



# History and evolution of the healing gardens: Investigating the building-nature relationship in the healthcare setting

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## ARTICLE INFO

### Keywords:

Healing gardens  
Nature-building integration  
Typology  
Healthcare design  
Therapeutic effects

## ABSTRACT

Healing gardens, a longstanding feature of medical institutions, have garnered attention from scholars for their health-promoting properties across various stages of research. Through a historical literature review and contemporary case analysis of healing gardens, this research investigates how to achieve therapeutic integration by fostering effective connections between buildings and nature through typological design. Combined with qualitative and design-driven research methodologies, including the use of visualization tools such as drawings, models, and images, six models of building-nature integration in contemporary healthcare architecture are identified. This article bridges a research gap in the field of healing garden design and concludes by demonstrating that "typology" is only a design strategy according to context and building performance. In addition to positions of healing gardens, critical factors such as spatial organization, aesthetics, and sustainability, incorporating elements such as accessibility, readability, comfort, and ecological factors, must be carefully considered to achieve integration.

## 1. Introduction

In the twenty-first century, the rapid process of urbanization has led to an increase in mortality rates attributed to non-communicable diseases linked with lifestyle factors, hospitals assume a critical role as facilities for disease treatment and recovery. In this context, scholars have directed their attention toward optimizing the design of healthcare environments to enhance patient health and overall well-being. An increasing body of evidence highlights the positive effects of green spaces in healthcare, which are now commonly referred to as 'healing gardens', on patient and staff outcomes (Eckerling, 1996). In recent years, healing gardens have been utilized in various forms as green spaces attached to medical institutions to treat specific conditions such as trauma, cancer, and Alzheimer's disease (Marcus & Barnes, 1995). Studies have demonstrated that hospitals with healing gardens have psychologically healthier patients who are discharged in a shorter time (Di Sivo and Claudia, 2019). Therefore, through design strategies, healing gardens are able to establish good building-nature relationships that contribute to a comfortable environment, allowing patients and their families to enjoy the greatest possible well-being in the healthcare institution.

Throughout human history, nature has been viewed as a healer, leading to an ongoing search for the ideal landscape design to promote health and well-being. Since the late twentieth century, numerous research theories emerged regarding the "healing garden concept", offering valuable design guidance for practitioners across various disciplines, including architecture. Ulrich (1984), Velarde et al. (2007), and Bratman et al. (2012) demonstrated the positive impact of incorporating natural elements such as greenery, water features, and sunlight in healing environments. Marcus investigated the arrangement of different types of healing gardens, such as courtyards, terraces, viewing gardens, and roof gardens, and how these spaces can influence user engagement for well-being (Marcus & Barnes, 1999; Marcus, Sachs, & Ulrich, 2014). Duzenli et al. (2017), Lu et al. (2021), Scartazza et al. (2020), and Trentini et al. (2020) explored how technology and ecological features can enhance the therapeutic potential of healing gardens and their impact on patients and healthcare providers.

Moreover, architects and scholars also emphasised the design strategies to incorporate nature through connecting architectural space and greenspace. Baker (2018), in his book *Captured Landscape: Architecture and the Enclosed Garden*, established that the enclosed garden could mediate between dwelling and nature, building and landscape, and it is

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<https://doi.org/10.1016/j.ssmqr.2024.100450>

Received 12 October 2023; Received in revised form 19 April 2024; Accepted 30 May 2024

Available online 1 June 2024

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one of the keys to the longevity of this architectural expression. Jiang (2022), in her book *Nature through a Hospital Window: the Therapeutic Benefits of Landscape in Architectural Design* focused on exploring people-nature interactions through windows, transparency, and continuous transitions between indoor and outdoor environments, particularly in extensive healthcare facilities. Wagenaar et al., in their book *Hospitals: A Design Manual*, present a carefully curated selection of case studies documents general hospitals, children's hospitals, university hospitals, specialised hospitals, community hospitals, and rehabilitation clinics. They explore the design interventions through spatial arrangement and how they interact with their environment. These diverse scholarly works collectively enrich the understanding and implementation of harmonious connections between architecture and nature, mainly green space, in the built environment.

However, although these theoretical findings explain the contemporary relevance of healing gardens and demonstrate health-promoting effects through building-nature integration, most of the research outcomes still focus on the attributes of single elements, such as building facades, water, and plants, which contribute to restoration. There remains a lack of discussion concerning the integration strategies of different typologies of healing gardens within the discourse of healthcare architecture. For example, what are the design techniques for integrating healthcare buildings within the natural environment? How are the evolving paradigms of healing gardens in response to shifting hospital narratives throughout history? How do these paradigms manifest in contemporary healthcare settings?

## 2. Methodology

In light of the prevailing humanistic care approach, which prioritises individual well-being, there arises a demand for hospital designs that delve deeper into the relationship between site, landscape, and building. This necessitates the exploration of methods to enhance integration, thereby more effectively fulfilling its role in promoting health.

This research is based on the assumption that by integrating building and nature through scientific design strategies, healthcare institutions may provide individuals with a good treatment experience that contributes to therapeutic effects. By tracing the evolution of the 'healing garden', it aims to investigate the evolving dynamics of the building-nature relationship in healthcare settings, specifically focusing on the Western context, and identify the most representative integration typologies and design techniques. Then, classify contemporary practices according to different typologies of nature-building integration, by discussing the features of selected cases according to each integration typology to explore how these design techniques are applied in contemporary times under new requirements.

To gather evidence, the paper employs a qualitative approach, which involves identifying representative typologies of 'healing gardens' through a historical review spanning from antiquity and the medieval period to the twentieth century, alongside contemporary practices. The investigation is conducted through design-driven research by drawing-based tools such as photographs, drawings, and sketches, to enhance the comprehension of the relationship between building and natural surroundings focusing on spatiality, sensory perception, and sustainability. Through analysis and comparison, the study reveals the evolving dynamic integration forms between buildings and green spaces, as well as the current state-of-the-art practices in building-nature integration in response to contemporary requirements.

## 3. Historical review

### 3.1. Healing gardens in antiquity and the medieval period: Sanctuary Temple and Cloister Hospitals

The use of natural landscapes for promoting health has a rich history dating back to ancient civilizations such as the Egyptian, Greek, and

Roman periods. Among the earliest known healing sites is the Asclepiad at Epidaurus, which operated from the fourth century BCE to the sixth century CE (Fig. 1). This site, situated on a hillside plateau with panoramic views, clear water, and surrounded by greenery, was considered a sanctuary. During that era, hospitals modeled themselves after classical temples, as healing was intertwined with religious rites and rituals (Thompson & Golden, 1975). The landscape was also an integral part of the healing process, and natural spring water was used for cleansing rituals, while a library, museum, theater, marketplace, and groves of trees provided a pleasant environment with aesthetic perception for their residence.

During the medieval period, monasteries in the West emerged as crucial sites for spiritual and mental healing due to the influence of religion. Before establishing the 'germ theory', the military hospitals in Rome featured naturally lit, cross-ventilated wards which were separated from each other to prevent cross-infection and promote a healing environment (Vethanayagam & Abu-Hijleh, 2019). Thus, the monastic infirmaries' design incorporated many landscape elements to facilitate the spiritual healing process. Within the monastic cloisters, infirmaries were strategically situated adjacent to a central courtyard, allowing patients to contemplate their surroundings and establish a profound connection with the 'divine'. Additionally, the construction of monastic hospitals mandated the integration of lawn and garden spaces dedicated to providing recreational activities for patients and staff (Thommen, 2012). The complex encompassed infirmary buildings designed for patient care, featuring outward views and granting access to an internal courtyard. Moreover, at the heart of the cloistered garden, a healing fountain was prominently positioned to enhance the overall therapeutic ambiance (Fig. 2).

### 3.2. Healing gardens from the renaissance to the eighteenth century: Corridor-Based Hospitals

The rise of cities in the 13th century, first in Italy and Flanders, then elsewhere, stimulated the development of non-religious forms of healthcare. Brunelleschi's Foundling Hospital in Florence is credited with being the building that ushered in Renaissance architecture, but its Milanese counterpart is better known. The Ospedale Maggiore, designed

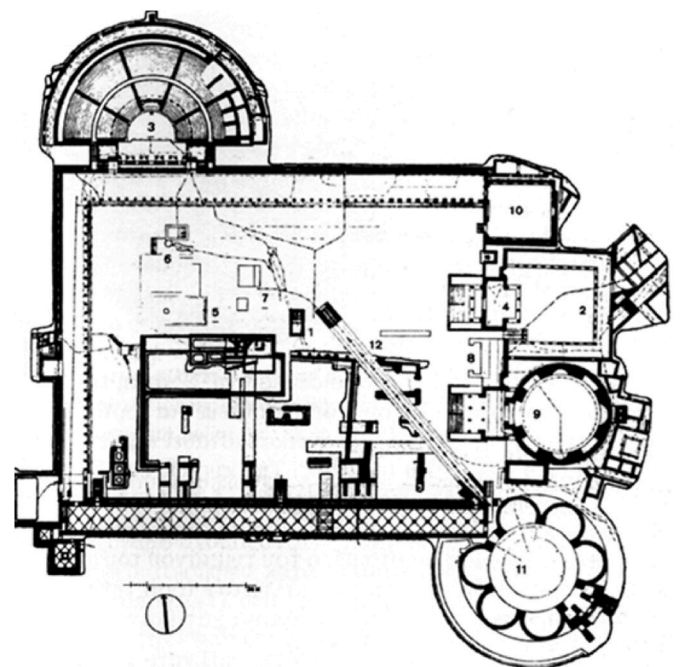
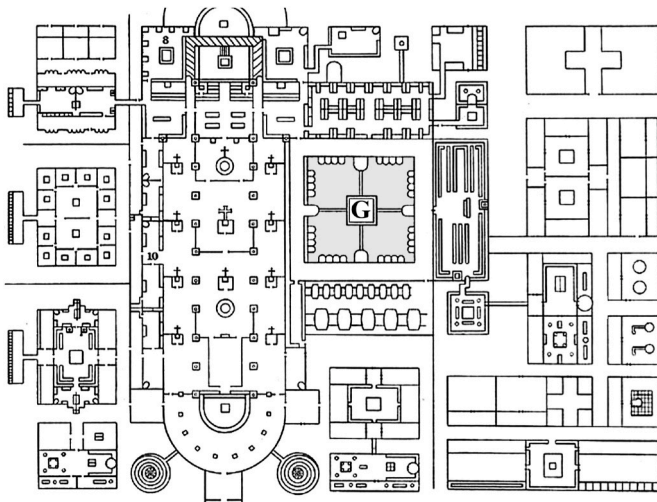


Fig. 1. Pergamon, plan of Asclepiad and sanctuary complex at Epidaurus, 5th century BC (Krug, 1993).

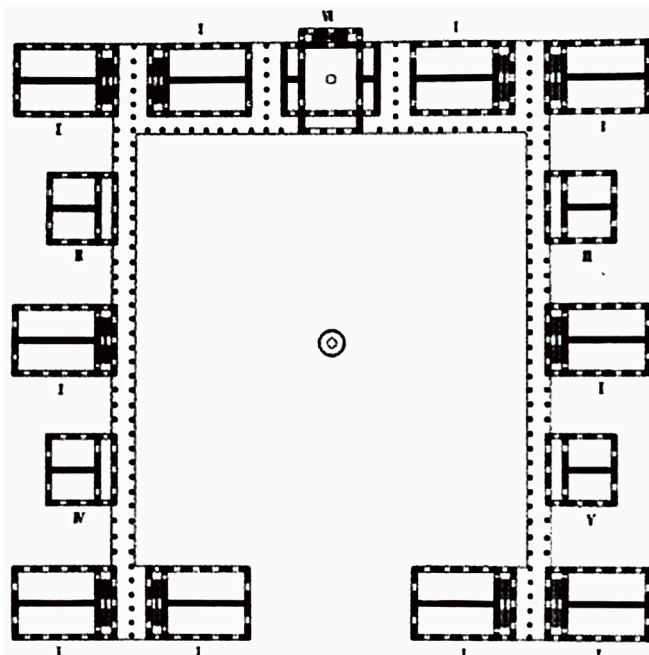




**Fig. 2.** Partial plan of the monastic gardens at St Gall, Switzerland, c.ad 820 (Farrar, 2016).

by the architect Antonio Averulino, better known as Filarete, was founded in Milan in 1456 and replaced a number of smaller structures. Although it was no more specifically designed for its function than the religious hospitals, the Ospedale Maggiore is regarded as a novelty: it was the first hospital to be structured in accordance with the geometric design principles of the Renaissance.

In the late seventeenth century and the eighteenth century, the design of hospital buildings was significantly influenced by 'military-style' hospitals with corridor-based plans (Fig. 3) (Newman, 1976). Prominent examples illustrating this approach include the Chelsea Hospital (1682), and the Greenwich Royal Naval Hospital (1694), both masterfully designed by Sir Christopher Wren, as well as the Royal Naval Hospital at Stonehouse near Plymouth, expertly crafted by Alexander Rovehead (1756–1764). At the end of the eighteenth century, rapid urbanisation and the emergence of infectious diseases due to unsanitary living conditions increased awareness of the environment's impact on



**Fig. 3.** Representative plan form of the 'military-style' hospitals with corridor-based plans. Royal Naval Hospital, UK, Alexander Rovehead, 1756–1764.

public health, hospitals were designed as ventilation machines to provide their patients with clean air. Among them, the Allgemeines Krankenhaus in Vienna (1784) was among the first to use technology to improve the supply of fresh air, and the Paris Hôtel-Dieu (1774) was reformed by A. Petit through proposing a radial plan as a healing machine to promote ventilation.

During this period, healing gardens primarily served as landscape features surrounding hospitals, often located outside corridor-based structures (Table 1). Their principal functions encompassed air purification and the facilitation of indoor ventilation.

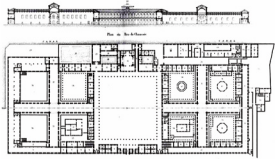
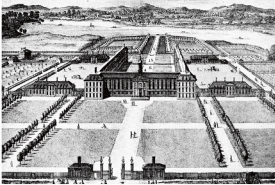
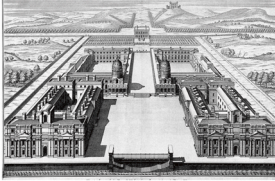
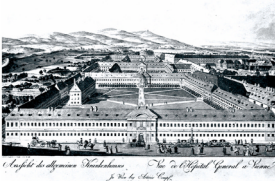
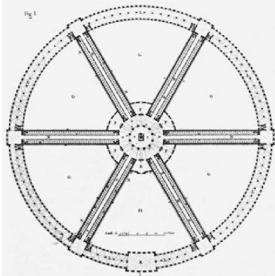
### 3.3. Healing gardens in the eighteenth and nineteenth centuries: the emergence of the pavilion hospital

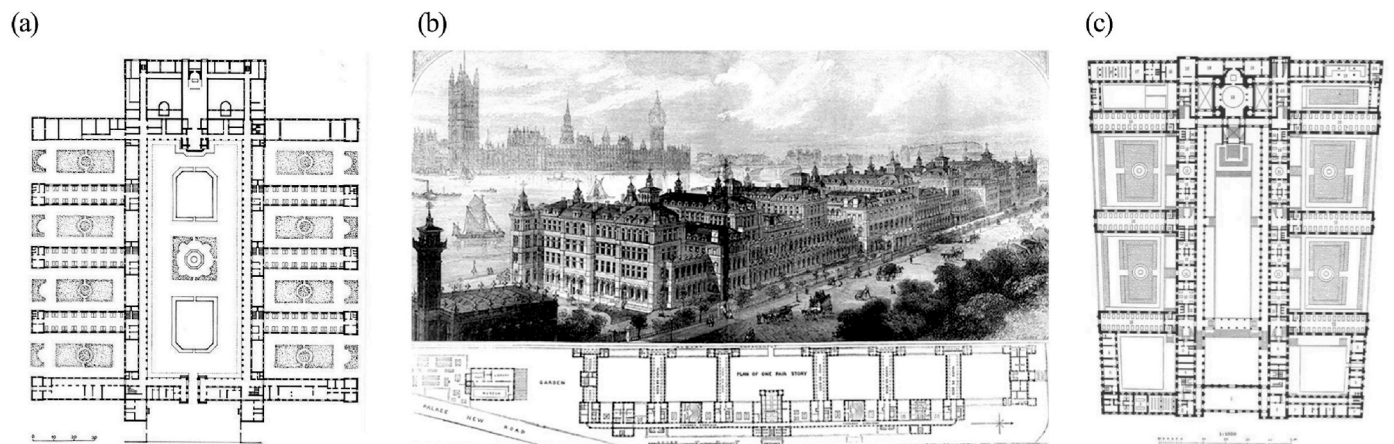
In the nineteenth century, despite incorporating advanced architectural features and technical installations, the corridor-based system fell short of contemporary standards. Consequently, subsequent expansions embraced a pavilion system instead. This approach involved erecting separate structures characterised by relatively low heights, interconnected through the external breezeway, and facilitated the segregation of patients based on their specific illnesses. An essential feature of this layout was the incorporation of multiple windows on various sides of the nursing wards within each individual building. Consequently, patients were afforded ample access to natural sunlight, cross ventilation for fresh air, and meaningful visual and physical connections to the surrounding outdoor environment. Notable examples of hospitals adopting the pavilion plan that exemplify these principles include Hôpital Lariboisière, St Thomas's Hospital, and the reconstructed Hôtel Dieu (Fig. 4).

Meanwhile, rooted in moral treatment and environmental determinism, Thomas Kirkbride (1844) in British advocated for the humanisation of mental health facilities. For example, the architectural design of asylums is an approach to providing treatment to people with mental illness. Vast tracts of designed parklands often surrounded nineteenth-century private lunatic asylums which can be viewed as similar to airing courts and provided primary access to outdoor space (Fig. 5). In a reflection of wealthy country house estates, these contained many ornamental features, from ornate thatched cottages to aviaries and Gothic summerhouses to ornamental pagodas (Stevenson, 2000, pp. 1660–1815). Three famous examples of this type of elite institution are Ticehurst House Asylum (1792), Brislington House – Lunatic Asylum (1804–1806), and Northampton General Lunatic Asylum (1838).

In the mid-nineteenth century, growing concerns regarding creating healthy environments brought a new understanding of the building-nature relationship. Within this context, the glass house at the Jardin des Plantes in Paris (Gérard, 1833) is a significant historical precedent within a conceptual framework of modern architecture (Stein & Virts 2021). In the realm of medical institutions, the urban sanatorium proposal by horticulturist Joseph Paxton (1851) serves as a compelling illustration of this shift (Gibson et al., 2000). As an integral part of Paxton's comprehensive portfolio, the sanatorium structure proposal exemplified the hypothesis that plants granted urban populations access to experiences rooted in the natural world and formed an indispensable component of the environmental system. A notable example is the winter garden located at Leeds General Infirmary, England (Fig. 6). The Winter Garden is an inviting indoor garden within the hospital that centres around the glass house and its impact on health (Henry Burdett, 1910). Abundant with plants, it enhances air quality by removing toxins and supplying fresh oxygen. The combination of light, plants, and fresh air establishes a therapeutic space for patients, providing respite from the clinical environment. Visitors and staff members also benefit from this setting, enhancing their overall experience. Through the incorporation of glasshouses, the environmental dimension of architecture became visibly apparent. The transdisciplinary research concerning temperature, humidity, solar radiation, and air movement and their impact on plant health gave rise to new conceptualisations of healing

**Table 1**  
Dominant garden types found within selected healthcare institutions from the nineteenth centuries.

Name of institution	Illustration	Architect/Founder	Location	Year
Ospedale Maggiore		Antonio Averulino	Milan, Italy	1456
Royal Chelsea Hospital		Christopher Wren	London, England	1682
Royal Naval Hospital		Christopher Wren	Greenwich, England	1694
Allgemeines Krankenhaus		Josef Gerl	Vienna, Austria	1784
Hôtel-Dieu		Antoine Petit	Paris, France	1774



**Fig. 4.** Notable examples of pavilion plan hospitals, (a) Hôpital Lariboisière in Paris, 1839–1854 (Tillaux, 1877), (b) St. Thomas Hospital, London, UK, Henry Currey, 1866–1871 (McInnes, 1959), (c) Hôtel-Dieu, Paris, Emile Jacques Gilbert, 1866–1876 (Coury, 1968).





Fig. 5. Famous examples of the representative military-style hospital, (a) Ticehurst House Asylum, 1790s (Turner, 1990, pp. 1845–1890) (b) Brislington House – Lunatic Asylum, 1800s, (c) Old Vienna General Hospital (AKH), 1830s.

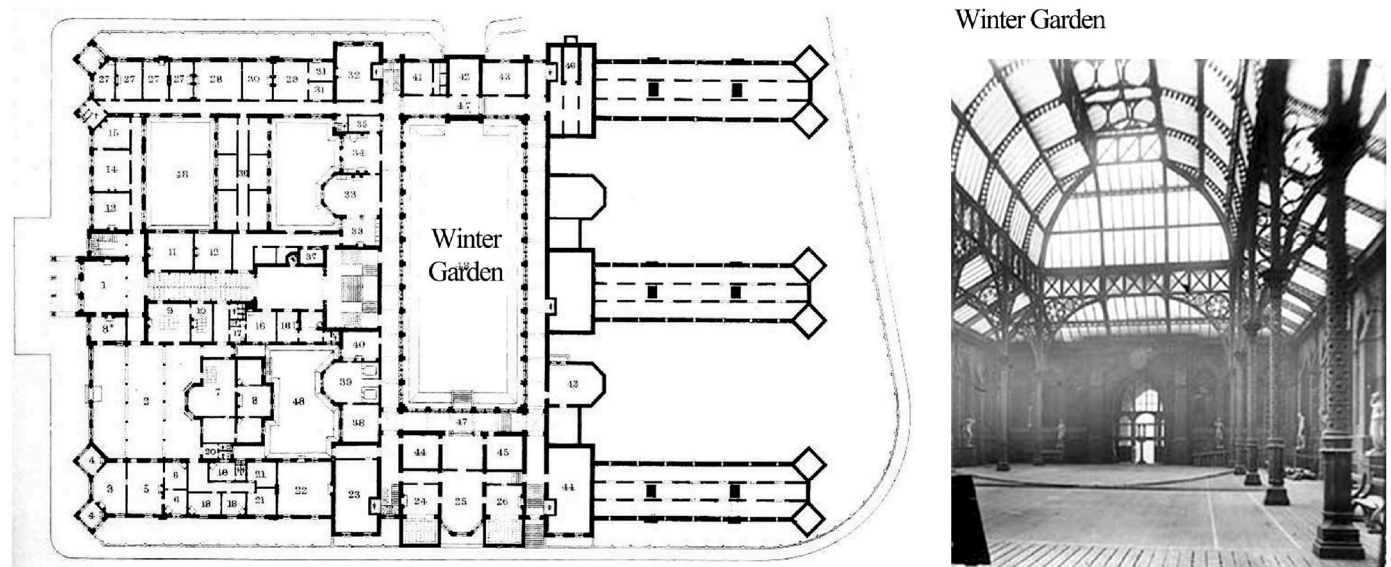


Fig. 6. Plan (left) and the winter garden (right) of Leeds General Infirmary (Henry Burdett, 1910), in 1911, the roof, which had created significant maintenance problems, was dismantled.

environments.

### 3.4. Healing gardens in the twentieth century: Patient-Centred Design

Throughout the twentieth century, hospital gardens experienced significant transformations, paralleling a paradigm shift within the medical field that resulted in a redefined appreciation of natural landscapes as essential buffers against urban epidemics (Battisto & Wilhelm, 2020). Consequently, notable advancements have been made in both the theoretical framework and practical implementation of therapeutic landscape. Healing gardens, recognized as non-pharmacological interventions, have acquired a stronger scientific foundation and demonstrated increased design adaptability.

Drawing from the works of architects including Alvar Aalto, Richard Döcker, Le Corbusier, Jan Piet Kloos, Krohn & Hartvig Rasmussen, and Herman Hertzberg, the design of healthcare in twentieth-century hospitals embraced a patient-centred approach, emphasizing technological integration and material selection. Notable examples such as the Paimio Sanatorium exemplify hospital architecture's early twentieth-century incorporation of specific elements to facilitate open-air therapy, recognising the therapeutic potential of ventilation, daylight exposure, and green surroundings, which was considered revolutionary at the time. However, hospital architecture remained largely resistant to the influence of Modernist architects during this period, with their significant contributions to healthcare primarily confined to a select few renowned

sanatoria.

Following the Second World War, horticultural therapy began to gain traction in various settings, leading to the emergence of rehabilitation gardens tailored to the unique needs of patients with specific illnesses. Hospitals in the form of mat-building, exemplified by the proposed Venice Hospital by Le Corbusier and the original De Drie Hoven designed by Herman Hertzberg. They connected each building block through courtyards or roof gardens to offer diverse architectural experiences that harmonized with natural landscapes.

In the late twentieth century, healthcare planning and design gradually shifted their focus towards evidence-based principles, aiming to create holistically supportive environments catering to diverse user groups, including patients, healthcare providers, staff members, families, and visitors. Spaces such as patios, inner courtyards, roof terrace, and entrance halls, subject to more flexible regulations than treatment and nursing units, afforded architects greater creative latitude. The traditional dominance of ward layouts, long prevalent in healthcare design, diminished as designers recognized the architectural potential of public areas. Furthermore, post-occupancy evaluation (POE) studies have evidenced the positive impacts of individual experiences within healing gardens on health outcomes.

#### 3.4.1. The Prewar Modernism period: the rise of sanatoria buildings and spaces for open-air therapy (1900s–1940s)

In the Prewar Modernism period, healthcare settings incorporated

specific design techniques to accommodate open-air therapy that posed a challenge to the conventional definition of architecture (Hickman, 2018). Sanatorium buildings became prevalent and were often situated in remote locales that embraced picturesque surroundings such as forests, lakes, and mountains (Colomina, 2019). Rather than being conventional structures with appended balconies for solar exposure, they were conceived as complexes centred around expansive sun terraces (Fig. 7). This therapeutic approach gained popularity across various institutions, including the Hailey Open-Air Sanatorium (1903) in Oxfordshire, the Stannington Sanatorium in Northumberland (1907), the Winford Orthopaedic Hospital in Bristol (1930) (Fig. 8), and the Paimio Sanatorium in Finland (1933).

The Paimio Sanatorium (1929–1933), situated in the municipality of Paimio in southwestern Finland, is a celebrated architectural masterpiece known for its groundbreaking design and significant contributions to modernist architecture and healthcare facility planning (Aalto et al., 2004). Designed by the renowned Finnish architect Alvar Aalto, the project played a pioneering role as a tuberculosis treatment centre during an era when the disease posed a significant public health concern (Heikinheimo, 2016). Its perfect integration with the natural surroundings is its most distinguishing feature, set on a lawn in front of the main entrance is a lung-shaped flower-bed planted with parallel strips of red bedding begonias representing the healing effects of fresh blood into the lungs (Fig. 9). The gardens were an integral aspect of sanatoria planning, and the grounds, with their maze-like paths, were carefully designed to provide convalescent tubercular patients with varying degrees of rehabilitative, therapeutic exercises.

Aalto also incorporated the natural environment through expansive windows and balconies, which ensured patients had ample exposure to sunlight to experience the beneficial effects of fresh air, tranquility, and heliotherapy as they reclined on wicker chaise longues (Hipeli & Laaksonen, 2014). The balconies are designed to receive ample sunlight, allowing opportunities for light therapy, which has been proven beneficial for specific medical conditions (Fig. 10a). Aalto also had additional pine trees planted in circular concrete tubs on the balconies (Since classical times the smell of pine had been considered therapeutic for patients with tuberculous) (Fig. 10b). These were intended to soften the concrete structure as well as waft the scent of pines over the resting patient (Eylers et al., 2016).

### 3.4.2. The postwar period: mat-building hospitals with multiple courtyards (1950s–1970s)

As mechanical transport options and pneumatic dispatch systems improved, the significance of proximity diminished, and compact-building hospitals were gradually replaced by mat-building hospitals (Wagenaar et al., 2020). Healthcare settings started integrating courtyards or roof gardens with certain interior functions, effectively introducing the contextual surroundings into the architectural framework. Notable examples include the Venice Hospital designed by Le Corbusier (1964–1965), the original De Drie Hoven designed by Herman Hertzberger (1964–1974), and the Streekziekenhuis in Almelo designed by Roelofs Nijst Luca (1976–1984) (Fig. 11).

The Venice Hospital, designed between 1964 and 1965, is an avant-garde exemplar of modern hospital architecture conceived by Le Corbusier and Guillermo Jullian de la Fuente. They aimed to build a hospital that blended in with the city by arranging the building horizontally rather than vertically. This project presents an intriguing interplay between public open spaces and interior architectural elements, offering diverse architectural experiences harmonising with natural landscapes (Corbusier, 1984). In his writings, Le Corbusier emphasised the significance of allowing natural light to permeate the spaces, including verdant areas, to promote clean air and create a sense of expansive spatial perception (McLeod, 1996). Within the hospital floor plan, the courtyard functions as an intermediary space, effectively bridging various architectural functionalities, and additionally providing the interior with natural daylight (Fig. 12).

The building, as a whole, integrates nature-connected spaces on each floor through courtyards, roof gardens, skylights, and pilots connecting interior spaces with nature, providing unobstructed views and direct access to the outdoors, enabling the permeation of natural views and abundant sunlight (Corbusier et al., 1984). In addition, the roof gardens serve as interactive spaces where even bedridden patients can actively engage with the natural surroundings (Yoon & Lim, 2020).

The corridor space between patient rooms is strategically designed to harness the advantages of ample natural light and captivating views of greenery, achieved through deliberate architectural features such as openings on the walls facing the courtyard and the presence of skylights (Fig. 13). The strategically positioned openings allow for captivating views of the surrounding greenery, fostering a connection with nature that contributes to patients' overall healing and well-being (Dupont, 2015).

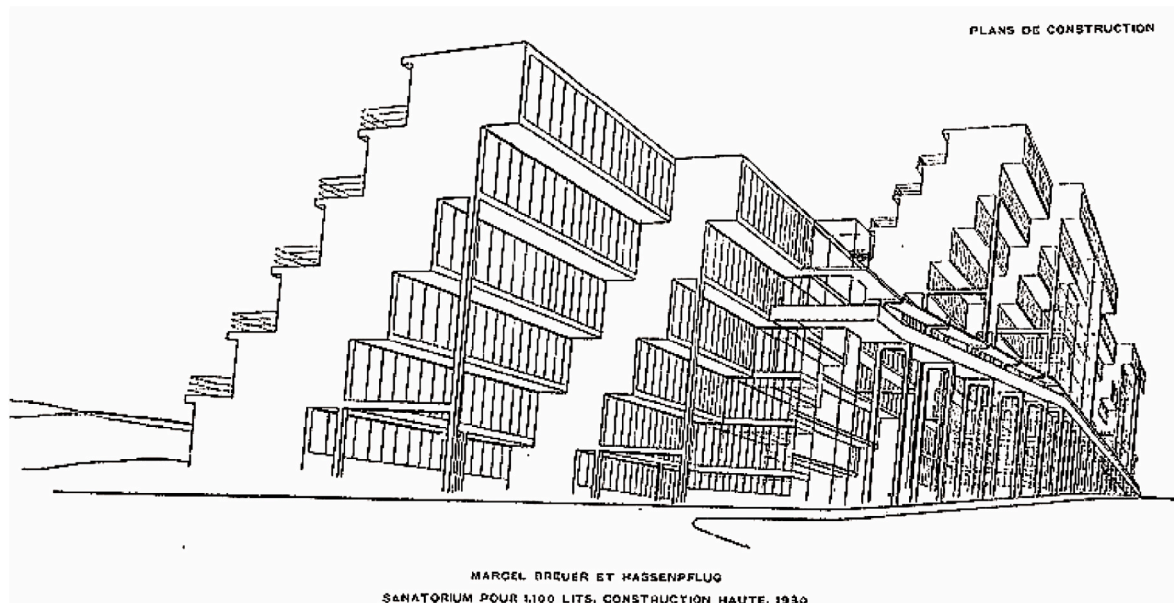
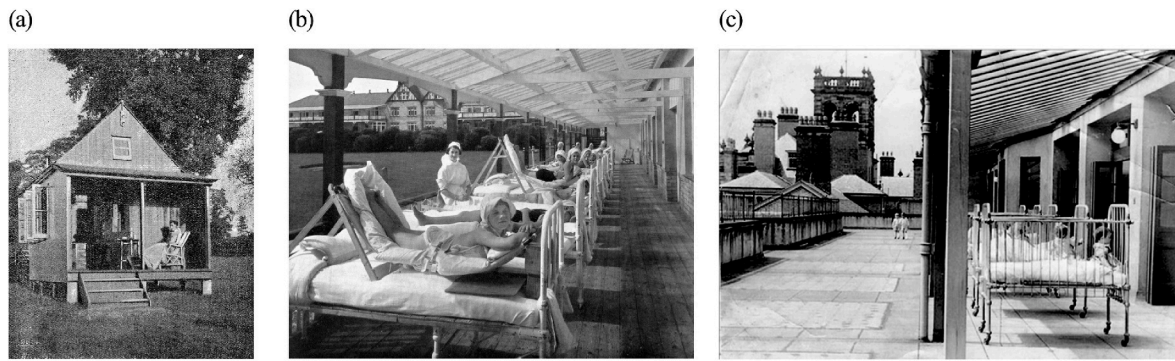
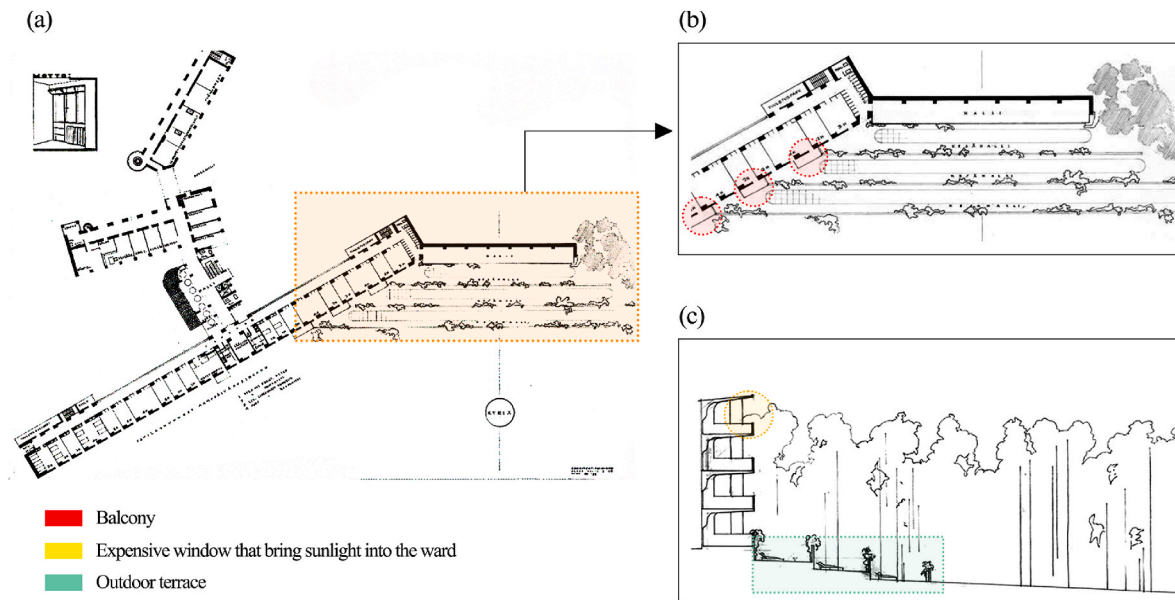


Fig. 7. Marcel Breuer and Gustav Hassenpflug's 1930 project with a set of deep sun terraces act as solar devices for the building.

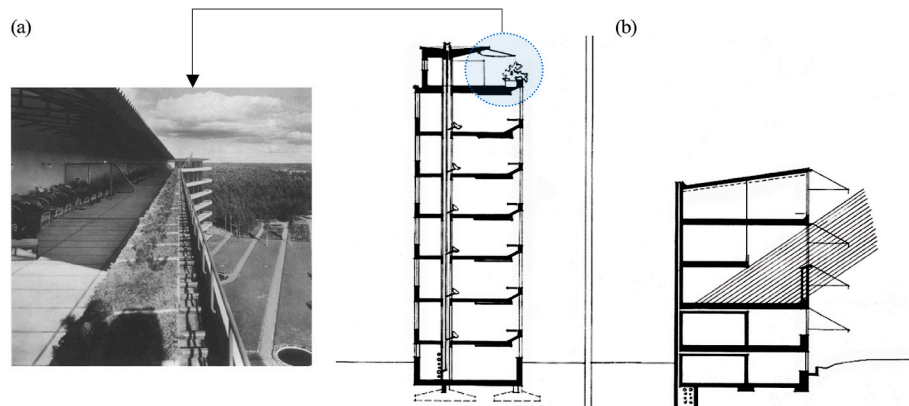




**Fig. 8.** Examples of hospitals with open-air therapy, (a) Hailey Open-Air Sanatorium in Oxfordshire (Walters, 1911), (b) the first British sanatorium for tuberculosis children in Morpeth, Northumberland (Roberts & Bernard, 2015), (c) Winford Orthopaedic Hospital in Bristol, England (Marie & DipLib, 2001).



**Fig. 9.** (a) The main building ground floor plan of the competition-stage design of the Paimio Sanatorium from 1929, (b) The sun patios are planned at the competition stage to be situated in front of the sundeck, (c) Section of expensive windows and outdoor terrace (images elaborated by authors).

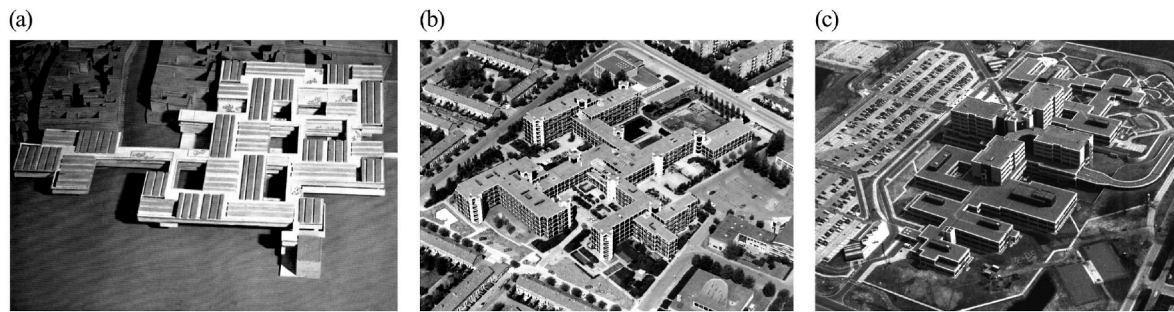


**Fig. 10.** Sections (a) and (b) show that the sunlight penetrates the interior spaces through the window façade and the methodology for controlling the amount of sunlight.

**3.4.3. Late twentieth century: a focus on public space and nature integration in the hospital building (1970s–1990s)**

In the early 1970s, a significant paradigm shifted in medicine, transitioning from the traditional biomedical model to a more holistic

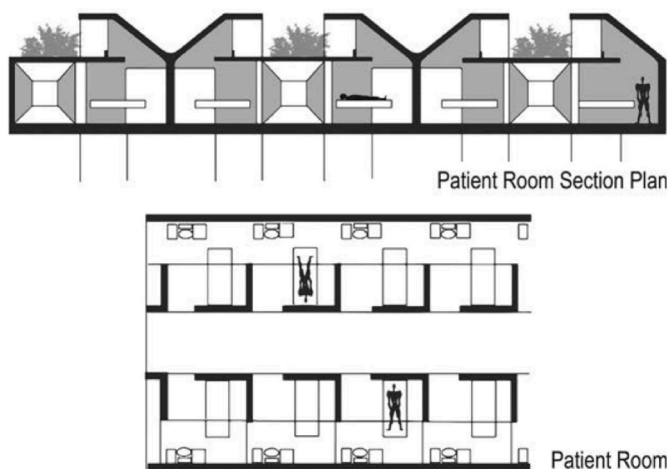
'bio-psycho-social-environmental model.'. It promoted the integration of accommodation and functional aspects within each area of the healthcare facility, advocating for hospitals to adopt a 'human scale' and seamlessly blend into the surrounding urban environment. Architects



**Fig. 11.** Examples of mat-building hospitals with multiple courtyard, (a) the Venice Hospital project designed by Le Corbusier (1964–1965), (b) the original De Drie Hoven designed by Herman Hertzberger (1964–1974), (c) the Streekziekenhuis in Almelo designed by Roelofs Nijst Luca (1976–1984).



**Fig. 12.** Plans of Venice Hospital project (Le Corbusier, 1984).



**Fig. 13.** The patient room, patient unit, and spatial configuration in the original plan of the Venice Hospital by Le Corbusier and Guillermo Jullian de la Fuente, designed in 1965 (Jiang, 2022).

were tasked with creating spatial environments that fostered a synthesis between compassionate care and modern functionality. Spaces like patios, inner courtyards, and entrance halls, subject to more flexible regulations than treatment and nursing units, offered architects greater creative freedom. The dominance of the ward layout, prevalent for

years, waned as designers recognized the architectural potential of public areas.

During the 1990s, the implementation of the substitution policy marked a significant transition towards small-scale and non-institutional healthcare. Meanwhile, a significant emergence of healing gardens was observed in various outpatient and day treatment, including hospitals, chronic-care facilities, hospices, and senior communities (Fig. 14).

The Family Life Center (1991), designed by Martha Tyson, functions as a day centre catering to individuals living at home with their families who have conditions such as Alzheimer's disease, other forms of dementia, schizophrenia, multiple sclerosis, Parkinson's disease, and Huntington's disease. Serving as a successful healing garden for individuals with Alzheimer's disease and other forms of dementia, this case study exemplifies the key considerations landscape designers must consider when creating a successful garden (Marcus, 2007). For instance, individuals with Alzheimer's disease often exhibit wandering behaviour, necessitating the inclusion of designated pathways for walking. In the central garden, a six-foot wide loop path spans 300 feet, featuring varied path-side details while minimizing potentially distressing decision points for wayfinding. Landmarks, such as the entry arbour, a flagpole, a grotto adorned with a statue of the Virgin Mary (of significance to 50 percent of the centre's users who identify as Roman Catholic), a waterfall and pond, and bird feeders hanging from trees, aid in orientation (Fig. 15). Areas such as the working garden and the lawn serve as gathering spaces, fostering physical activity and social engagement. Two wooden gazebos, the Garden House and the Tea House, are designated destinations and provide comfortable settings for scheduled activities. The design elements, including the building, walls, fence, and peripheral plantings, define the spatial boundaries and edges of the garden.

Maggie's Centre in Dundee, designed by architect Frank Gehry and opened in 2003, is a purpose-built facility that stands as a landmark for Maggie's organisation (Wallersteiner, 2019). The outdoor area of Maggie's Centre can be categorised into four distinct zones, each serving a specific purpose. The "labyrinth grassland" provides an open and symbolic space for contemplation, with varying elevations and landmarks for walking and relaxation. The "walking path forest" is a secluded area featuring tall canopy trees, offering shade, benches, and a peaceful environment for physical activity and rest. The "Gehry's building area" is a friendly and distinctive structure that enhances spatial coherence with its unique design elements inspired by nature (Fig. 16 left). The "transition terrace," located beneath the kitchen window, acts as a private outdoor space for visitors, featuring seating and a small terrace for socialising and connecting with others. The terrace and bench are frequently utilized elements, extending the social space into the landscape (Fig. 16 right).

In Dundee, the labyrinth at Maggie's Centre is a contemplative space for patients, symbolising a journey towards possible healing (Jencks & Heathcote, 2015). Visitors and hospital staff utilise the grass banks of the labyrinth for various activities, including eating, reading, smoking, and walking. The terraced step formation of the labyrinth provides



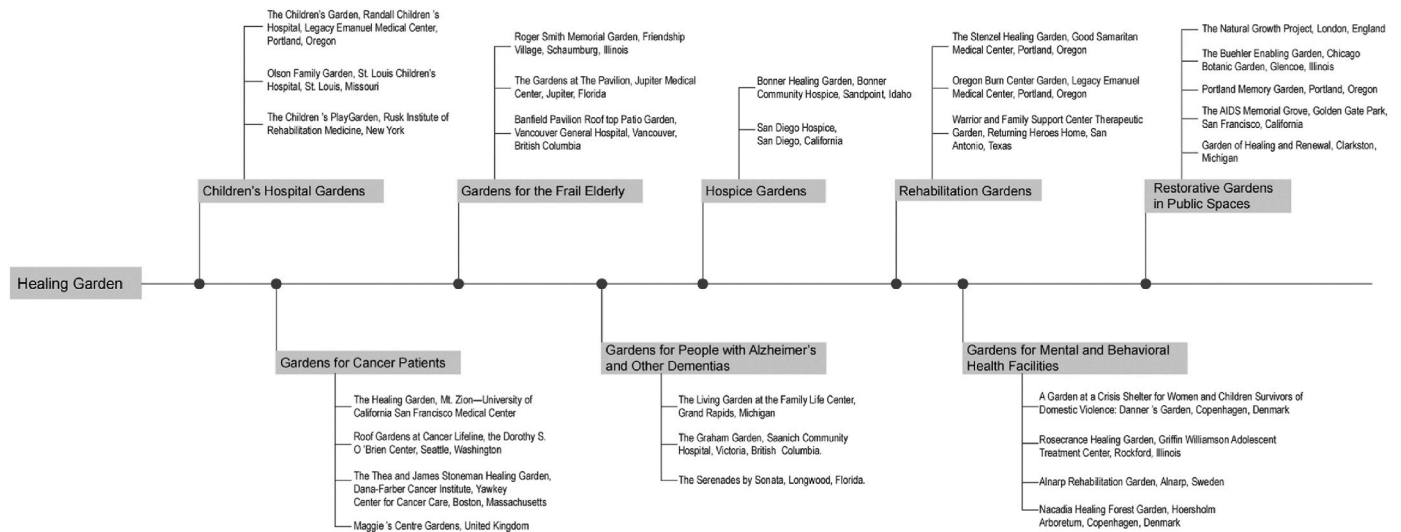


Fig. 14. Different themes of healing gardens (Image by authors).

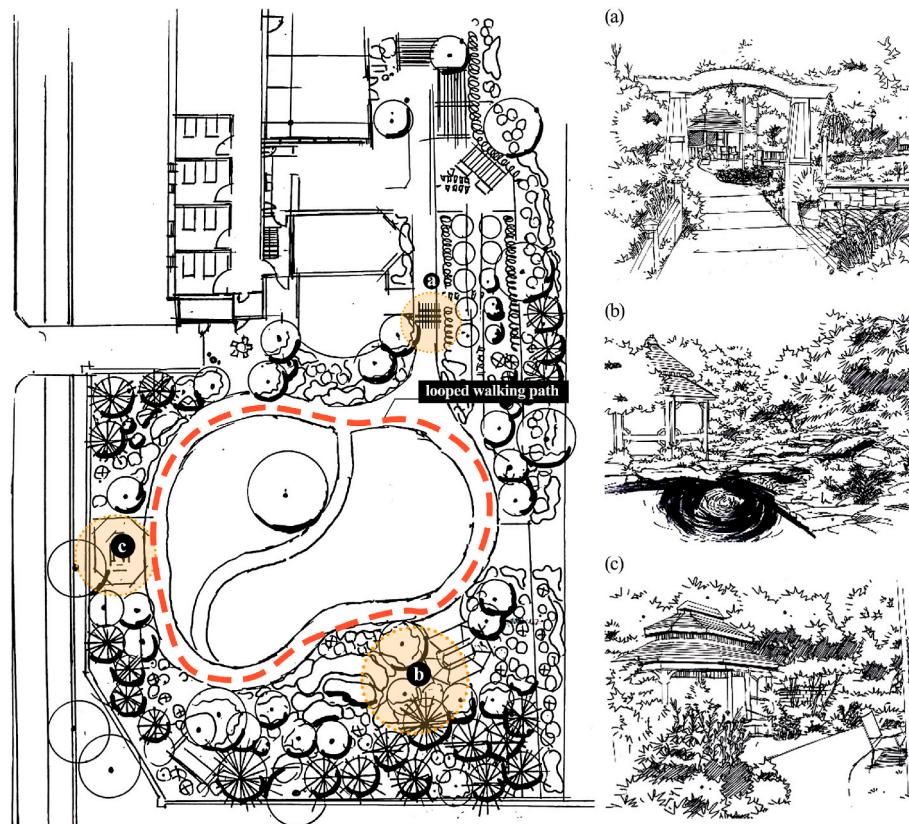


Fig. 15. Plan of the Family Life Centre, the “looped walking path (wayfinding system)” is highlighted in red colour (left), and Landmarks in the garden, (a) An archway marks the transition from a working garden with raised beds and a small orchard into a large area with lawns, paths, perennial beds, and places to sit, (b) A waterfall and pond for contemplation and meditation, (c) The gazebo is a favourite destination point for the residents. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

opportunities for socialising, dining, resting, and relaxation. Natural materials like sand, stone, and grass are incorporated into the labyrinth design (Fig. 17).

The “walking path forest” is a semi-private space designed for physical activities such as walking and exercise. Large canopy trees offer shade, while benches along the pathway provide resting spots. This green oasis, created by the density and height of the trees, along with low box hedges and shrubs, enhances the sense of immersion and

provides a calming environment. Considerations are made to accommodate the fatigue experienced by cancer patients during treatment, necessitating frequent seating options along the pathway. The design also prioritises shade to protect patients from direct sunlight, as some chemotherapy drugs require avoiding exposure. Moreover, fragrant flowers and highly scented plants are avoided in consideration of olfactory sensitivity and the potential for triggering nausea in patients. The garden design at Maggie's Dundee includes lightly scented and

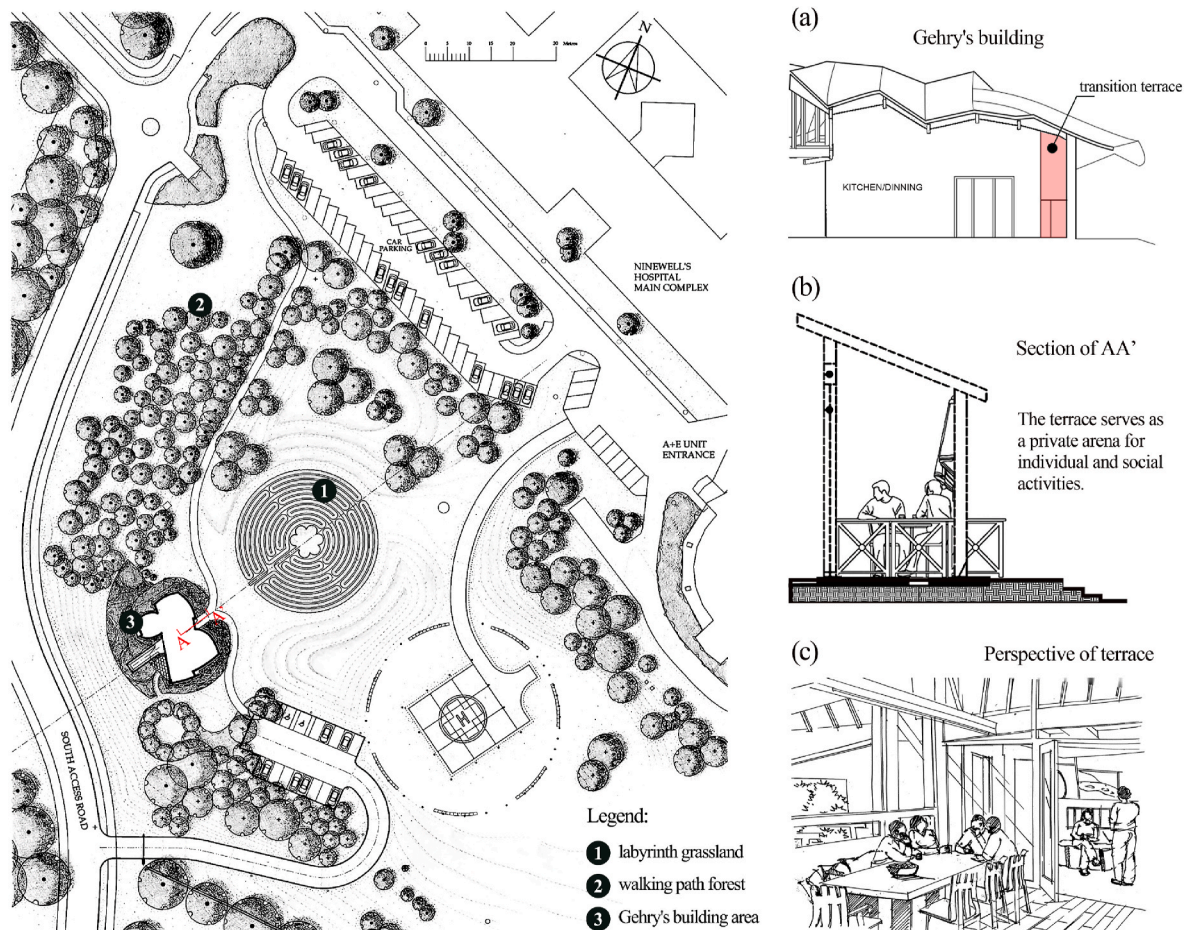


Fig. 16. Garden plan of Maggie's Dundee (left) and transition terrace (right), (a) terrace leading off from the kitchen area at Maggie's, (b) section of the transition terrace, (c) perspective of the transition terrace.

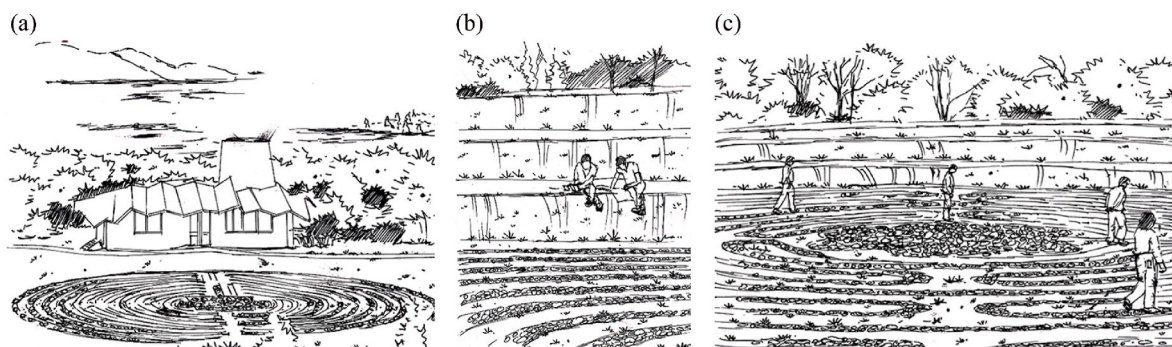


Fig. 17. (a) The Labyrinth Maze in Maggie's Dundee, (b) and (c) shows the height difference and people's activities on the labyrinth grassland (Image by authors).

unscented plants, ensuring a safe and supportive environment for cancer patients undergoing chemotherapy and radiotherapy.

#### 4. Contemporary analysis through design-driven research

##### 4.1. Case study clarification

Moreover, the literature on healing gardens is advancing toward the study of specific populations and groups. Through examining peer-reviewed publications from six databases—Scopus, Google Scholar, Web of Science, PubMed, ProQuest Central, and Google, it is found that the literature on healing gardens is advancing toward the study of specific populations and groups (Fig. 18). Research on diseases prevalent in

the elderly population, such as Alzheimer's disease and dementia, accounts for the largest proportion, representing 32.1%, followed by cancer at 17.8%.

Following the findings derived from the peer-reviewed publications, numerous investigations have been conducted on the design of healing gardens catering to individuals affected by Alzheimer's and dementia, cancer, disabilities, aging populations, and children. After careful consideration, the authors identified 23 exemplary projects associated with healthcare institutions in European countries, encompassing Denmark, Spain, England, Italy, Switzerland, Belgium, Austria, Germany, and France. This section comprises five Alzheimer's disease and dementia centres, six cancer centres, four facilities catering to individuals with disabilities, two centres for the elderly and retirees, a



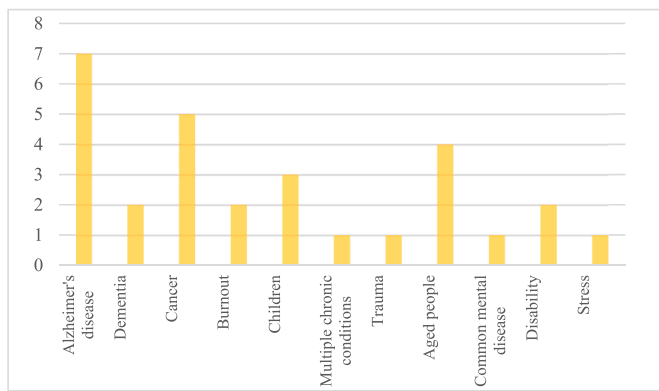


Fig. 18. User range of healing gardens based on review.

diabetes center, a children’s center, and four general hospitals or clinics (Fig. 19). These chosen case studies represent a spectrum of healthcare facilities, varying in size and providing comprehensive inpatient and outpatient care, which adopt different design approaches to connect with nature. After comparison, the typologies of healthcare institutions are classified into six forms based on distinct modes of integration between gardens and buildings, namely multiple courtyards buildings, multiple courtyards buildings with central roof terraces, central courtyard buildings, roof garden/terrace buildings, edge courtyard buildings, and healthcare community with building groups (Table 2).

## 4.2. Case study analysis

### 4.2.1. Multiple courtyard building

From the selected cases (Fig. 20), REHAB Basel in Switzerland, a renowned rehabilitation center specializing in spinal cord and brain injuries, integrates its design with the surroundings and inner courtyards to enhance the therapeutic environment. The deliberate creation of diverse courtyards, featuring unique shapes and characteristics, serves to evoke various sensory experiences and aid spatial orientation within the building. The facility’s architectural design incorporates a solar shading system using continuous horizontal wood decking, acting as a visual barrier to reduce heat and glare.

Kinderspital Zürich in Switzerland adopts a three-level structure with strategically placed courtyards that introduce natural illumination and guide visitors intuitively. The varied courtyards, aligned along a central ‘main route,’ facilitate wayfinding, infuse daylight, and seamlessly integrate nature throughout the building. Deliberate gaps in timber elements along the facades serve as semi-open screens, effectively mitigating indoor glare and fostering a harmonious connection between interior space and nature (Binswanger et al., 2021).

Municipal Healthcare Centres San Blas, Usera, Villaverde in Madrid feature a repeated floor plan that alternates public and private rooms around multiple accessible patios, preventing long, monotonous corridors. The San Blas Healthcare Center, in particular, employs blue tiles and views of plants in the patios to create an elegant and spacious interior, resembling an indoor sky. The reflective qualities of the vertical walls of blue tiles laid in a fish scale pattern contribute to a luminous atmosphere (Wagenaar & Mens, 2020, 235–236).

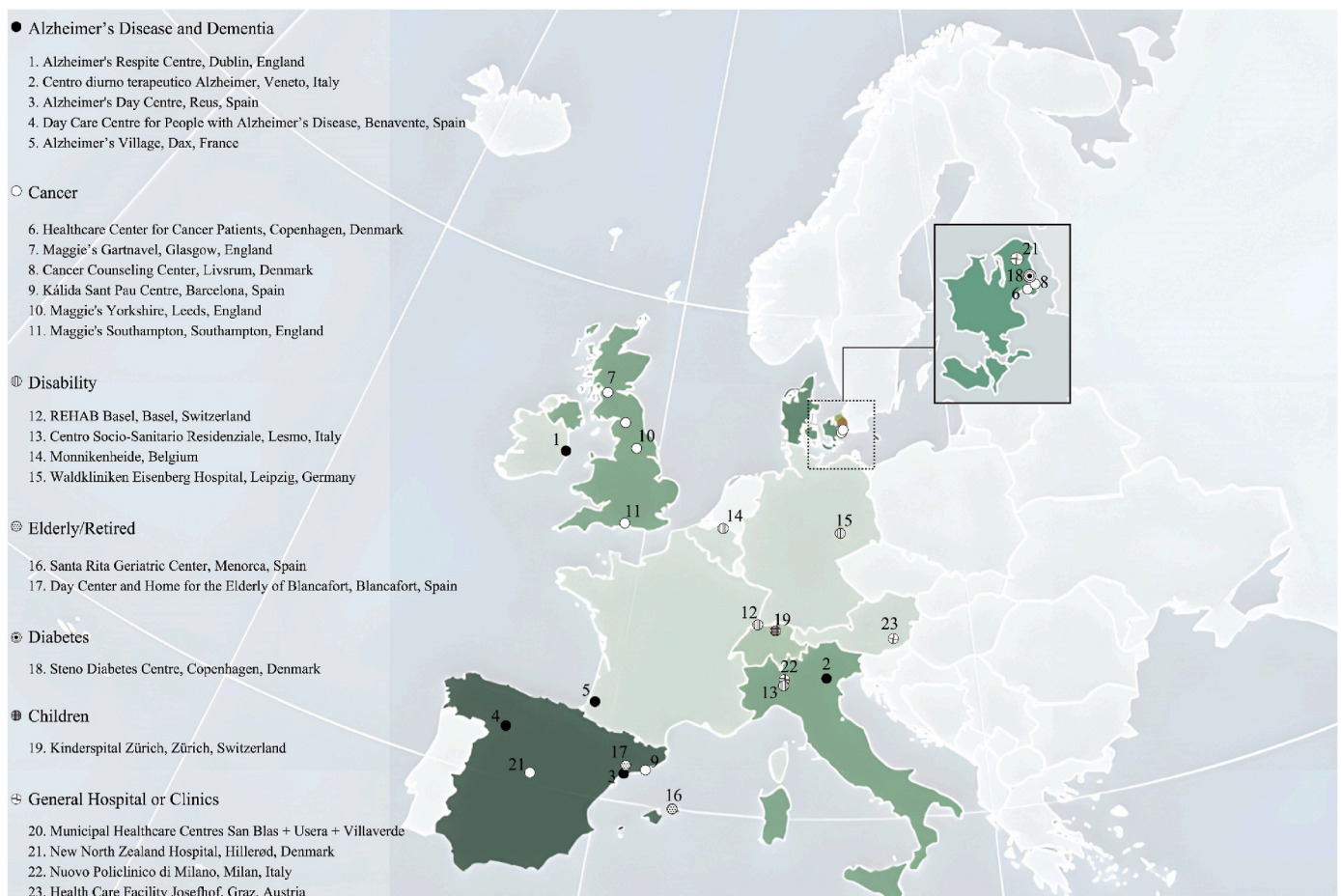


Fig. 19. Mapping of 23 exemplary projects in Europe.

**Table 2**  
Typologies of gardens at the building scale in healthcare institution.

Type/Use	Name	Architect/ Landscape architect	Location	Year
Multiple courtyards building	REHAB Basel	Herzog & de Meuron and August Künzel, Binningen	Basel, Switzerland	2002
	Kinderspital Zürich	Herzog & de Meuron and August Künzel, Münchenstein	Zürich, Switzerland	–
	Municipal Healthcare Centres San Blas + Usera + Villaverde	Estudio Entresitio	Madrid, Spain	2010
Multiple Courtyards Building with Central Roof Terrace	New North Zealand Hospital	Herzog & de Meuron and Vogt Landschaft architekten	Hillerød, Denmark	–
	Waldkliniken Eisenberg Hospital	Matteo Thun	Leipzig, Germany	2020
	Steno Diabetes Centre Denmark	Vilhelm Lauritzen and Mikkelsen Architects,	Copenhagen, Denmark	2021
Central Courtyard Building	Healthcare Center for Cancer Patients	Nord Architects	Copenhagen, Denmark	2009
	Maggie's Gartnavel Cancer Counseling Center	OMA, Lily Jencks EFFEKT Arkitekter	Glasgow England Livsrum, Denmark	2011 2013
	Day Center and Home for the Elderly of Blancafort	Guillem Carrera Arquitecte	Blancafort, Spain	2014
	Alzheimer's Day Centre	GCA Architects and Belén Mutlló Pamies	Reus, Spain	2019
Roof garden/ terrace building	Nuovo Policlinico di Milano	Stefano Boeri Architetti	Milan, Italy	2018
	Health Care Facility Josephhof	Dietger Wissounig Architekten	Graz, Austria	2019
	Day Care Centre for People with Alzheimer's Disease	studioVRA	Benavente, Spain	2019
	Maggie's Yorkshire	Heatherwick Studio, Chris Rankin	Leeds, England	2020
Edge Courtyard Building	Alzheimer's Respite Centre	Niall McLaughlin Architects and Arkitema Architects	Dublin, England	2009
	Centro diurno terapeutico Alzheimer	Martina Davanzo	Veneto, Italy	2016
	Kálida Sant Pau Centre	Miralles Tagliabue EMBT	Barcelona, Spain	2019
Healthcare Community	Maggie's Southampton	Amanda Levete, Sarah Price Landscape	Southampton, England	2021
	Santa Rita Geriatric Center	Manuel Ocaña, Teresa Gali Izard	Menorca, Spain	2003

**Table 2 (continued)**

Type/Use	Name	Architect/ Landscape architect	Location	Year
	Centro Socio-Sanitario Residenziale	Guidarini & Salvadeo Architetti Associati	Lesmo, Italy	2006
	Monnikenheide Alzheimer's Village	UR architects NORD Architects	Belgium Dax, France	2017 2020

#### 4.2.2. Multiple courtyard building with central roof

New North Zealand Hospital in Denmark and Steno Diabetes Center Copenhagen (2021) seamlessly integrate into their natural surroundings with a horizontally oriented structure connected to the landscape (Fig. 21). The ground floor surrounds multiple courtyards of varied shapes and sizes, facilitating wayfinding and providing natural activities for different themed common areas. The upper floor plan features a roof terrace and the seamless integration of the garden-facing façade with expansive glass panels erases the boundary between the interior and exterior environments and provides the essential demand for efficient internal connectivity (Davidovici, 2021; Frearson, 2014).

Waldkliniken Eisenberg, located in Germany's heavily wooded Thuringian Forest, integrates nature into its design by featuring 135-square-foot winter gardens strategically placed at the intersection of every two rooms on the ground floor. These shared spaces serve as conduits for natural light and air, creating a serene environment for patients to recuperate and socialize. Additionally, green roofs further strengthen the connection between the facility and the natural environment, enhancing thermal comfort and fostering an overall experience immersed in nature (Beautyman, 2021).

#### 4.2.3. Central courtyard building

From the five selected central courtyard buildings, the architects implemented a strategic approach by fragmenting the building volume, leaving the central portion of the middle zone open to create a courtyard, functioning as the focal point of the structure (Fig. 22). This design choice forms interconnected units around the courtyard, optimizing conditions for circulation both within and around the building complex.

For example, In the Maggie's Centre in Glasgow, all rooms have been arranged around a central garden and nature is an essential element of the building. Upon entering the premises, visitors encounter a thoughtfully curated progression of spaces, including living areas, communal zones for social interaction, a library, and a kitchen. This spatial arrangement is guided by a strategic logic aimed at striking a harmonious balance between privacy and communal engagement for patients seeking solace. The building adopts an interconnected design characterized by a sequence of L-shaped configurations, effectively delineating distinct zones while minimizing the need for corridors and facilitating seamless transitions between rooms.

Meanwhile, the central courtyard building prioritize advantageous attributes such as natural light, privacy, and connectivity to outdoor environments. Within the garden, pathways paved with natural stones effectively mitigate glare while offering leisure and recreational opportunities. The coordination of warm-colored seating with surrounding vegetation enhances the atmosphere and provides a positive distraction for indoor occupants. In the facade, windows featuring distinctive shapes and strategically positioned skylights ensure ample sunlight penetrates interior spaces, fostering a visually therapeutic integration with outdoor areas.

#### 4.2.4. Roof garden/terrace building

From the selected cases, the roof garden/terrace building serves as an extension of the living place for social activities, making full use of the topography to realize the connection between the building and the



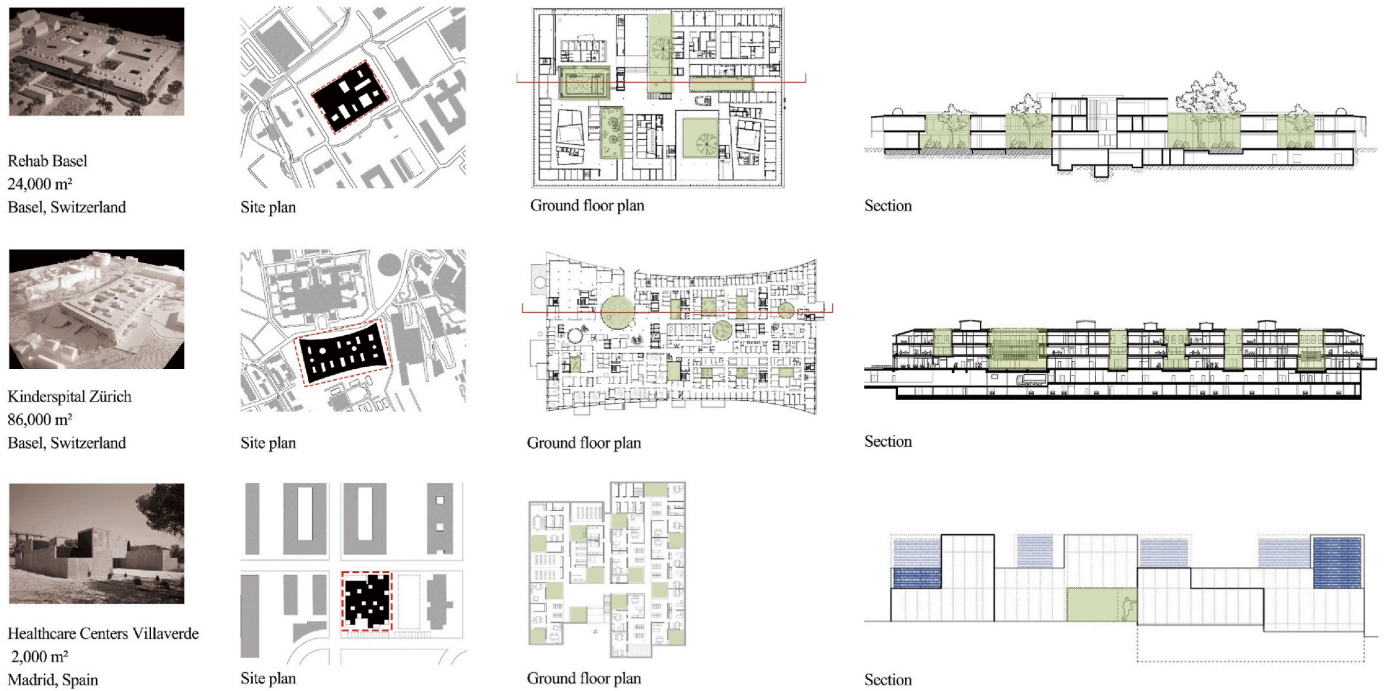


Fig. 20. Representative cases for multiple courtyards building.

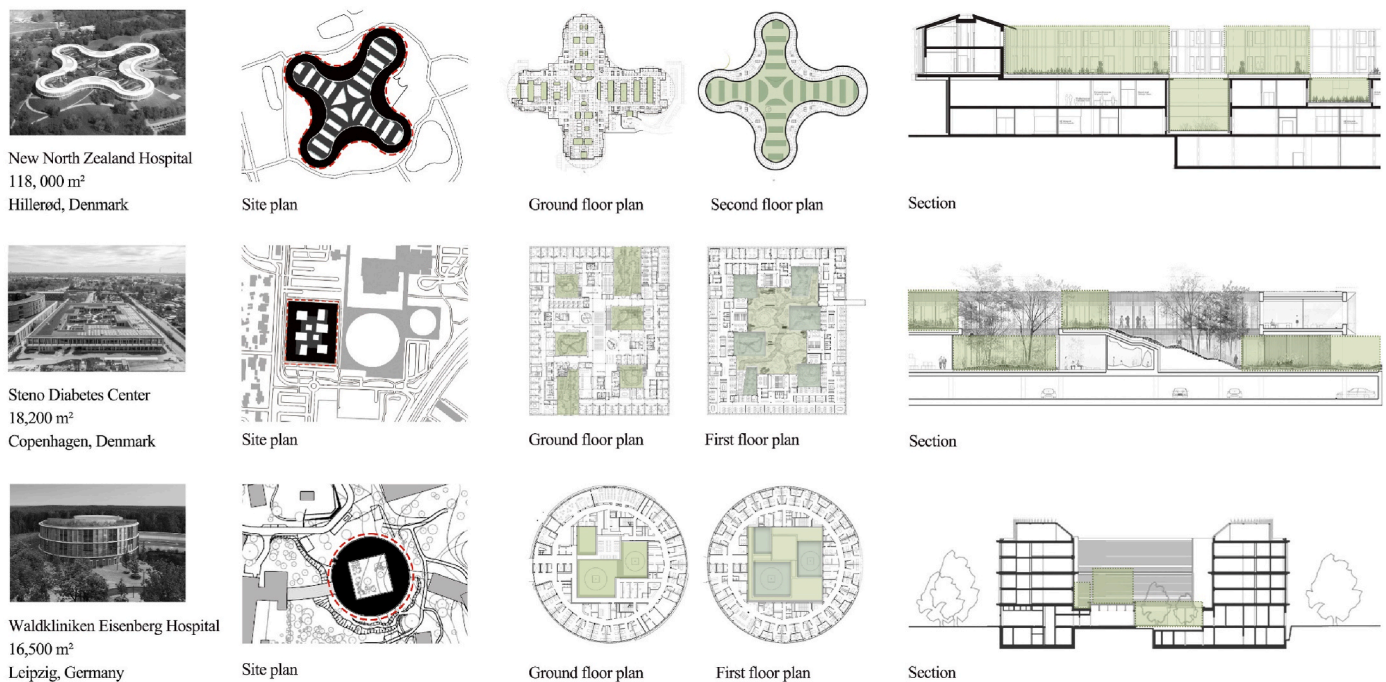


Fig. 21. Representative cases for multiple courtyard buildings with central roofs.

landscape (Fig. 23). For instance, the Health Care Facility Josephhof designed by Dietger Wissounig Architekten (2019) and Maggie’s Yorkshire designed by Heatherwick Studio (2020), through intentional incorporation of the site’s topography into the design process to create a unified and harmonious relationship between the built environment and the landforms. Meanwhile, design approaches prioritize environmental sustainability and minimize the impact on the ecosystem, such as the creation of microclimates, provision of thermal comfort, purifying the air, and enhancement of biodiversity.

In terms of spatial design, the terrace garden allows for flexibility and

adaptability. It can be modified or reconfigured to accommodate different activities, events, or changing healthcare needs. In concrete terms, the Day Care Centre for People with Alzheimer’s Disease designed by studioVRA (2020) was built with multi-layers in different heights, through sharing a series of balconies, atriums, patios, and porticoed spaces that open the building up to the exterior, further promoting ventilation, daylight exposure, and purifying indoor air. The Nuovo Policlinico di Milano designed by Stefano Boeri Architetti (2018), is a hospital located in the city center with a roof garden that provides activity spaces for users and acts as a transition space between two

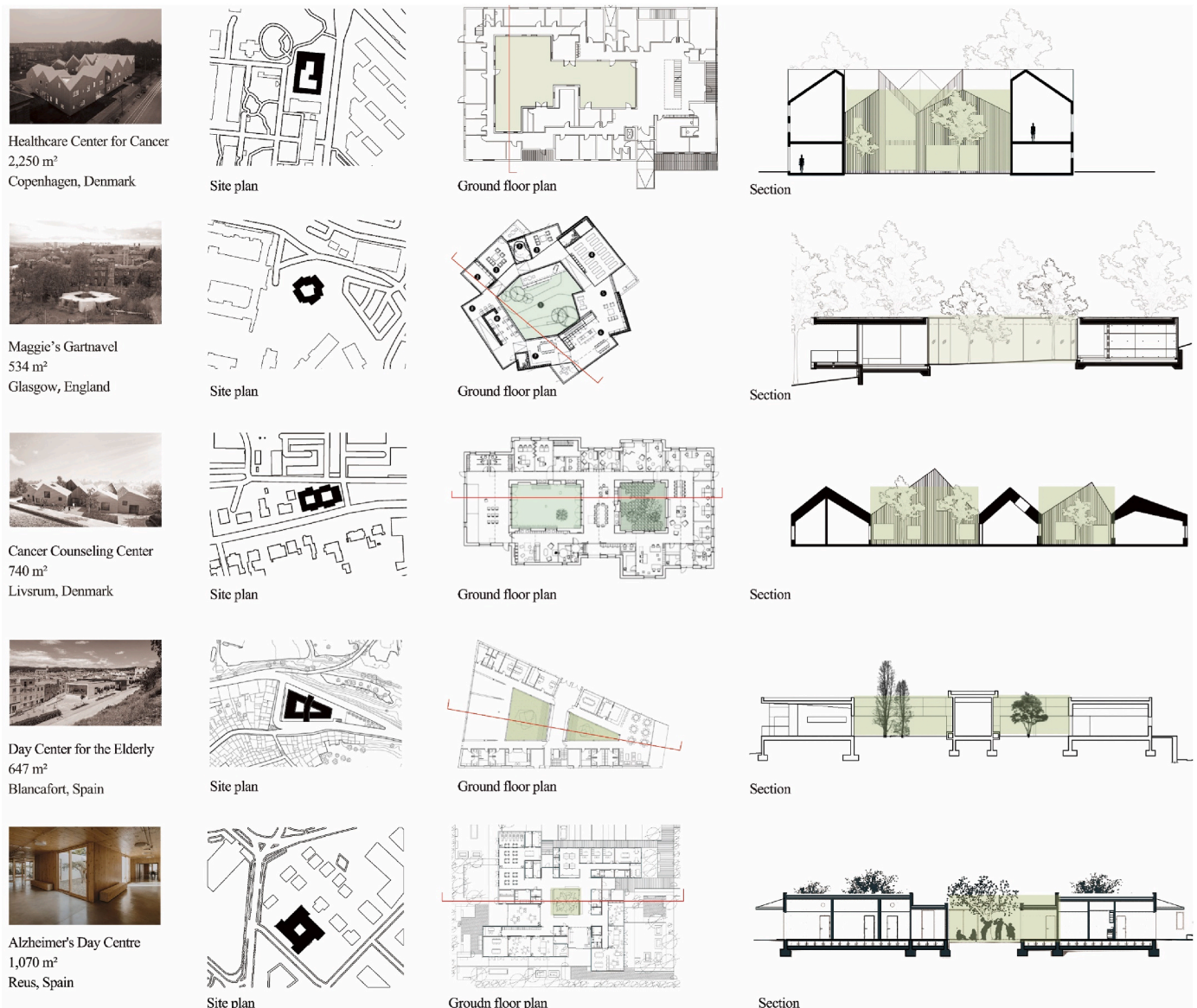


Fig. 22. Representative cases for central courtyard buildings.

building structures.

#### 4.2.5. Edge courtyard building

According to the needs of patients (Fig. 24), the Alzheimer's Respite Centre provides individuals with a sense of control by establishing gardens, terraces, interconnected social spaces, and private individual rooms, all of which connect with the walled gardens outside to prevent missing (McLaughlin, 2010; 2013). Each garden within the facility is strategically oriented to face different directions, facilitating diverse temporal and seasonal experiences. Furthermore, careful consideration of sunlight variations throughout the day encourages residents' natural circadian movement within the building. This thoughtful design approach not only enhances residents' sense of control and comfort but also supports their overall well-being within the facility. Key features of the gardens include a single main entrance delineated by a concrete boundary, multiple horticultural zones featuring a variety of plants (distinguished by color, scent, and height) to aid in spatial orientation, a transitional space that offers familiarity and comfort as individuals move between the interior and exterior, and easily identifiable spaces designated for various activities.

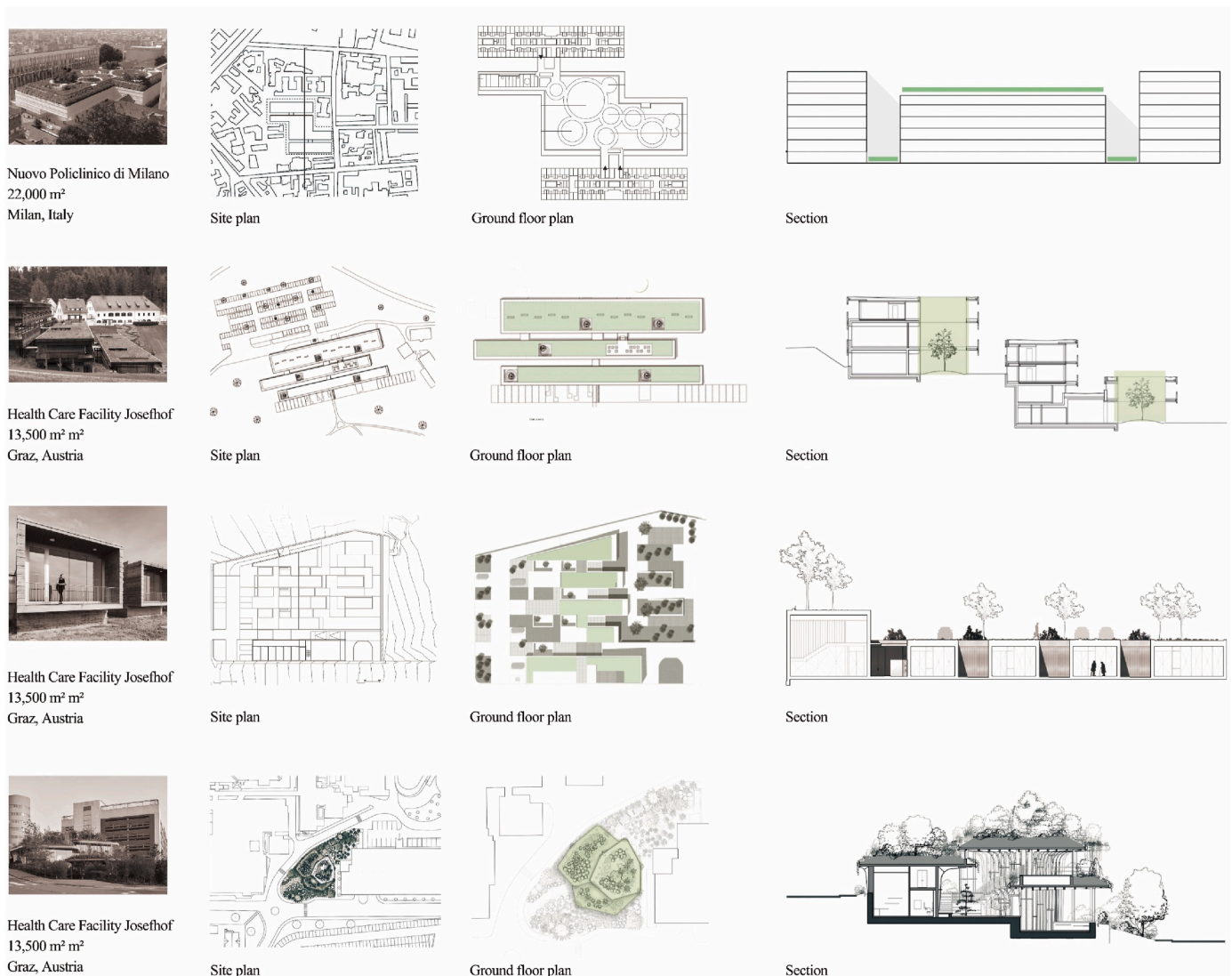
The design theme of the new Day Care Center for Alzheimer patients

in Castelfranco Veneto (Centro diurno terapeutico Alzheimer a Castelfranco Veneto) is to achieve autonomy and integration. The relationship between inner spatial route and garden is clear, the organisation in an east-west direction, marked by an entrance corridor on the north side which directs towards a central core, in contact with a fragment of green patios, where the care activities are organised. All the gardens are interconnected by a covered circular pathway to encourage, even in bad weather, the continuous "wandering" typical of some patients at a certain stage of the illness. Meanwhile, the patios are enriched by letting in direct light, but mitigated by the grid of holes.

In the Kálida Centre, each room is surrounded by greenery, timber, or pergolas, which are meant to hide the surrounding hospital facilities and respect the privacy of the Kálida Centre users. The garden, the pergolas, and the trees control views to make the massive volume of the new hospital disappear and let users stay outside without feeling observed from the taller buildings around the plot. The ground floor is an open and flexible space conceived as a garden or sequence of gardens where the kitchen, high-ceiling dining room, and a multipurpose room can be separated by sliding doors so the different types of activities can take place at the same time.

In Maggie's Southampton, gardens flank either side of the building,





**Fig. 23.** Representative cases for roof garden/terrace building.

featuring thoughtfully arranged flora and outdoor pathways that foster an interplay between the surrounding landscape and the interior architectural elements. Specifically, the delineation of four zones is achieved through the installation of "blade walls" extending outward from the structure, loosely demarcating distinct areas within the garden. These walls, constructed with pastel-colored ceramic blocks, were selected for their earthy aesthetic, evoking an appearance as if they had organically emerged from the garden soil.

#### 4.2.6. Healthcare community

The four selected cases pertaining to healthcare communities cater to specific diseases: the Santa Rita Geriatric Center (2003) serves as a community center for elderly individuals, the Centro Socio-Sanitario Residenziale (2006) focuses on sensory impairment, Monnikenheide is designed for individuals with disabilities, and the Alzheimer's Village is tailored for Alzheimer's patients and dementia care (Fig. 25). A common feature among these facilities is the division of community areas based on different functions, with distinct landscape elements, such as plant varieties, selected to aid in spatial orientation within the center.

#### 4.3. Case study comparison

A review of different typologies of healing gardens explores several

models of building-nature integration in contemporary healthcare architecture. In addition to positions of green spaces, parameters from aspects of spatiality, sensory perception, and sustainability such as accessibility, legibility, comfort, and sustainability are also essential.

Accessibility focuses on evaluating how gardens, acting as transitional spaces, offer clear directional cues and facilitate efficient internal connections to improve wayfinding. For instance, individuals with Alzheimer's disease often experience memory loss and disorientation, leading to a propensity to wander. In healthcare facilities designed for Alzheimer's patients, ensuring a recognizable and secure pathway to prevent disorientation and guide them back to familiar areas is of utmost importance. From selected case studies, the Alzheimer's Respite Centre designed by Niall McLaughlin Architects (2009) addresses these psychological and physical needs by establishing easily identifiable spaces for various activities, all interconnected with the surrounding gardens. Horticultural zones feature diverse plant varieties, distinguished by color, scent, and height, aiding patients in spatial orientation. Additionally, buildings with central courtyards facilitate circulation within and around the complex, forming a clear circular route. An example of this design approach is evident in the Healthcare Center for Cancer Patients, where the central garden shapes the primary circulation path within the building interior.

In terms of legibility, gardens with distinctive characteristics serve as

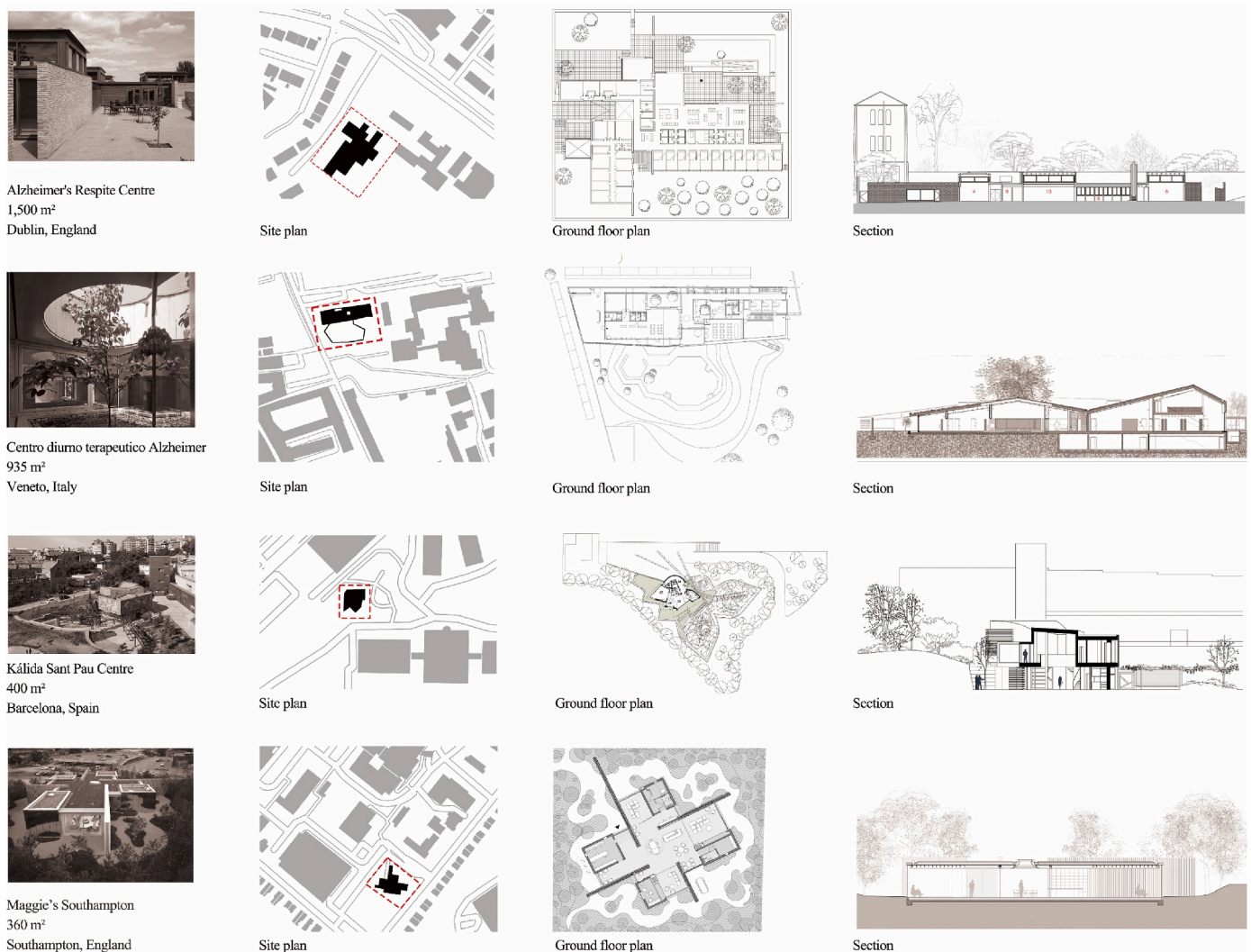


Fig. 24. Representative cases for edge courtyard building.

spatial orientation devices, functioning as landmarks within healthcare institutions on a medium or large scale. For example, the Rehab Basel (2002), designed by Herzog & de Meuron, resembles a multifunctional, diversified urban environment, akin to a small town featuring streets, plazas, gardens, public facilities, and more secluded residential quarters. Within this complex, various inner gardens of varied shapes and characters were strategically integrated to evoke a range of sensory experiences and facilitate spatial orientation throughout the building. The rooftop of the building was transformed into an extensively landscaped garden area, serving both as a therapeutic space and an accessible walking area. Similar design strategies are evident in projects such as the Kinderspital Zürich and New North Zealand Hospital designed by Herzog & de Meuron, as well as the Santa Rita Geriatric Center (2003) by Manuel Ocaña, and the Steno Diabetes Centre Denmark (2021) by Vilhelm Lauritzen and Mikkelsen Architects.

In terms of comfort, it focuses on sensory perception that comes from physical and emotional deriving health-promoting benefits through visual, tactile, olfactory, auditory, and gustatory stimulation by landscape elements in the garden (Souter-Brown, 2014). Corresponding design strategies such as avoiding glazed materials, providing safe and comfortable places to walk and sit, creating a positive distraction through various colors of seasonal plants, enabling interaction with plants, and creating opportunities for social connection and support all facilitate physical and emotional comfort (Marcus & Barnes, 1999). For

instance, the Centro Socio-Sanitario Residenziale (Residential Social-Health Center) designed for deafblind and psychosensory impaired adolescents and adults takes full advantage of this. Thematic routes are planned to stimulate users' perceptions: the odour route, which exploits the aromatic properties of certain plant species, and the noise route, which exploits certain water movements (a small waterfall, pools with drips, etc.).

In terms of sustainability, it focuses on daylight exposure and microclimate creation. For instance, in Health Care Facility Josefhof (2019) and Maggie's Yorkshire (2020), the building is fully integrated into the natural terrain. As an integral green space affiliated with the healthcare center, it fulfills multifaceted functions, including temperature moderation, provision of fresh air, and adjustment of the microclimate. The seamless integration of garden-interior spaces is facilitated by glass walls encircling the courtyard, maximising the amount of light that is able to enter the building.

## 5. Conclusion

From ancient beliefs to contemporary scientific findings, nature's therapeutic qualities are multifaceted, encompassing both individual elements and the broader relationship between building and their environment. Through a comprehensive review of historical literature, relevant design techniques of healing gardens were identified. This



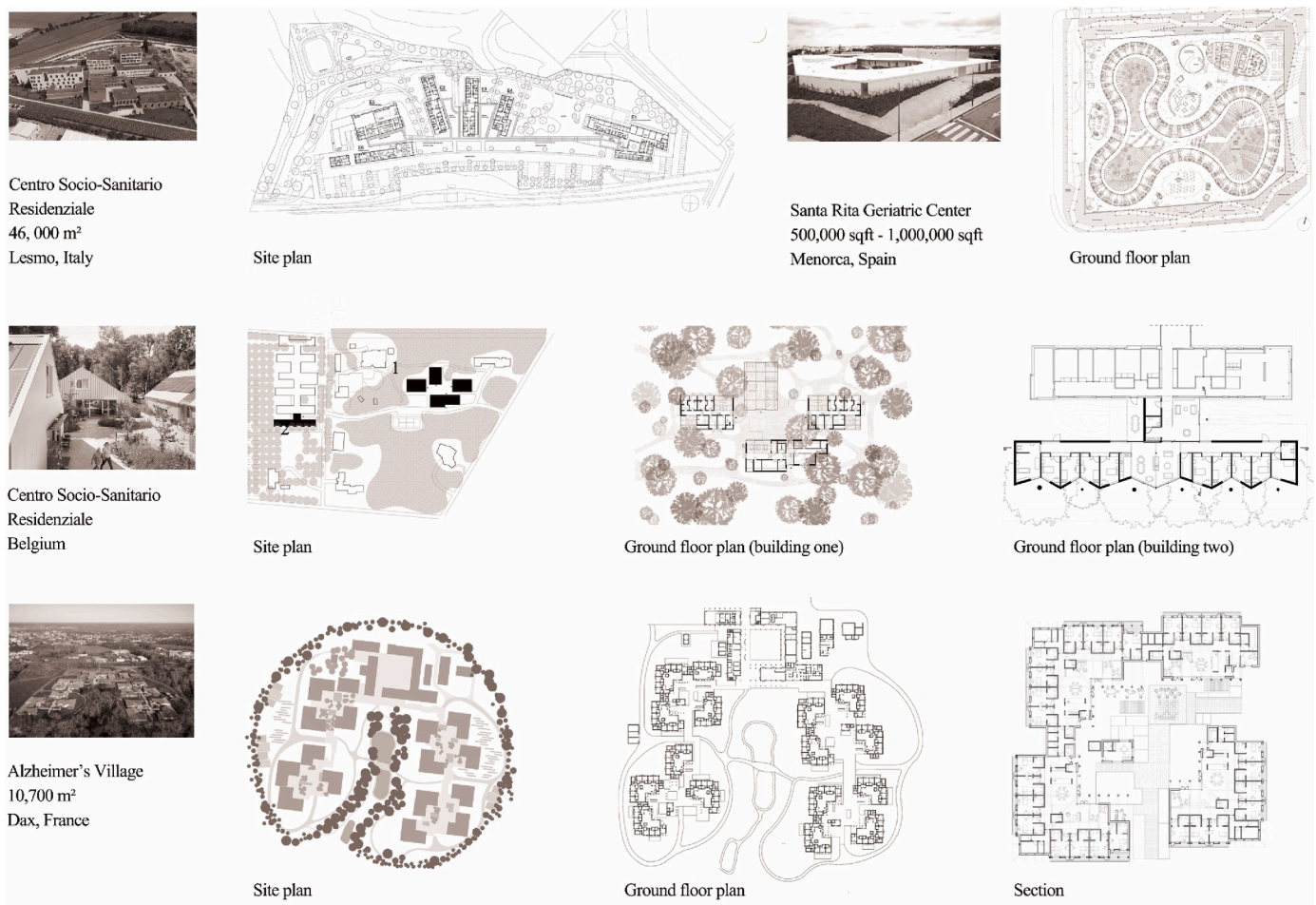


Fig. 25. Representative cases for edge courtyard building.

involves integrating different types of healing gardens, such as courtyards, interior gardens, and roof gardens/terraces, with architectural spaces. Exploring various spatial configurations and forms can significantly influence user experience, flow, and engagement with the environment. We found that the significance of healing gardens in fostering effective and meaningful connections between buildings and nature has become increasingly apparent, highlighting a growing trend toward achieving therapeutic integration.

In the twenty-first century, according to the contemporary needs of patients, twenty-three healthcare tailored for conditions such as Alzheimer's, cancer, disabilities, elderly, etc. were selected. Then, categorising these cases based on their location within buildings, resulting in six classifications: multiple courtyards building, multiple courtyards building with central roof terrace, central courtyard building, roof garden/terrace building, edge courtyard building, and healthcare community. Through the analysis and comparison of twenty-three cases, we have observed that "typology" only serves as a design strategy contingent upon context and architectural performance. The relationship between healing gardens and architecture appears to be inherently flexible and less constrained.

This study bridges the research gap in the field of healing gardens, offering a novel interpretation of contemporary building-nature integration. Regardless of the building typology employed to achieve therapeutic integration, key considerations encompass spatiality, aesthetics, and sustainability, incorporating elements such as accessibility, readability, comfort, and ecological factors. Specific design techniques encompass wayfinding, spatial orientation, sunlight exposure, plant selection, and material composition. Moreover, users' diverse needs

must be considered in design applications. For instance, in garden spaces designed for patients with Alzheimer's disease, a pathfinding system should be incorporated to establish seamless integration between indoor and outdoor road networks.

This research is part of an ongoing PhD research and forms the basis for developing the design guidelines for healing gardens and integrating them into the planning of hospitals and healthcare institutions. It aims to contribute to a comprehensive understanding of the evolution of healing gardens and informs evidence-based design principles for modern healthcare institutions. Architects and landscape architects can make a better health-promoting environment by designing interventions that calm patients, strengthen their stress-coping resources, and address their emotional and social needs.

#### Financial disclosure statement

The authors declare they have no financial interests.

#### Ethical statement

All data analyzed in the current research were obtained from publicly available datasets. A secondary analysis of publicly available data does not require Institutional Review Board approval according to the corresponding author's institution.

#### CRedit authorship contribution statement

**Liheng Zhu:** Conceptualization, Data curation, Formal analysis,

Funding acquisition, Investigation, Methodology, Resources, Software, Visualization, Writing – original draft, Writing – review & editing. **Javed Shah Sarah:** Methodology, Supervision, Writing – review & editing.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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