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Entry

Environmental Design for People Living with Dementia

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Definition: The term ‘environmental design for dementia’ relates to both the process and outcomes of designing to support or improve cognitive accessibility in physical environments. Environmental design for dementia is evidenced as an effective nonpharmacological intervention for treatment of the symptoms of dementia and is associated with higher levels of independence and wellbeing for people living with a variety of age-related cognitive, physical, and sensory impairments. Evidence-based dementia design principles have been established as a means of supporting both the design and evaluation of environmental design for dementia.

Keywords: cognitive access; dementia design; environmental design; independence; therapeutic environment; evidence-based design; assessment tools; supportive built environment



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1. Introduction

1.1. Background

Dementia is a widely misunderstood condition, leading to widespread stereotyping, stigmatisation, and mistreatment of people who live with it. Accordingly, before discussing environmental design for dementia, it is important to develop an understanding of dementia, how it manifests, and how this, in turn, impacts the abilities and experiences of people living with dementia.

1.1.1. Dementia

Dementia is a collective term for a range of symptoms that are caused by disorders affecting the brain and have impacts on memory, emotion, behaviour, and thinking. The most common type of dementia, Alzheimer’s disease, represents around two-thirds of diagnoses [1,2]. Other common types include frontotemporal, vascular, and Lewy body dementias. While dementia is most associated with a loss of memory, this is only one of many potential cognitive impairments that a person living with dementia can experience. Dementia can also affect mood, sensory perception, language, learning, problem-solving, and more based on the type of dementia, the specific affected areas of the brain, and the relative stage of disease progression being experienced. Accordingly, social and environmental support needs can vary widely from one individual to the next. More than 55 million people worldwide are now estimated to be living with dementia [2]. This figure is forecast to reach 152.8 million by 2050, with the largest increases expected in developing countries [3].

Dementia is not considered to be a normal process of ageing [4], and an increasing number of younger people under the age of 65 are being diagnosed with ‘early onset’ dementia [5]. Nonetheless, the incidence of dementia increases with age. In the US, for example, the incidence of dementia among people aged 70 to 74 years is around 3%, but the incidence rises to around 22% among those aged 85 to 89 years [6].

1.1.2. Misinformation, Language, and Stigma

Despite strong evidence to the contrary, a common misconception remains that people living with dementia lack the ability to live independently [7]. This, in turn, fuels the incorrect assumption that a diagnosis of dementia automatically results in the need for admission to residential care. This lack of awareness is also pervasive among health and care professionals, as indicated in a 2021 report suggesting that 33% of clinicians think of the diagnosis of dementia as a futile exercise, since they hold the belief that nothing can be done for the person [8].

The words used in reference to people living with dementia, such as ‘sufferers’, ‘senile’, or ‘demented’, have impacted how dementia is perceived. Not only can this type of language have a dehumanising effect on individuals living with dementia, but it can also add to stigma, contribute to fear of the condition, reinforce outdated stereotypes, and affect how people living with the condition are treated in the community.

Stigma is still identified as a major barrier to diagnosis by 46% of people living with dementia and their carers [9]. Dementia advocates believe this will change over time through community awareness and education, increasing recognition of the rights and experiences of individuals living with the condition, as well as changes in language. This is most notable in the evolution of terminology for describing the ‘behavioural and psychological symptoms of dementia’ (BPSD) [10]. Where ‘behavioural disturbances’ were once deemed to be direct and independent symptoms of dementia itself, they have come to be better understood as emotional or physical ‘expressions of unmet needs’ or ‘needs-driven behaviour’ [11]. They can also be thought of as a distressed reaction by the individual to an experience of a diminished sense of ‘choice and control’ over environmental conditions [12]. Accordingly, terms such as ‘challenging behaviour’ and ‘behaviours of concern’ are gradually being discouraged in favour of more informed and respectful terms, such as ‘changed behaviour’ or ‘responsive behaviour’ [13,14].

Consistent evidence from across the globe indicates that 61–70% of people living with dementia can remain living at home in their community when provided with appropriate practical and social support [15,16]. Many people living with dementia remain active, often taking on paid or voluntary roles in community organisations within their communities. Some even find new careers working as authors, researchers, or dementia rights advocates. Well-known examples in this area include Agnes Houston and Wendy Mitchell in the UK, Helen Rochford-Brennan and Stephen Kennedy in Ireland, Tomofumi Tano in Japan, Christine Thelker in Canada, and Kris McElroy in the US. An especially notable example is Kate Swaffer, an Australian who was diagnosed with younger-onset dementia just before her 50th birthday. She was advised after her diagnosis in 2008 that she needed to ‘give up work, give up study and go home and live for the time’ she had left [17]. Instead, Swaffer completed bachelor’s and master’s degrees and, in 2014, founded an international organisation, Dementia Alliance International (DAI), which gives a global voice to people living with dementia, demanding respect and inclusion for them. She remained chairperson of the DAI until 2022.

1.1.3. Environment and Wellbeing with Dementia

The traditional biomedical approach to health, with its focus on disease diagnosis and the amelioration of objective symptoms of physical and mental illness, has been criticised for largely ignoring the roles of the physical and social environments in supporting or undermining wellness [18]. In 2003, the Alzheimer’s Health Organisation (WHO) identified a multitude of nonbiomedical contributors to wellbeing, which they referred to collectively as ‘social determinants of health’ [19]. These contributing factors include social inclusion, discrimination, equitability in access to services and amenities, and the physical environment, including living conditions.

Huber et al. expanded part of this towards a dynamic understanding of social health, which was characterised by three dimensions: the ability to fulfil one’s obligations and potential, the ability to manage life with a certain degree of independence, and the ability

to participate socially [20]. Under the notion of social health, a state of wellbeing can be achieved when people living with dementia are able to actualise opportunities to maintain or reclaim some of their abilities and make adaptations to their limitations [21].

The built environment has a significant impact on the independence and wellbeing of people living with dementia. It affects their behaviour, affective responses, and ability to engage in both basic activities of daily living (ADLs) and instrumental activities of daily living (IADLs) [22], whereas unsupportive or poorly designed physical environments can be a contributory cause of unwanted responsive behaviours, anxiety, agitation, and spatial disorientation [23]. Well-designed environments can provide affordances that allow the individual to remain at ease, optimising independence and compensating for physical, sensory, or cognitive impairments [24].

The experience of dementia and its associated cognitive challenges can be different from one individual to the next, meaning that the cognitive prosthesis or support required from the environment will differ from one person to the next. While it is important that the design of the built environment can respond to and support individuals' specific needs, the application of broad evidence-based dementia design principles remains important due to their known universal benefits across a wide range of cognitive, physical, and sensory impairments.

The potential complexity of environmental design for dementia is further highlighted when we consider that people living with dementia are also more likely to experience a wide range of physical and sensory disabilities, such as hearing impairment, mobility impairment, and visuospatial perception issues [25]. This overlap of different impairments can further undermine the person's ability to understand and then navigate their social and physical environments, compounding any barriers to autonomy. Designing for people living with dementia therefore requires architects and others to possess the knowledge and skills to design for all three types of impairment: cognitive, sensory, and physical.

In a care setting, a close relationship between the design of the environment and its operation is essential. A focus on person-centred care [26,27], for example, aligns well with the notion of creating supportive and therapeutic physical environments. This signifies a shift from task-oriented care concerned with symptoms and disability to a support-based approach that emphasises the capacities, preferences, and potential of the whole person [28].

The built environment plays supportive and therapeutic roles in supporting people living with dementia [29,30]. Such an interactive relationship acknowledges diverse lived experiences and sensory perceptions of space and place according to a person-centred understanding of the environment [31]. This person-centred approach to design also needs to address the diversity of roles, identities, and life experiences of different people coming from different cultures [32]. Culture serves as a therapeutic resource in caring for people living with dementia, in which sensitivity to different cultural environments is heightened [33]. Culturally appropriate interiors and outdoor spaces correlate with individual identities, personal experiences, and traditional practices, which are embedded in cultural contexts [34].

There is a significant, helpful cross-over between the principles of design for people living with dementia and other key movements in accessible environments, universal design, and salutogenesis. Universal design recognises that people have changing needs at different stages in their lives. It proposes the creation of environments that can be adapted and changed by factoring in design features that enhance quality of life [35]. Salutogenesis is an approach that focuses on motivation, strengths, and assets, to maintain and improve the movement towards health. It centres on creating a sense of coherence, which has three components: comprehensibility, manageability, and meaningfulness [36].

All three approaches build upon the moral and philosophical basis of the long-established disability rights movement, which, with the support of the United Nations, has led to widespread legislative grounds on the need to ensure equality in the provision of access to environments, goods, and services for people living with disability [37,38].

However, despite the addition of dementia as a recognised form of disability within the UN Convention on the Rights of Persons with Disabilities (CRPD) (2006), national-level policies and legislation of individual member countries rarely acknowledge this [39].

1.2. Dementia Design Evidence Base

Several reviews of the dementia design research evidence base concur that the design of physical environments can have substantial impacts on people living with dementia [40–44]. Fleming et al. (2008 and 2010), for example, graded the reliability of preceding literature, confirming to designers that they may confidently employ ‘guiding principles’, such as providing unobtrusive safety, maximising visual access, and controlling levels of sensory stimulation [40,41]. More recently, Bowes and Dawson (2019) organised their assessment and discussion of the evidence base with respect to designing for specific uses of the environment (e.g., mealtimes and eating), room types (e.g., bathrooms), and building types (e.g., hospitals) [42]. Although they identified several specific gaps in the evidence base for various environment types beyond long term residential care settings, they concluded by stressing the need for designers to cater for a wide range of individual needs among occupants living with dementia. The *World Alzheimer Report 2020 (WAR 2020)* included a number of accessibly written literature reviews that are organised according to a set of dementia design principles [45]. They include, among others, a review of dementia design in residential aged care by Harrison and Fleming (2020) and a review focusing on home modifications for dementia by Osborne (2020) [46,47].

Building on the research evidence base, many authors have published lists of dementia design principles. Some notable examples include frameworks by Cohen and Weisman (1991), Calkins (1998), Judd et al. (1998), Marshall (1998), Regnier (2002), Marcus and Sach (2014), Grey et al. (2015), and Halsall and MacDonald (2015) [35,48–54]. However, the most sustained development and testing of dementia design principles over the past 35 years has been undertaken by Fleming, Bennett, and colleagues. Fleming and Bowles (1987) proposed eight design principles [55]. Bennett (2000), then Fleming, Forbes, and Bennett (2003) added further design principles [56,57]. These principles were further developed and refined over the next decade to become the Fleming and Bennett principles listed below [58]. Under Fleming and Bennett’s principles, environmental design for dementia should:

1. Unobtrusively reduce risks;
2. Provide a human scale;
3. Allow people to see and be seen;
4. Reduce unhelpful stimulation;
5. Optimise helpful stimulation;
6. Support movement and engagement;
7. Create a familiar place;
8. Provide a variety of places to be alone or with others;
9. Link to the community;
10. Design in response to a vision for way of life [58] pp. 32–33.

In *WAR 2020*, Bennett et al. evaluated, summarised, and mapped 15 different sets of dementia design principles against the ten Fleming and Bennett Principles (Table 6, pp. 41–44) [58]. Bennett et al. concluded that although other authors had approached the topic in a variety of ways with varying terminology, they had been consistent in their aim of providing a framework that would allow designers to respond to various needs, lifestyles, preferences, and socioeconomic and cultural backgrounds of occupants whilst taking local geography and climate into account. This exercise also showed that the Fleming and Bennett Principles encompassed the full combined range of design considerations covered by other sets of dementia design principles [58].

Since their earliest emergence, Fleming and Bennett’s principles have been used by state and national-level organisations to inform and evaluate environmental design for dementia in hospital and residential aged care settings [55,57]. For example, they are currently used by the Australian Aged Care Quality and Safety Commission to guide

environmental assessments as part of their federal role in regulating quality aged care. The Fleming–Bennett principles form the foundation of a range of ‘Environmental Audit Tools’ (EAT) [55,56], which are now in use worldwide.

2. Applications

2.1. Applying Evidence-Based Dementia Design

As noted previously, there is a broad consensus about what constitutes a well-designed and supportive environment for people living with dementia, but there are a variety of terms, concepts, and ideas involved. As such, the applicability of design knowledge may be compromised, and conversations may be at cross purposes.

Goals, Principles, Approaches, and Responses: Untangling Design Terminology

Bennett proposed a four-part schema that provides a way to untangle design terminology [58]. According to this schema, the four main domains of designing for people living with dementia are goals, principles, approaches, and responses. Each domain corresponds to other domains at increasing levels of detail and specificity.

- *Goals* are a higher-order, societal- or civilisation-level domain. A goal could, for example, be to ‘respond to the UN Convention on the Rights of Persons with Disabilities by providing dignity and autonomy’ [39]. In a specific project context, a key question that can be used to identify the goal(s) could be, ‘Why are we doing this project?’ The goal that arises from this could be to ‘Provide a place where people living with dementia can continue to live with respect and be valued’.
- *Principles* guide a design. They do not stipulate how a design should be realised, but highlight what has to be achieved through design to provide an enabling environment for people living with dementia. Principles allow for a variety of approaches, and responses that are context-specific. The principle ‘Allow people to see and be seen’, for example, can be achieved in a multitude of ways. The schema places design principles at the heart of design practice. Principles are applied in response to the goals, and say something about what is needed to create environments that meet these goals.
- *Approaches* do not provide design details, but instead indicate areas that need to be considered when applying design principles. When responding to the principle ‘Allow people to see and be seen’, the approach to the design of the layout of the building, the placement of walls, and the extent of their permeability will be important. The approach to accessing the outdoors, the design of outdoor spaces, the design of the building edge, and the design of the building interface will also be influenced by the application of this principle. Approaches offer a design direction and identify key areas that need to be considered in design responses.
- *Responses* are detailed design solutions that respond to specific client and project contexts and individual needs. They respond to design principles and approaches. In an aged care setting, for example, the design of a window will be important if the design of the building interface is to successfully respond to the principle of ‘Allow people to see and be seen’. The shape and location of windows need to take into account the layout and features of the internal and external environments. The height of a window sill needs to be determined according to whether the person is lying down, sitting, or standing.

The relationship between each domain is dynamic, with an increasing level of detail and specificity. Each domain relates to the domains that precede and follow it. Goals, for example, are important at every stage of the design process, not just the beginning. As approaches and responses are identified, it is vital that goals are referenced to ensure that the vision for the project is not lost. This relationship is illustrated in Figure 1. The schema enables people living with dementia to inform and influence design at different levels, whether it be through goals or specific design responses that reflect their lived experiences.

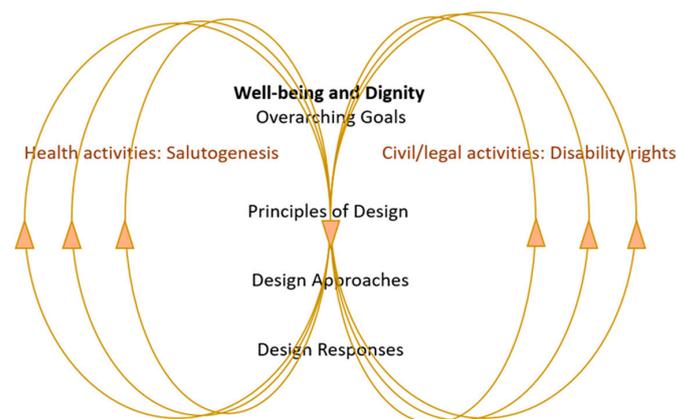


Figure 1. Overarching goals, principles, approaches, and responses to well-being and dignity. Adapted from the WAR 2020 [58].

Figure 2 shows how the schema can work in practice. Here are two examples of places to sit: one inside (left [59]) and one outside (right [60]). In both cases, the goal is to provide equality in opportunity, dignity, autonomy, choice, and independence. One of the principles that needs to be applied to achieve these goals is to ‘Create a familiar place’. An approach that responds to this principle is to create a homelike environment. In this example, it is the design responses that are very different, as they consider people’s specific contexts and cultures. As a result, in one setting, people sit indoors at a table or in an easy chair looking out of the window, whilst in another setting, people sit outdoors on ground with good sand located under a structure with shade.



Figure 2. Homelike environments in different settings, adapted from the *WAR Volume 2* ((left), [59] and (right) [60]).

A well-planned and supportive environment is important for people living with dementia to live well. The use of this schema will:

- support a conversation that uses a common language to begin with goals and principles instead of solutions (which are often not relevant or transferable);
- provide a consistent framework for conversations and allow knowledge gained over many years to be embraced;
- enable context and culture to be taken into account in any specific design response during design principle application;
- facilitate the application of knowledge obtained in well-resourced countries to less-resourced situations; and
- encourage people living with dementia to be included in all aspects of the design process rather than simply at a project level.

2.2. Designing Environments and Assessment Tools for People Living with Dementia

The importance of designing for people living with dementia in all environments has been increasingly recognised, rather than merely focusing on formal care settings. Most people living with dementia live at home in their local community. They go to shops, theatres, and parks and make use of public transport. Given the appropriate social and environmental support, people living with dementia can be active participants in society. Similarly, given the right conditions, they can self-advocate and participate in design processes, offering a valuable contribution to decision-making about the environments in which they live [61–64].

Assessment tools play an important role in enhancing the quality of environments for people living with dementia. They should preferably be used as a means to prompt discussion and understanding of design principles and how they may be applied and are therefore useful for raising awareness or as an information resource on dementia design principles for design professionals, policy makers, and advocates alike. In many cases, they are used as a means of carrying out a systematic evaluation of existing environments with the objective of identifying areas for potential design improvement. However, some of their greatest potential lies in their use to support discussion and evaluation of design proposals for new environments, where significant improvements in dementia design quality may be possible.

Dementia design evaluation tools now exist for various specific environment types (care homes [65–68], hospitals [69], and private homes [70]), while other tools can assess more than one type of environment. Examples include the Dementia-Friendly Community-Environmental Assessment Tool (DFC-EAT) which can be used for a range of common public spaces such as cafés, shops, or community centres, while the Environments for Ageing and Dementia Design Assessment Tool (EADDAT) covers up to 30 environment types [71,72].

Several assessment tools have been developed around Bennett and Fleming’s dementia design principles [49]. These tools are designed to focus on the design principle rather than the design approach or response (refer to Section 2.1). The questions are focused on high-level issues rather than details, such as the design of a door handle. Several of these tools have been independently validated and are suitable for use by non-design professionals, facility staff members, or visitors to an environment [73,74]. The three key versions are as follows:

- The Environmental Assessment Tool-Higher Care (EAT-HC) for the review of environments for mobile and less mobile people living with dementia and the identification of improvement areas [75];
- The Environmental Assessment Tool-Acute Care (EAT-AC) for use in acute health care settings to cater for patients staying for a week [76];
- The Dementia Friendly Community-Environmental Assessment Tool (DFC-EAT) for use in public and commercial buildings, such as shops, banks, libraries, and medical facilities [77].

Although the EAT was developed primarily in Australia, it has been adapted by others for use in other countries and cultures, including Germany [78], Singapore [79], and Japan [80]. One version, Plan-EAT, was especially adapted for evaluating dementia design quality in building layout planning in residential aged care settings [81].

It is crucial to be aware that using the assessment tool is not aimed at obtaining a specific score. There are always areas for improvement without a perfect design. The objective of these tools is to offer a systematic framework for the review of an environment and the identification of areas for further enhancement. Some questions in an assessment tool will not be applicable to a particular setting. It is important to recognise that these ‘not applicable’ questions present an opportunity for a conversation about the relevance of, and the need for, the item that is not applicable.

The questions in assessment tools should not be seen as a list of universally applicable rules. Instead, they should be interpreted based on specific circumstances. The geographic

location, site characteristics, and climatic condition, as well as the culture, lifestyle, and socioeconomic background of the users, are merely some factors that should influence the responses. There will be different applications to address diverse needs in various settings. Bennett's proposed schema (per Section 2.1) offers a practical means of applying design principles in a way that considers physical and social context whilst focusing on the needs and priorities of occupants living with dementia.

2.3. Environmental Types

As noted in Section 2.2, the need to design for people living with dementia in all types of environments has been increasingly recognised. Some positive examples of different environment types are described below.

2.3.1. Dementia Friendly Community

Both the physical and social environments play important roles in dementia friendly communities. Since they tend to emerge from localised grassroots movements, they can manifest in a variety of ways. However, they tend to revolve around two key objectives, which are (1) to be inclusive to reduce stigma and enhance better understanding of dementia; and (2) to empower people living with dementia to feel respected and to make decisions about their lives [82]. The key design principles are to reduce risks unobtrusively and support movement and engagement to align with the vision for way of life. These objectives and principles enable people living with dementia to recognise their rights and capabilities and facilitate meaningful social interactions with others to arouse public awareness.

Bruges, in Belgium, has been recognised as one of the European leaders in the dementia-friendly communities movement (Figure 3) [83]. In Bruges, Foton is a charity that is dedicated to the promotion of dementia support, care, and awareness. Funded by the city council and voluntary donations, Foton coordinated the project "Working together towards a dementia friendly Bruges", involving various stakeholders, such as businesses, communities, and the local government [84]. A whole-society approach was adopted to strive for shared goals and foster community collaboration through multidisciplinary and cross-sectoral partnerships [85].

Various initiatives have been implemented in Bruges under the coordination of Foton. More than 90 shops display a logo of a knotted red handkerchief to signify that the staff have a high level of awareness about dementia and can provide compassionate assistance to those in need [86]. The Foton choir, composed of members living with dementia, has been actively participating at the Bruges' Music for Life Festival through live performances. A database has been set up to identify residents who are prone to wandering and to provide necessary assistance with wayfinding and navigation for those in need [87].



Figure 3. Bruges, Belgium (adapted from [88]).

2.3.2. Outdoor Public Space

Outdoor public spaces are a vital part of any community. If they are to be truly used by all members of the public, they need to be designed to meet the needs of people living with dementia. The Therapeutic Garden at HortPark, which opened in 2016, is the first of its kind in Singapore. The overarching goal is to enhance the wellbeing of visitors, including people living with dementia and poststroke patients. The key design principles are to reduce risks unobtrusively, support movement and engagement, reduce unhelpful stimulation and optimise helpful stimulation, and offer various places to stay alone or to interact with others to align with the vision for the way of life. The approaches are the enhancement of the physical and mental health and wellbeing of visitors through horticulture therapy and their involvement in therapeutic horticulture programmes [89,90].

The Therapeutic Garden has a clear and simple layout with a looped circulation path without confusing dead ends and is enclosed with planting beds to provide safety and separation. The garden comprises a passive restorative zone and an active activity zone. The restorative zone offers respite and a holistic rehabilitative environment for strolling and seating, with pavilions and benches scattered across the garden as vantage points. Large shady trees and various types of plants with different colours, textures, and fragrances provide shading against strong sunlight and an attractive landscape with sensory stimulation.

The activity zone has exercise equipment and provides space for conducting therapeutic programmes and horticultural activities (Figure 4). Moveable and raised planter beds with easily accessible water sources facilitate wheelchair users and people living with dementia to participate in typical garden tasks, such as watering, weeding, and harvesting [91].



Figure 4. Therapeutic garden at HortPark, Singapore (adapted from WAR 2020 [92]).

2.3.3. Neighbourhood

Within a community, there are often a number of different neighbourhoods. The neighbourhood serves a significant role in the lives of people living with dementia, with evidenced impacts on physical, psychological, and social wellbeing [93]. Neighbourhoods can support wellbeing if they are designed to be both physically accessible and cognitively legible to enable residents, regardless of age or circumstance, to enjoy and navigate the immediate environment beyond their front doors during their whole lifetime, towards the objective of neighbourhoods for life [93]. Cessation of vehicle driving is challenging, especially for those who have been used to driving, and it is regarded as a loss of independence and a significant disruption to one's own sense of identity [94]. Transport mobility is closely associated with wellbeing and social inclusion [95]. People living with dementia may find public transport systems, particularly subway or train stations, complex with confusing layouts and signage [96]. They may also find it hard to get on the right bus, cope with the crowds of passengers on board, and be aware of which stop to get off at [97]. Compared with traditional public transport, the emergence of 'Mobility as a Service' (MaaS) provides

an alternative option. MaaS involves the collaboration of different transport providers and provides flexible, reliable, and affordable tailor-made mobility solutions for users based on their individual conditions and mobility needs [98]. If people living with dementia are still physically and socially active in their neighbourhoods and communities, the cost of caring and the burden on family members, social welfare, and healthcare systems will be reduced. The sense of isolation and the risk of retreating into domestic confinement will also be mitigated, leading to a better quality of life [99].

2.3.4. Day Care Centre

Many people living in the community will go to a day centre, either regularly or infrequently. Hawthorn House is a daycare centre located in rural Western Australia. Opened in 2014, it is the first care facility in Australia based on Dr Bill Thomas' Eden Alternative Principles. The overarching goal is to provide person-centred care to support meaningful social interactions with a sense of ownership, despite the loss of memory and progressive impairment among people living with dementia [100,101]. The key design principles are to provide a human scale, reduce risks unobtrusively, support movement and engagement, offer various places to stay alone or to interact with others, and achieve familiarity to align with the vision for way of life. The approach is to deliver a warm and familiar homelike environment for users to support autonomy, ability, and independence.

Based on the Alzheimer's WA Enabling Household model [102], Hawthorn House has two bedrooms for overnight respite and supports up to 12 people living with dementia as household members together, with different social groups visiting during the day. Compared with traditional day care centres that serve meals and provide planned activities for a large group of participants as mainly passive recipients, a person-centred approach is embraced at Hawthorn House to offer the maximum possible decision-making to household members depending on their abilities and needs [103,104]. All meals are prepared in the domestic kitchen, which welcomes various levels of engagement, from watching the food preparation process to helping with setting tables, doing dishes, and preparing food. Household members are invited to share daily chores, which promotes a feeling of usefulness among them as they are contributing to the operation of the facility and freeing up the staff to provide care services to those in need [105].

In addition to the kitchen, both dining and living areas are domestic in scale, with homely lighting, furniture, and interior design. Small-scale lounges are provided for enjoying solitude and engaging in social interactions with others, subject to their own choices (Figure 5). Visits from intergenerational community groups offer opportunities for household members to connect with others, including a mother and baby playgroup, a community choir, and a group of retired farmers [106]. Household members are encouraged to spend time in gardens with clear wayfinding paths, a men's shed, and raised vegetable planting beds for outdoor activities. They can also interact with animals by cleaning out the canaries cage, feeding the chickens, collecting the eggs, and walking and bathing the dog, allowing them to enjoy loving companionship with animals [107]. The care environment is designed and operated with a clear focus on wellbeing, enablement, and therapeutic benefits for people living with dementia.



Figure 5. Domestic style and scale of Hawthorn House (adapted from WAR 2020 [108]).

2.3.5. Residential Aged Care Facility

Residential aged care facilities play an important role in a community. The majority of people who live in residential aged care institutions are living with dementia. While many care environments are not specifically designed to meet these people's needs, there are some examples where this is the focus of the environment. De Hogeweyk is a residential facility for people living with dementia in Weesp, The Netherlands. The overarching goals of the Hogeweyk Care Concept are the de-institutionalisation of care and a person-centred approach with freedom of choice for self-fulfilment [109]. Similar to Hawthorn House, the key design principles are to provide a human scale, reduce risks unobtrusively, support movement and engagement, offer various places to stay alone or interact with others, and achieve familiarity to align with the vision for the way of life. The approach is to create a familiar environment, both indoor and outdoor, on a neighbourhood scale with various amenities to support everyday life.

To create a familiar living environment, different functions, such as restaurants, gardens, a hair salon, a pub, a grocery store, and a theatre, are provided to allow residents to live their lives as normally as possible. Staff wear casual and street clothes, rather than the uniforms worn in common care institutions. Residents are encouraged to participate in various social activities according to their personal interests to alleviate boredom and loneliness [110].

De Hogeweyk is organised into 27 small-scale households with six to seven residents per house. Households are designed and decorated to cater for seven different lifestyles: (1) urban, for those who are used to living in the city and enjoy urban life; (2) domestic with homely decor, for those who mainly stay indoors; (3) cultural, for those who are interested in the arts; (4) craft, for those from the working class; (5) Christian, for those who value church life with religious value; (6) Indonesian, decorated in traditional style with rich historical heritage; and (7) elite/wealthy people, who pay attention to etiquette, formal sitting, fine tablecloths, and tableware [111].

Each household is configured around courtyard spaces, and each of them has distinctive features to form key landmarks for wayfinding and orientation. All households are accessible to outdoor spaces to maintain a connection with external environments (Figure 6). Generous outdoor spaces with gardens, water features, alleyways, and streets allow residents to wander and explore in a stimulating manner [83]. The objective is to maximise residents' autonomy, encourage social interactions, and foster community engagement [112].



Figure 6. Courtyard and outdoor seating of De Hogeweyk, The Netherlands (adapted from WAR 2020 [113]).

3. Building and Environmental Design Considerations

People living with dementia often perceive their physical surroundings differently from people who do not live with dementia. In this way, the design or management of an environment can impose divergent psychological, social, or physical experiences of space upon its occupants [48]. Overlapping impairments may compound any negative effects where the environment fails to compensate across the necessary combination of cognitive, physical, and sensory competencies. However, while people living with physical or sensory impairments without dementia will usually be aware of their challenges and be able to articulate them, verbally or otherwise, people living with dementia may not have a conscious awareness of their impairment, not understand the causes of their discomfort, and not be able to clearly communicate their needs.

It is even more important, therefore, that any environments likely to be used by people living with dementia be created using evidence-based design and that others who use or manage these spaces understand why they have been designed in the way that they have. While the goals, principles, approaches, and responses outlined should be applied to suit each context, in the following three sections we focus on some specific considerations where attention to technical detail could help improve overall dementia design quality. These considerations include the indoor climate and thermal comfort, the indoor air quality and smells, lighting and visual comfort, indoor acoustics and noise, furniture, signage, and finishes.

3.1. Indoor Climate and Thermal Comfort

There is a need to pay extra attention to the thermal comfort of people living with dementia [104]. The established desirable ambient air temperature range for older adults is between 18 °C and 24 °C [114]. However, people living with cognitive impairment may be more sensitive to heat, cold, or temperature changes [115]. Crucially, they may be unable to verbalise their discomfort, understand the cause, or identify appropriate solutions. Hence, a lack of thermal comfort is a potential cause of agitated response behaviours among people living with dementia [116]. Where possible, then, the environment should be designed to be easy to understand, providing greater choice and control by making it easy to operate windows and heating or cooling fixtures [12,117,118].

3.2. Indoor Air Quality and Smells

Air pollution can have negative short- and long-term impacts on human health [119–121] and has even been linked to accelerated risks of developing cognitive impairment [122]. The World Health Organisation (WHO) has published guidance on safe versus unsafe concentrations and exposure times for a wide range of potentially harmful airborne toxins [123]. However, air quality monitoring tends to focus on key measurements such as carbon dioxide (CO₂), volatile organic compounds (VOCs), and particulate matter (PM) [124]. Several countries have published their own air quality indices (AQIs), though they can differ by the substances measured and health hazard levels applied to them.

Factors including poor ventilation, indoor emissions (such as VOCs from furnishings and finishes), and fuel combustion (such as burning fossil fuels for heating and cooking) often cause indoor spaces to contain higher concentrations of air pollutants than nearby outdoor spaces [124,125]. Poor air quality is therefore of greatest concern when designing or managing environments occupied by care home residents and others who tend to spend a high proportion of their time indoors.

Some people living with dementia can experience a reduced sense of smell, which can negatively impact their experience of the environment. They may not notice smells that indicate danger, such as smoke or leaking gas [126], increasing the need for (preferably unobtrusive) safety measures such as smoke detectors, gas alarms, and other environmental sensors to be installed in indoor environments [127]. The loss of olfactory sensitivity can also diminish the ability of a person living with dementia to enjoy some positive aspects of daily life. Awareness of this may be helpful when designing gardens and planting for

optimal therapeutic and experiential value [128], to optimise the role of food aromas in stimulating appetite, increasing food intake, and supporting multi-sensory wayfinding towards kitchens and dining spaces [129].

3.3. *Light for Health, Comfort, and Independence*

A lack of time spent outdoors with regular exposure to bright daylight can negatively impact wellbeing [130], including the disruption of the melatonin cycle, or circadian rhythm. Symptoms can include sleep disturbance and wandering at night and can affect mood, reaction times, cognitive ability, and agitation levels during the day, potentially increasing the burden on carers [131,132]. Therefore, residential environments should provide safe and easily accessible outdoor spaces, such as balconies, verandahs, terraces, and porches, where people living with dementia can engage in meaningful activities that provide incidental exposure to bright daylight. There is some evidence that biodynamic lighting with varying light intensities (over 1000 lx for daytime spaces) and colour temperatures (6500 K to 8000 K) aimed at mimicking daylight can be mildly effective in reducing nocturnal unrest, easing agitated behaviour, and stabilising the sleep–wake cycle [133,134].

Low illuminance levels can adversely influence visual acuity, affecting confidence in mobility and fine motor activities [135]. As older people (60 years plus) tend to need approximately three times more light to see as well as younger people (20 years), significantly higher levels of artificial illumination are recommended to support independence and safety in kitchens, bathrooms, and other spaces that host activities requiring good balance or visual acuity [136]. Indoor lighting should ideally comprise multiple fixtures per space so that lighting is evenly distributed and unhelpful shadows are minimised. For social spaces, dimmers and supplemental local lighting sources are recommended so that illuminance levels can be adjusted to avoid overstimulation from excessive lighting and accommodate a range of different types of activity within the space [126].

Bringing daylight indoors is welcome, but glare from windows should be carefully mitigated so that overall light levels are not adversely affected. Conversely, blinds or curtains that provide a black-out function can help minimise sleep disruption, thereby reinforcing the diurnal biorhythm.

3.4. *Indoor Acoustics and Sound*

People living with dementia can be especially sensitive to the soundscape around them [137]. Excess background noise can create difficulties in engaging in conversations, while the additional cognitive load created by sustained exposure to unhelpful sounds can trigger anxiety and agitation and potentially lead to reductions in sleep quality [138]. Many sound sources that cause distress to people living with dementia on a daily basis may often go unnoticed by others. Examples include appliances such as dishwashers, exhaust fans, and flushing toilets, as well as the audio output from TVs or radios.

Conversely, quieter environments can allow people living with dementia to benefit from helpful audio stimulation, including the therapeutic effects of bird song, water features, and relaxing music [139,140]. Reduced levels of background noise may also allow for clearer communication, including allowing fire alarms and other audio warnings to operate at a lower decibel range [137].

The most effective means of improving the acoustic environment revolve around addressing the sources of unhelpful sound. This can be achieved by omission (e.g., turning off unwatched TVs), reduction (e.g., selecting quieter-running appliances), or location (e.g., locating noise sources away from social spaces or sleeping quarters).

The acoustic environment can also be improved through careful design of how the environment controls sound absorption, transmission, and reverberation. Each of these factors can be modified through careful consideration of the materials and fixing methods used for internal finishes (e.g., carpets and curtains for absorption), the materials used in the construction of walls and floors (e.g., flooring underlays for transmission dampening),

and the overall sizes, shapes, and relationships between spaces (smaller room sizes have shorter reverberation times, giving better quality acoustics) [141].

3.5. Furniture, Signage, and Finishes

While furniture needs to fulfil basic physical, functional, and ergonomic needs, familiar-looking designs can also support recognition of the social function of a space as well as contribute to spatial orientation [139]. Through careful arrangement, furniture can encourage and support different kinds of social interactions, from group activities to more intimate conversations [142,143]. In residential aged care facilities, residents should be encouraged to bring some of their personal items, including photos and furniture, as this will help to personalise their rooms and make the environment feel more like home.

Well-designed environments combine multiple spatial characteristics, including visual access, views, variations in the sizes and shapes of spaces, furniture, colour, and unique objects, to provide an intuitively navigable wayfinding experience. Once these architectural methods have been exhausted, further wayfinding support can be provided through well-placed and carefully designed signage [144]. Where signage is needed, pictograms or photos should be used in addition to any text, as these have been found to be more effective spatial cues for people living with dementia, as they allow them to compensate for reduced memory, language loss, or problem-solving ability [145,146].

The materials and colours used in the environment can have a dramatic effect on the spatial perceptions of people living with dementia. Colour contrast, specifically tonal contrast, can be helpful when drawing attention to key information that helps improve confidence (e.g., if a door contrasts with the wall, it is easier to find). Conversely, tonal contrast should be minimised or avoided where it could cause confusion or a risk of harm (e.g., tonal change where flooring materials are associated with falls [147]).

High-sheen finishes should be avoided on floors where they can be perceived as water. Bold geometric patterns on flooring that cause visual misinterpretations and hallucinations should be avoided [48]. The haptic and tactile qualities of materials in the environment should also be considered. Timber handrails and furniture items can provide a natural appearance and be relatively comfortable to touch compared to metal, especially outdoors during winter or mid-summer conditions [148].

4. Conclusions

In previous times, environmental design for people living with dementia tended to be applied in only limited ways, with most of this occurring in formal care settings. The weight of established empirical evidence, the development of dementia design principles, and the variety of available case study examples combine to provide both the moral case and the practical know-how for expanding the application of dementia design to all types of physical environments. By designing for people living with dementia in a contextually sensitive manner, communities and organisations gain the opportunity to improve cognitive accessibility. This enhances human equity and supports more people living with dementia to live well in their community, with more independence, for longer.

Environmental design for dementia is most likely to be effective with the least effort if considered in the earliest stages of an environmental project. Many effective dementia design interventions can be achieved at a low cost, so they need not be dependent on available resources. The case studies presented in this encyclopaedic entry provide a limited sample of the range of physical environment types. They do, however, highlight some salient examples of how the application of key design principles, adapted to context, can underpin high-quality design outcomes in a wide range of environmental types.

It is important for architects and designers to develop their knowledge and confidence in the application of environmental design for dementia, preferably with other age-related conditions. However, this knowledge could be just as relevant to other groups, including individuals who may wish to future-proof the design of their own home or commissioners of large projects who may have greater decision-making influence on the application of

dementia design principles than the architects they employ. Those managing existing environments may have the power to make small, incremental changes to their environments. Some helpful changes can be implemented almost anywhere and can be as simple as reducing noise or visual clutter. A collection of small changes that are made across multiple environments can provide great cumulative benefit to people living with dementia, and the upgrading and modification of existing buildings to better meet the needs of people living with dementia should always be encouraged.

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