only made the retirement village more environmentally friendly but also addressed the special requirements of older people. For example, site/unit orientation design is of extreme importance in reducing heating and cooling costs, and also creates a quiet, secure and content community for the residents. The selection of sustainable construction materials should result in lower energy consumption during the life-cycle of the building and reduce noise and temperature changes. Water recycling/harvesting systems, energy saving appliances and fittings were installed not only for their efficiency of energy saving but also for their ease of operation. Table 1 summarises

these green features and related energy and cost savings involved. 'Additional cost related' is defined as the increase of the initial investment or the operation and maintenance costs for one specific application. This list provides a useful reference to developers during the decision making process. It is worth noting that this is not an exhaustive list of sustainable practices needed to respond to unique requirements of aged people. The exercise also needs to be carried out in each individual retirement village project to identify other green practices that can be adopted for achieving affordable and sustainable retirement facilities.

Table 1 Summary of best green practices in retirement village developments

| **Aged requirements** | **Best green practice** | **Additional cost related** |
|---|---|---|
| Easy access | Wide doorway access | No |
| | Open floor plan (wide doors, open toilet, etc ) to reach Federal Govt Liveable Housing Guidelines Platinum level adds approximately $10m^2$ to each unit | Yes |
| | Larger bedroom to allow aged care and other services | No |
| | Wide passage for aged mobility access | No |
| | Paved areas around the units – wider 1200mm pathways | Yes |
| Community belongingness | Location of units (having a view of the central area) | Yes |
| | Common gazebo area in the centre | No |
| Quietness | Unit location (using existing housing as a noise buffer) | No |
| | Double brick wall | Yes |
| | Steel partitions clad with insulated plasterboard | Yes |
| | Double glazed window fitted with roller shutters | Yes |
| Safety | Location of the village (part of the local community) | No |
| | Avoid having a main entrance from a main road | No |
| | Location of units (all units to have the view of the central area) | Yes |
| | Sensor lights in the front of the units | No |
| | All windows fitted with locks and roller shutters | Yes |
| | Speed limit within the village | No |
| Easy operation | A Gopher charge station for easy and convenient charging | Yes |

| | | |
|---|---|---|
| | Easy-to-use tap ware, toilets and showerheads | No |
| Energy efficiency | Unit position to take full advantage of sunlight | Yes |
| | Orientation of windows, location of walls, etc. | No |
| | Undercover veranda at the rear of each unit | No |
| | Double brick wall | Yes |
| | Steel partitions clad with insulated plasterboard | Yes |
| | Double glazed window with UPVC frames and roller shutters | Yes |
| | Gas hot water system | No |
| | Water-saving fixtures (tap ware, toilets and showerheads etc.) | No |
| | Rain water harvesting and recycle system | Yes |

Finally, it needs to be emphasised that, when introducing green features, the related costs are always a major concern for the developer. For example, during the planning stage of the development, one of the key areas given consideration was the gas hot water system. However, the supply cost of gas was too expensive and the developer finally chose solar HWS and solar energy systems as they are almost completely maintenance free once installed. During the village development, even though some green innovations may have resulted in reduced costs in the long-term, an escalating higher initial cost often intimidates potential developers and owners. This is particularly the case in retirement village developments as residents normally spend some 12 years in the property. However, for future larger projects or similar developments for residents with a higher financial capability, some green features may well turn out to be a viable proposition.

## CONCLUSIONS

The environmentally friendly features that were incorporated into this development mainly include green design for the site and floor plan, adoption of thermal efficient

building materials (e.g. DB walls, double glazed windows and High R value insulation for the ceiling), window orientation, water harvesting and recycle systems, water saving fittings and appliances, and waste management during construction. Despite concerns to the contrary, the developer managed to do all this and the units still remain relatively affordable. Although the project in this case study had its own uniqueness, the result illustrates how retirement living can become more environmentally friendly in the future. All the technologies and techniques used in this case study can be easily and affordably adapted to new developments. Moreover, some of these environmentally friendly practices (e.g. water fitting and appliances, rainwater tanks) can even be incorporated into existing developments.

It was also revealed that, although the long-term project cost of green retirement residences is lower than traditional ones, the increased initial costs involved is the major concern for developers when incorporating environmentally friendly technologies into retirement residential developments. That the case study was affordable is a great encouragement for the future. Affordability was relevant to the area and the price paid for land in a high socio-economic region. Where this is not possible, however, government intervention in form of mandatory regulations and standards are needed for sustainable technologies such as solar power, water recycling and the use of environmentally sustainable materials. This would make housing less affordable particularly in lower socio economic areas. Alternatively, government rebates for the use of these technologies may be necessary to encourage green development that is affordable.

The research findings provide practical implications for project developers. Firstly, it is necessary for environmental sustainability to be taken into account during all project stages. Considerations made in the planning, design, tender, and construction stages provide developers with the foundation for determining what needs to be incorporated, a workforce that is capable of achieving the desired outcome and to manage and monitor the successfulness of the techniques and technologies. Secondly, that a green retirement village can significantly reduce energy bills for the residents in the long run, without extra initial costs, may be used as a selling point for developers.

The major limitation of this study results from the lack of precise data to quantify the benefits and costs associated with the sustainability measures adopted. The overall cost of the development is based on the developer's estimation rather than the real costs involved. Additionally, there is a lack of information indicating the extent to which increases would be acceptable to potential residents. Future research would benefit from a better understanding of the consumers' willingness to pay for the sustainable features and quantification of the actual associated benefits and costs involved. In addition, case studies in other locations would enable local and international comparisons to be made.

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