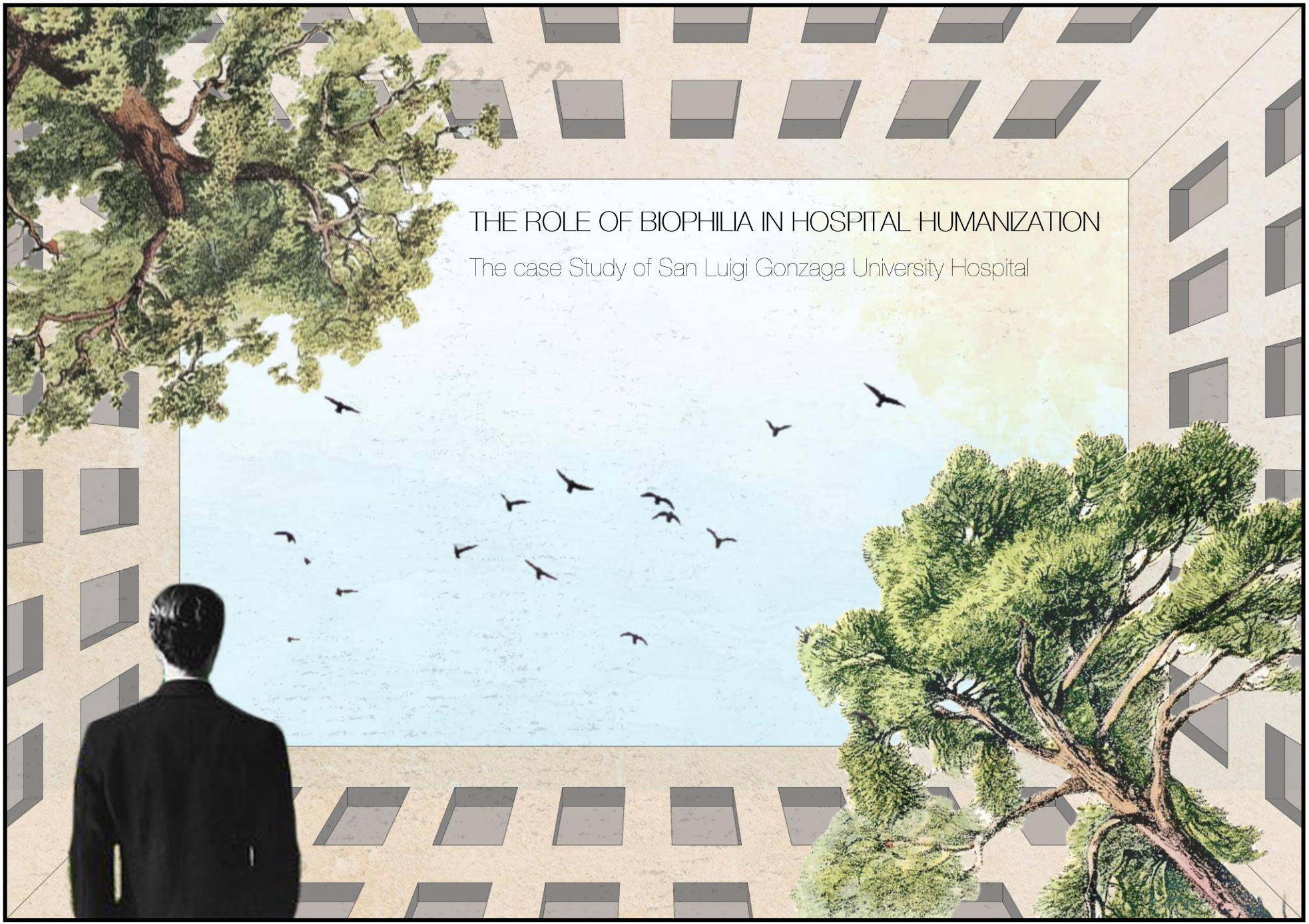
THE ROLE OF BIOPHILIA IN HOSPITAL HUMANIZATION
The case Study of San Luigi Gonzaga University Hospital

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THE ROLE OF BIOPHILIA IN HOSPITAL HUMANIZATION

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Dedications

I proud of myself to have a precious family and I feel honored to be a part of this family. I would like to express my gratitude for your care and support over the years. Thank you, mommy and daddy, for instilling me with a strong passion to learn and doing the bests to find the right path of my life. I will never forget the best and valuable gifts you could give me—perseverance and ambition. A special thanks to my brothers for motivating me to reach this point. Words are limited to describe the importance of each of you in my life.

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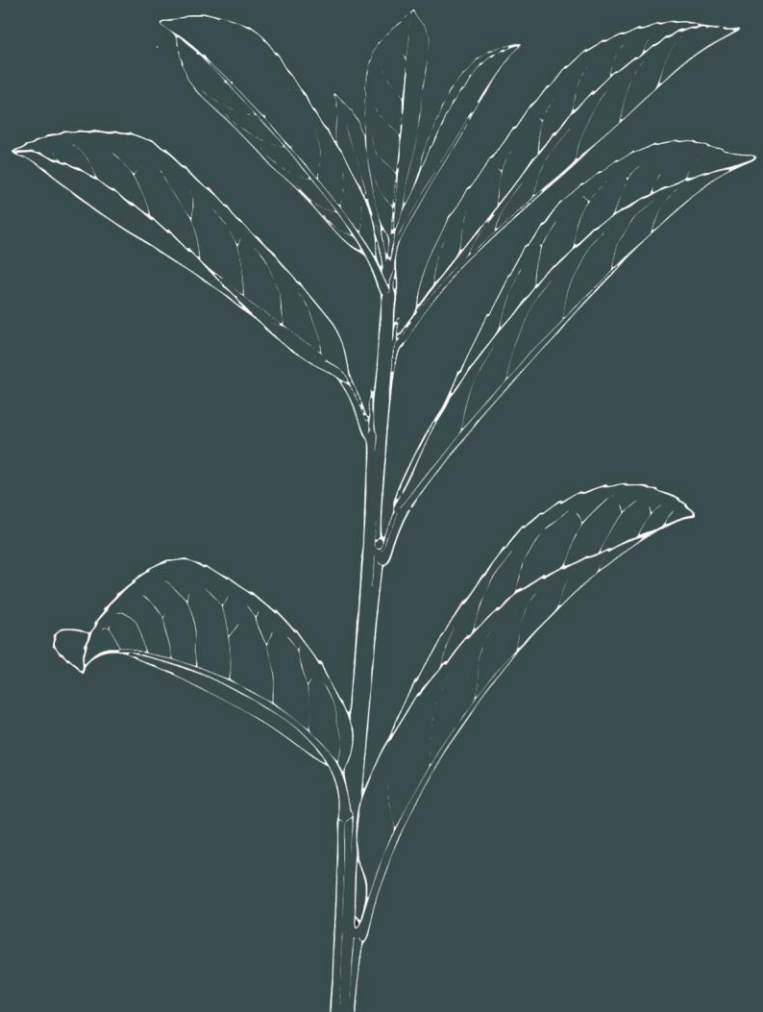
Abstract

Hospitals and healthcare centers have faced with radical transformations over the past decades. Additionally, the expectations from these institutions have been increased to cover a wider range of human needs (users of hospitals), coincide with functional and technological improvement, to turn these places pleasant and free from intense pressures and stress. That is to say, architecture has always been in close relation with health, therefore, the concept of humanizing spaces and architectural quality could mean also focusing on the non-physical needs of patients and their interaction with the environment too, despite the fact that this subject wasn't always evident.

Looking at the modern era and its impact on the construction industry and people's lives, a deep gap has been formed between human and his source of existence, nature, and this has multiplied with the advancement of technology and functionalism. Thus, the theory of Biophilia which describes the innate affinity that humans have for nature suggests a scientific hypothesis for environmental behavioral responses.

Natural environments have restorative and benefits forming positive changes in cognitive, physical, and social functions. Humanized spaces can be reached following the findings of environmental psychology researches, and expanding the principle of connection to the nature through the methods of Biophilic architecture and healing environments design in an evidence based design perspective.

Contents



INTRODUCTION

01

Pages 7-36

HOSPITAL HUMANIZATION

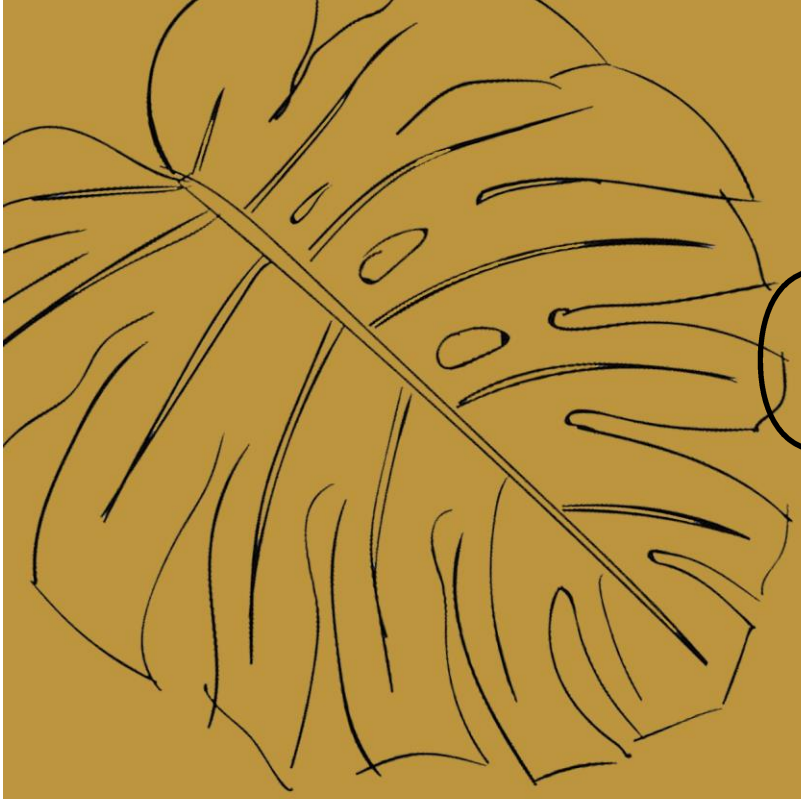
1.1 HEALTHCARE ARCHITECTURE THROUGH THE AGES

1.1.1 The Sanctuary of Asklepios at Epidaurus
1.1.2 The Church and Spiritual Healing
1.1.3 The Pavilion System and Nightingale wards
1.1.4 Hospital as Machine

1.2 THERAPEUTIC ENVIRONMENTS

1.3 THE CONCEPT OF HUMANIZATION

1.3.1 Anthropology, Human scale and Architecture
1.3.2 Humanization in Healthcare Environment



02

THEORY OF BIOPHILIA

2.1 BIOPHILIA THEORY

2.2 GREENERY IN HOSPITALS

2.2.1 Design Based on Biophilia

2.3 EXAMPLES OF BIOPHILIC DESIGN IN HEALTHCARE FACILITIES

2.3.1 Khoo Tech Puat Hospital

2.3.2 Östra Psychiatric Facility

2.3.3 Meyer Pediatric Hospital

BIOPHILIA AND HUMANIZATION

3.1 TOOLS AND METHODS OF BIOPHILIA FOR HEALTHCARE HUMANIZATION

3.1.1 Viewing Nature in healthcare Environments
3.1.2 Using Natural Light in Healthcare Spaces
3.1.3 Utilization of Plants in Healthcare Facilities
3.1.4 Wood and Other Natural Elements in healthcare Facilities

03

Pages 63-84

04

DESIGN INTERVENTION

4.1 THE CASE STUDY OF SAN LUIGI GONZAGA HOSPITAL

- 4.1.1 History of Complex
- 4.1.2 Structures and departments
- 4.1.3 Site Location

4.2 SITE ANALYSIS

4.3 COURTYARD DESIGN

4.4 ROOF GARDENING

4.5 HOSPICE DESIGN DEVELOPMENT

Introduction

Healthcare facilities, Hospitals, clinics, and in general these institutions, are daily dealing with a multitude of a patients, struggling with problems and diseases, prepared to be treated. That is to say, the main task of mentioned places is focused on the diagnosis and treatment of the “body” content.

But here a question is forming that; whether the physical diagnosis and treatment are the only functions that have to be done in these places?

Does only physical treatment mean the complete recuperation from the pain and illness of the patient? If the answer is yes, then what is exactly the provider of the psychological and social wellness aspects of the patient?

Healthcare facilities environments potentially play a significant role to influence, positively or negatively, on their occupants and patient's medical result. The health state of an individual according to the World Health Organization (WHO), is defined not only as being free from illness but also a complete physical, mental and social wellbeing. Therefore the function of a hospital is more than a body treatment in the medical sectors. In addition, the built environments, planning, and the type of wards or other spaces have been changed in healthcare facilities over time but, the spatial quality and characteristics in these facilities are given the slightest preference and priority. In such a sense the psychological and social needs of the users almost have been neglected which resulted in less humanized spaces. (World Health Organization, n.d.)

Unlike collective thinking, medicine healthcare is not all about the treatment of the body. This is while digging the architecture history of healthcare facilities reveals the importance of holistic treatment from the first steps until forming the concept of hospitals.

As described by Flavio Albanese, the meaning of 'wellness' is the balance of mind-body-spirit. To attain this balance, it is essential to study the role that architecture plays in healthcare, in addition to the one played by the community and the ever-progressing technology. (Sheth, 2018)

Characteristics of an environment can create hope and positivity. They can accelerate or vice versa, decelerate the healing process. It is clearly comprehensible that there is an active interaction between the environment and occupants. Thus, the quality level of this interaction eventually will be the determinative factor. To achieve this quality or increasing it in the hospital spaces, the environment not only should meet the medical needs of the patients but also should cover wide aspects of needs to provide different types of comfort, or in another word setting up the environment based on the human needs to make a place more pleasant or more suitable. Hence, it is imperative to have a clear concept of humanized spaces in healthcare centers that can be defined as healing spaces.

The objective of this thesis is to synthesize the established research concerning human-nature relationships from the fields of Healthcare Design Architecture and Environmental Psychology to investigate Biophilic approach and use it, as a key to apply the humanization concept, increase the connection to nature and enhance places of wellbeing within healthcare environments.

This study will rely heavily on a review of previous literature from the fields of humanization of healthcare spaces and Biophilic design for healthcare facilities identified above.

Within this thesis, attention will be given to quantitative and qualitative evidence that supports tested hypotheses related to connection to nature and the subject's well-being. Examples of successful projects implementing Evidence-based healthcare design approaches will also be utilized to understand previous and current design solutions that increase connection to nature with preferential consideration given to projects that incorporate greenery concepts in the environment.

These bodies of knowledge will then be utilized for parallels and synergies in order to propose design ideas by applying the Biophilic attitude of healthcare environments.

Research on changing the healthcare and its environment toward more comfort of the user connected with natural aspects provides an opportunity to identify the missing elements in the prevailing system. Toward the changing intellectual process of communities about feeling a lack of linkage with nature and naturalness more than before and demanding a patient-oriented and holistic environment, this study may help to understand these concepts theoretically.

The conducted study leads to some proposal design ideas for San Luigi di Gonzaga Hospital, a pavilion hospital complex situated amidst the suburban context surrounded by plenty of trees. The proposed ideas offer to utilize the potential features of abandoned but useful spaces between the buildings, in addition to an extending plan of a hospice care facility of the complex.

The proposed project aims to implement the humanization attitude in order to provide therapeutic environments that make patients, visitors, and staff more comfortable, relaxed, minimizing the stress level, and any kind of distresses by applying the theory of biophilia through benefits of existing features of the site.

This dissertation is a study concentrated on The San Luigi di Gonzaga Hospital relying on its existing features, specifically the greenery potential of the complex. The project contains design proposals for re-designing the unused spaces and designing additive parts for hospice care to develop the unit. It is also worth mentioning that the structure of the thesis is rooted in two main concepts comprising the Hospital Humanization and the Biophilia Hypothesis. Generally, the thesis configuration is based on the following chapters:

The first chapter deals with the humanization of hospital spaces. In addition to that, some observations, examples and researches around these topics will be provided.

More precisely, the key aspect discussed in the first chapter is the concept of humanizing the space, specifically in healthcare facilities, aiming at increasing the quality of the indoor and outdoor environment building and its linkage to human health and productivity and reviving the human value in the hospital complexes. To enlarge this, different attitudes, perceptions, and notions toward humanizing investigated that allow us to have a clear prospect from an architectural point of view and the importance of this subject. Therefore the different types of care spaces and styles from ancient times to the new era scrutinized, finding advantages and disadvantages which help us for better understanding. In addition, the sources of literature related to humanization content in healthcare facilities and hospitals are reviewed to clarify and understand better their potential outcomes between the consumers to establish a theoretical framework for the study.

Another essential point discussed in the second chapter is emphasizing the greeneries in hospital environments and benefits by introducing the Biophilia hypothesis that leads us to take advantage of the positive characteristics of nature and naturalness to our design approach and applying Biophilic architectural design.

In the second chapter, the Biophilia hypothesis introduced and the human-nature relationship from the different viewpoints are explored. The other important purpose in this chapter is to understand the implication of the Biophilia hypothesis and Biophilic elements in the healthcare facilities to improve the quality of the environment and subsequently health and well-being of the user in the beneficial experience through space.

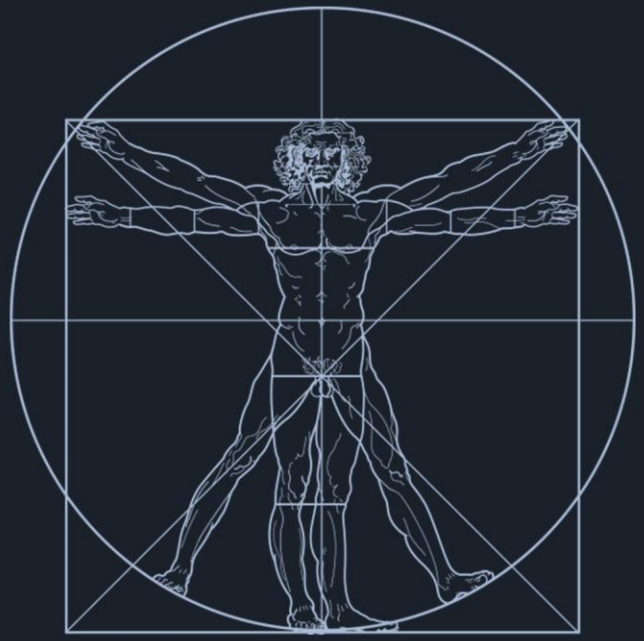
In chapter three the tools and methods that Biophilia can offer have been investigated in order to identify possible opportunities to apply the concept of humanization in the healthcare facilities. Thus, the growing body of previous literature has been reviewed to address the topic strives to focus more on the evidence that connects the two and looks specifically at environmental quality and comfort.

In the fourth chapter, the case study of San Luigi Gonzaga Hospital, its current situation, and its functionalities are examined. Moreover, some examples and observed case studies which are notable in this particular field are mentioned to provide a better intuition.

The pursued aim is to present two design ideas based on the Biophilic approach in order to provide environments that can offer the concept of humanization in an applicable way at an optimal level.

Chapter 01

Hospital humanization



Nowadays, hospitals and therapeutic complexes are the center providers of treatment and healing services for the communities. The economic situation and sequential changes within the society on one hand, and advancement of psychological and medical knowledge as well as technology, on the other hand, have always created opportunities to promote health services by changing the way of delivering them. Studying and reviewing the design development of the hospital's construction during history illustrates the extensive changes throughout technology and medical sciences, however, these changes have not always influenced positively and even sometimes and in some cases restricted establishing an appropriate environment to prepare these services.

It should be kept in mind that a hospital must not work as an organization in which the patient hospitalized, treated, and returned home. It must work as an active community for the patients who make this complex succeed. So to say, a hospital should be a living space that meets the needs and expectations of patients rather than a place to store and stash them. (Marfo, 2007)

In this chapter, the concepts of humanization in healthcare centers and hospitals are discussed by studying the history of healthcare facilities and various published works of literature around this subject to understand different definitions, perceptions, and attitudes in order to perceive the right implication and comprehensive understanding of this term. Then, the subject of the therapeutic environment as a concept referred to the humanization will be presented and discussed.

1.1 HEALTHCARE ARCHITECTURE THROUGH AGES

Through the history, there were some spaces ranged from the home to the church which have been served the treatment and care the people who are struggling with the different kinds of sick and illnesses, and then,

those spaces developed until nowadays to the places that we all know as hospitals.

The term *Hospital* is taken from the Latin word "*hospitalis*", which relates to guests and their treatment. (Lundy & Masters, 2017)

This word represents the initial use of these institutions not only as places to heal and caring people, but also as a shelter for the tired or poor travelers. In another word, a healing space is a kind of house or mansion built by some governments or philanthropists in some cities, where the poor patients are accepted for free and doctors treat, medicate and care for them. (Kaviani pooya, 2010)

Hospital first appeared in ancient civilizations of Egypt, Greek, Persian Empire (Iran), and India as an institution aiming to provide cures. Crossing through the eastern territories, by citing historical evidence, the temples were the first general provider of diagnostic services, healing, and treatment that functioned as the centers of medical advice which were often run by religious system. "Asclepius" was among the first hospitals which was known as the god of medicine in Greek. The hospital and medical training center of "Gundeshapur", built by Sassanid Persian Empire is also a mentionable example in the historical background of the hospitals and healing places. (Marfo, 2007)

Figure 1. Medieval home centered care (Sheth, 2018)

For many centuries, hospitals developed in association with religious institutions and in early western history and by increasing the power of Catholic Church, the responsibility of caretaking of the infirm was in hand of the monastic and religious orders within the cathedrals. Although the healing centers of some wealthy cities in Europe were operating under the religious rules, but they gradually became more a hub of “civic enterprise” in the community, rather than being a religious one, and many of those were looking like the schools in the urban environment and this was the starting point of forming the urban hospital landscape in the 19th century. In the late 1700s. Re-evaluation aiming to reform the hospital spaces in order to set some fundamental standards of hospital typology was initiated and promoted by Louis XV in Paris. In such a way that for the first time, transforming the environment of hospitals relying on creating a pure and natural ambiance that provided clean air was in the spotlight, and some ideas proposed in order to emphasize the importance of space and recognition of the clean air and hygienic conditions as the main factors of health within the hospital's environment. (Burpee, 2008)

In recent decades, new ideas and concepts have appeared in the architecture and design of healthcare environments toward providing a more homely atmosphere that induces more comfort to the users. These ideas required integrating the inner and outer environments to promote the level of healing. By surveying the architectural evolution of healthcare environments and spaces dedicated to caring and treatment, brings us an important question; why these factors never considered? If so, what leads to its elimination?

In order to answer the question, it is necessary to head back the evolution of healthcare architecture to understand when and how healthcare regarding treatment began to fail and comprehend the current requirements.

1.1.1 THE SANCTUARY OF ASKLEPIOS AT EPIDAURUS

An Asclepius sanctified to the god of medicine is a great example of a Hellenic architecture for healing containing theater, temples, halls, Baths and for hospital as well as sports activities in ancient Greek and Rome. (Sheth, 2018)

Asklepion as the first examples of the hospital architectural form, with its leading role in the emergence of a new typology for therapeutic sites, greatly influenced Greek medicine and emphasized the need for treatment, consist of sleep, fitness and snakebite in a specific environment, to create better and more comfortable conditions.

They could provide such environments that were bigger and enclosed in order to prepare a situation in which the patient could sleep and heal while accessing the open spaces aimed at reaching the acceptable fitness were dynamically obtainable. Examining various examples of Asklepion architecture shows that the use of columns as a functional element in these spaces has been common.

Also, with the expansion of the construction of these spaces, the use of Greek architectural tools and elements was used to improve performance, so these buildings became the most practical hospital typology that pursued a specific goal of treatment and healing. (Demiray, 2018)

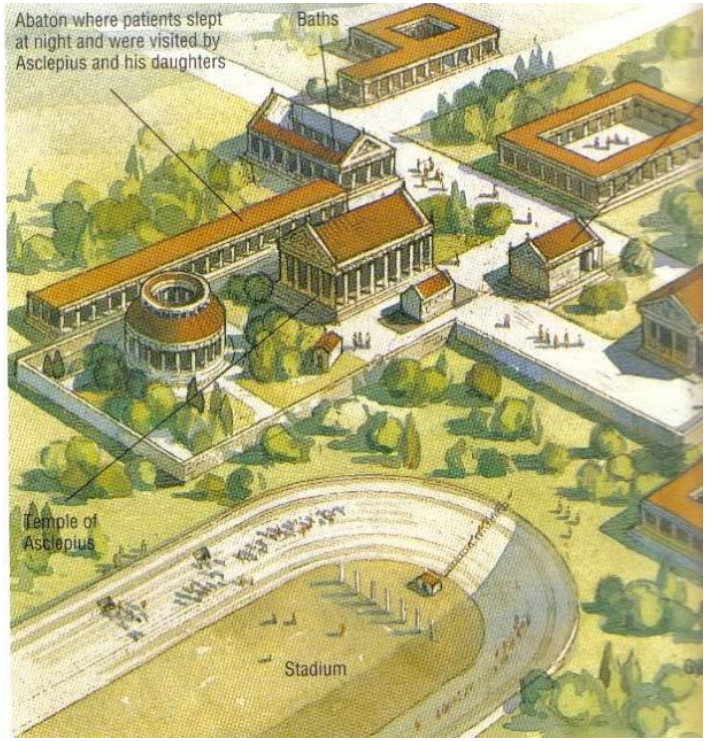


Figure 2. Asklepios at Epidaurus (Greek History and Prehistory, 2016)

According to the evidence prepared by the historian and archaeologists, any kind of action and function was organized and designed in these places to reconcile the mind-body-soul balance, referred to as what we are called today as holistic healthcare. The shell form of a structure operated as an acoustic tool where the users served it to escape from the unpleasant noises suffering them. Clean places for relaxing and calming were prepared by a dome-shaped structure which also allowed patients and other occupants to connect the nature accessing the landscape view around. (Sheth, 2018)

The treatment in these temples is largely focused on creating a healthy lifestyle with a special emphasis on the spiritual needs of the individual, and the healing process usually takes place in the settings of natural beauty and the appearance of beauty and the primary treatment for acceptance in Asklepions was cleansing, therefore a series of baths and with a cleansing diet were included. (Osborn, n.d.)

Figure 3. Pergamum Asklepion by Stephen Maybury (Maybury, 2015)

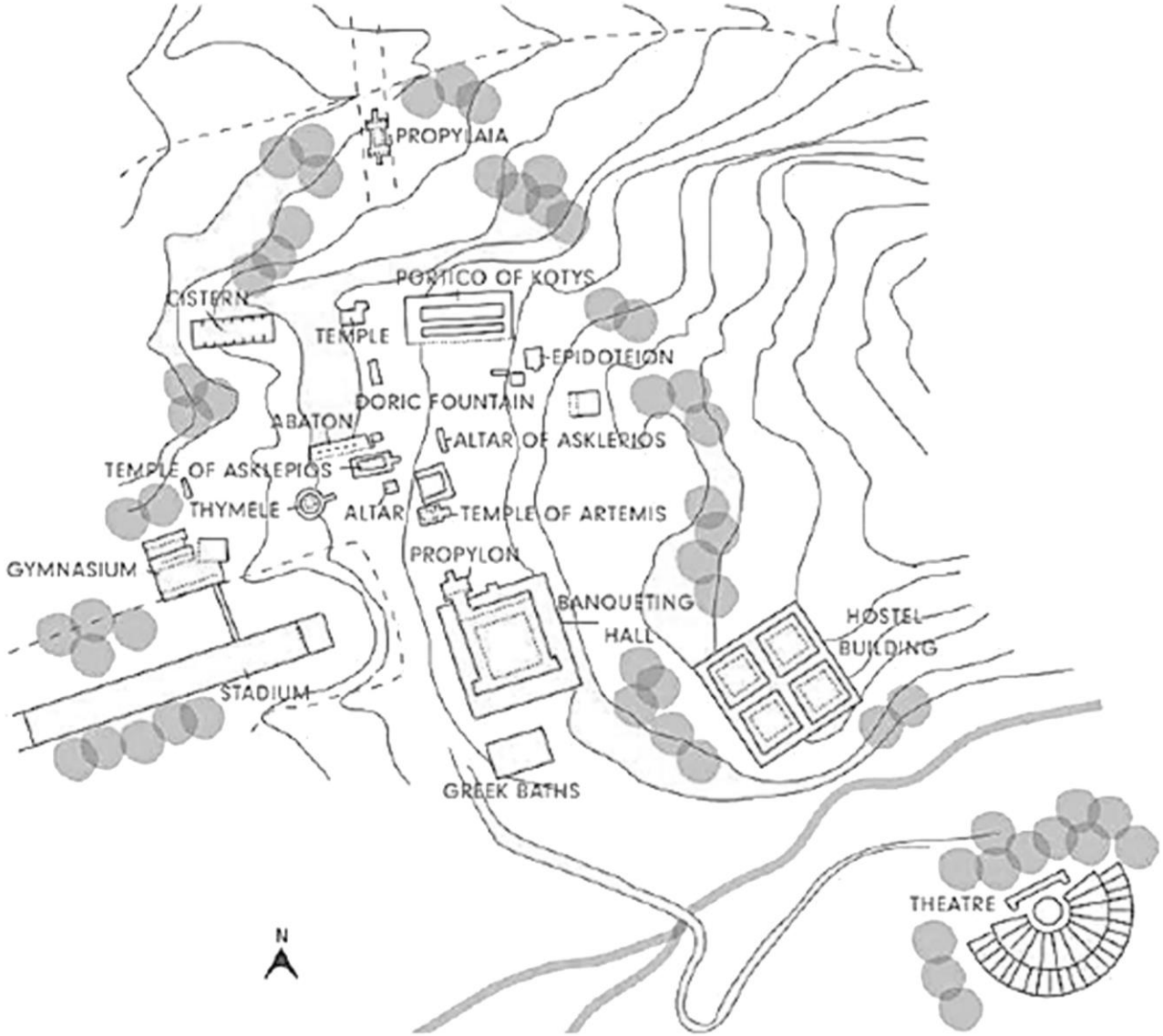


Figure 4, site plan,
the sanctuary of Asklepios at Epidaurus (Sheth, 2018)

1.1.2 THE CHURCH AND SPIRITUAL HEALING

After 400 AD and then after for many centuries, hospitals developed in association with religious institutions and in early western history and by increasing the power of the Catholic Church, the responsibility of caretaking of the infirm was in hand of the monastic and religious orders within the cathedrals.

The monarchs of the 6th century such as Charlemagne reinforced the role of the churches through attaching hospitals for every cathedral in their empire. Therefore, most of the churches or cathedral were the health providers for poor people or travelers by multiple ward housing forms. By continuing to expand the multiple wards within the religious institutions, this became a standard for many years for public hospitals. The configuration of the wards provided a possibility for the sick people to see the altar which assists with their recovery. The plan of cross-shaped in these buildings is similar to many buildings today.

The most important emphasis of the healthcare facilities under the religious rules was on the treatment with the help of spiritual intervention to heal the infirm, and other factors were mostly neglected. (Sheth, 2018)

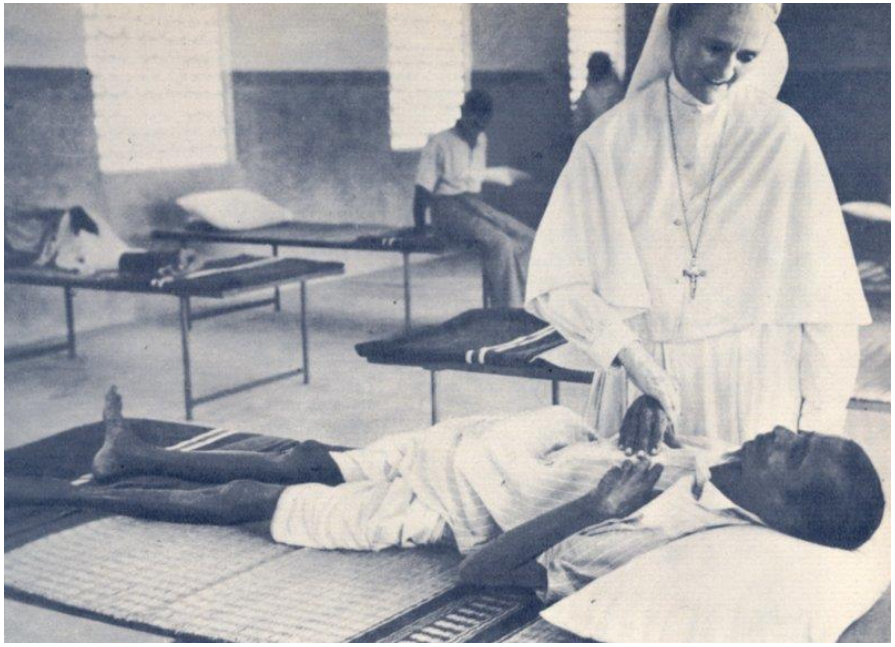
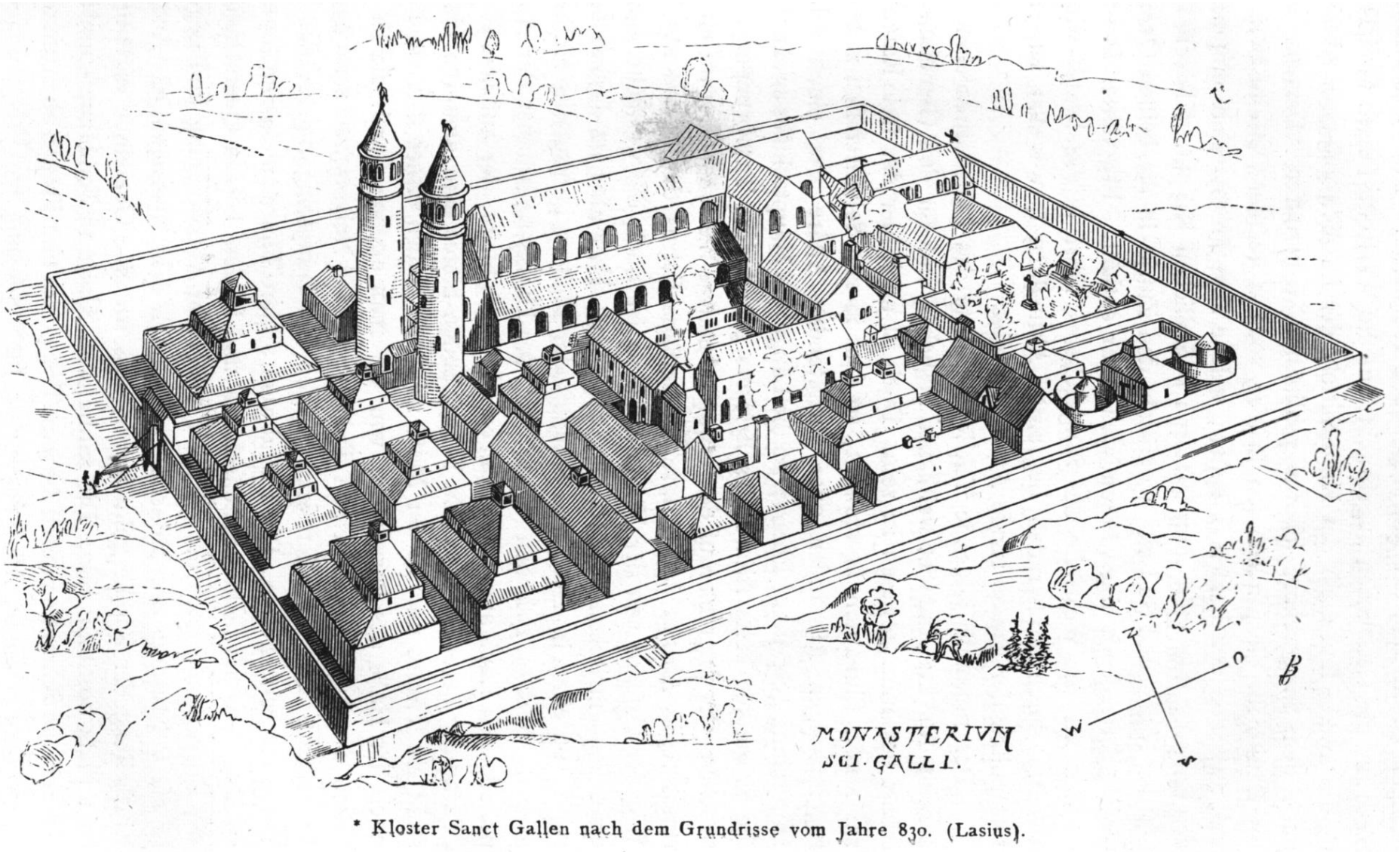


Figure 5. Salesian sister caring for sick and poor in former Madras Presidency, India. Catholic women have been heavily involved as care givers. (Hunger and sickness Madras, 1939)



* Kloster Sanct Gallen nach dem Grundrisse vom Jahre 830. (Lasius).

Figure 6. The Carolingian Abbey of Saint Gall, by Johann Rudolf Rahn (Rahn, 1876)

Catholics who have been involved in health care for centuries have always strived to serve the spirit of Christ and to reach out to the church as they did their duty. In the sixteenth century, theologians repeatedly start to do the treatment process and the issues set in medical practice. Therefore, questions toward how to ascertain death and which medical manners are needful to extend the life and which methods are optional. Specialists in Catholic health care employed treatment rules that have been accepted upon by theologians as the complete table of rules for sympathetic health care. The growth of catholic health care during the late 19th century and early 20th-century was more prosperity. (Kopfen, D'Rourke, & Hame, 2001)

Figure 7. Catholic theologians and Hansen's disease patients.
(Gibson and Mother Marianne Cope, 1886)

1.1.3 THE PAVILION SYSTEM AND NIGHTINGALE WARDS

In the late 1700s. Re-evaluation aiming to reform the hospital spaces in order to set some fundamental standards of hospital typology was initiated and promoted by Louis XV in Paris. In such a way that for the first time, transforming the environment of hospitals relying on creating a pure and natural ambiance that provided clean air was in the spotlight, and some ideas proposed in order to emphasize the importance of space and recognition of the clean air and hygienic conditions as the main factors of health within the hospital's environment. Among the two proposed architectural typologies, the pavilion system prevailed. (Burpee, 2008)

By changing the basic typology of hospitals, the first steps were taken to design more healthy space and creating a better healing environment by observing the basic principles into the hospital wards, therefore the "humanist approaches" were taking into account more than before. From the most influential figures in this field, Florence Nightingale, known as the mother of nursing is mentionable. She saved many soldiers life during the Creamin war by providing a better healing environment which focused on physical surroundings, social welfare of the patients, providing access to natural light, fresh air and feeding healthy in a hygenized space with the environment management in a clean manner. (Nightingale, 1863)

Figure 8. Florence Nightingale (Hering)

Figure 9. Typical plan of the Nightingale ward | by author

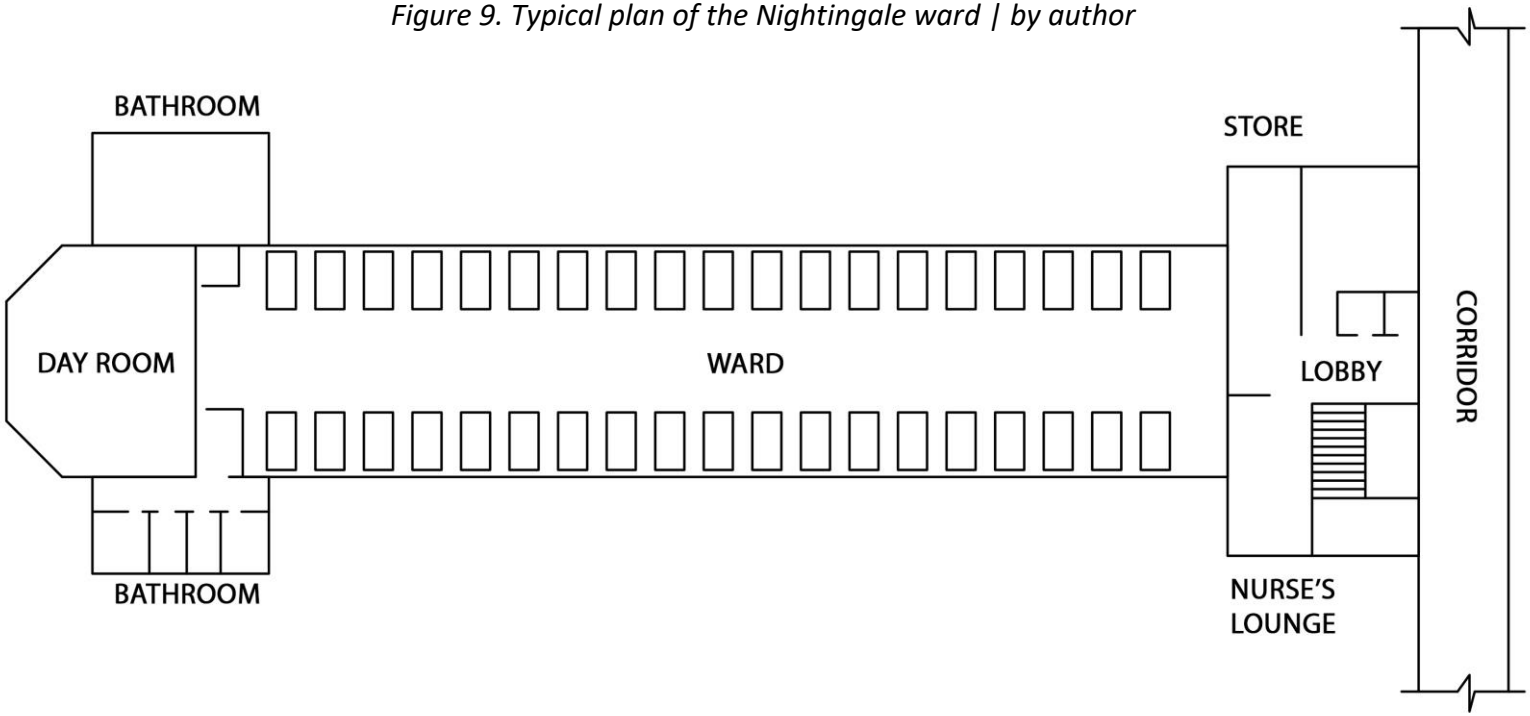


Figure 10. View of Hopital Lariboisiere, Paris, before 1880 (b/w photo) (French Photographer)

Corridors as the main body in the hospitals with the pavilion-style typology, played a key role to keep active the circulation system. Moreover, the finger planed wards were extended off to the linear shape of the corridors in order to penetrate the light, fresh air, and garden view. The pavilion-style demonstrates the function over form. The influence of these priorities for designing hospitals continued over the next hundred years until the beginning of the Second World War.

What that still has influenced today's hospital buildings somehow can be seen in the pavilion design style that has reflected being the forerunner of "evidence-based design," strategies in which environmental factors such as creating garden views, allowing to penetrate fresh air and, natural light make a set. (Wagenaar, 2006)

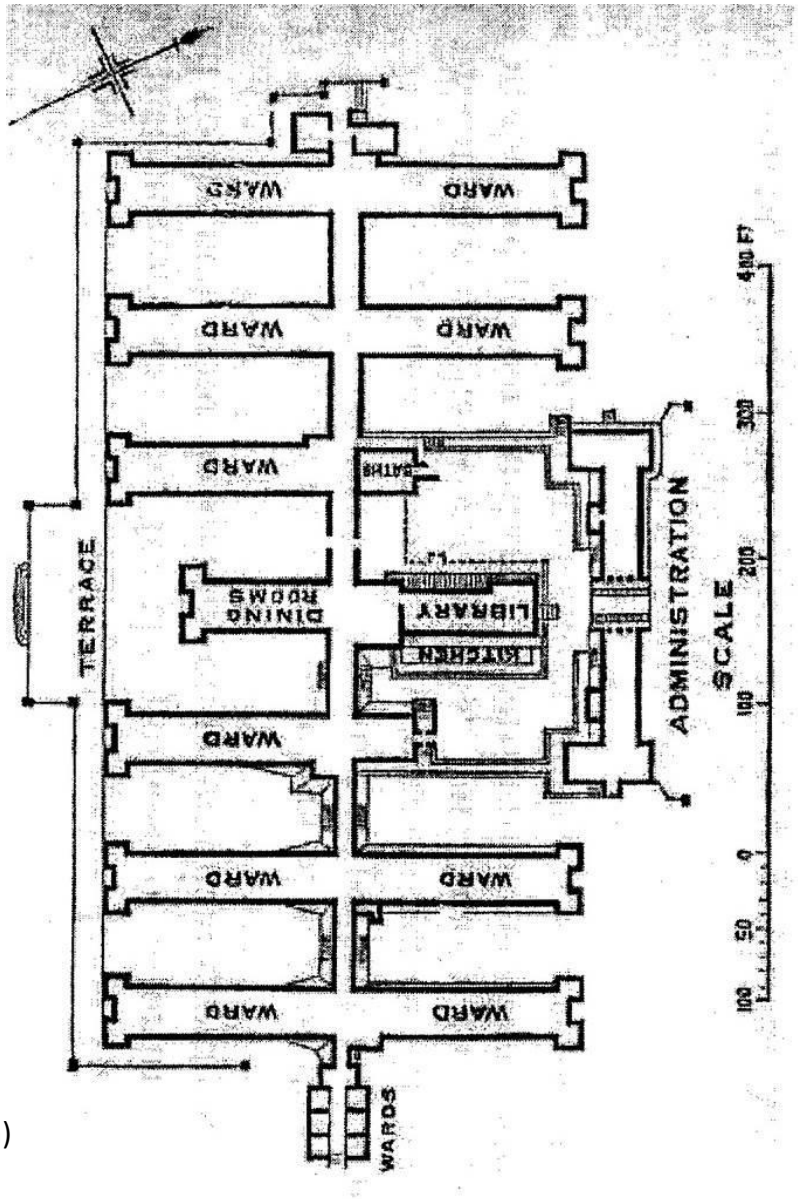


Figure 11. The Royal Herbert pavilions in Woolwich (Galton)

1.1.4 HOSPITAL AS A MACHINE

The hospital architecture after the Second World War through its association with booming the modern business, as well as entering technology into the building industry, transformed the concept and the pavilion models of Nightingale into Podium or the Platform typology that expressed and prioritize the efficiency and extraordinary power of medicine over comfort, healing, and cure. Regarding this matter, their configuration became more like an office building, with the long and deep span, mechanical ventilation inside the interior spaces, rising the levels into the vertical direction and multi-floor blocks dedicated to the wards on top and moving people through them with elevators. (Adams, 2017)

The complicated structure of platform typology resulted in creating a confusing circulation pattern without discipline arrangement and hierarchy program in which as an example, at the peak of the hospital day, nurses spent 40% of their time to commute and to move the patients from a point to another. So that eventually, this attitude aided in turning out these mega hospitals into mechanization, shifted to mechanized approach and made a complex machine that did not care about the humanistic factors. Also nowadays this kind of hospitals are being built with no relation to the outside of it. (Burpee, 2008)

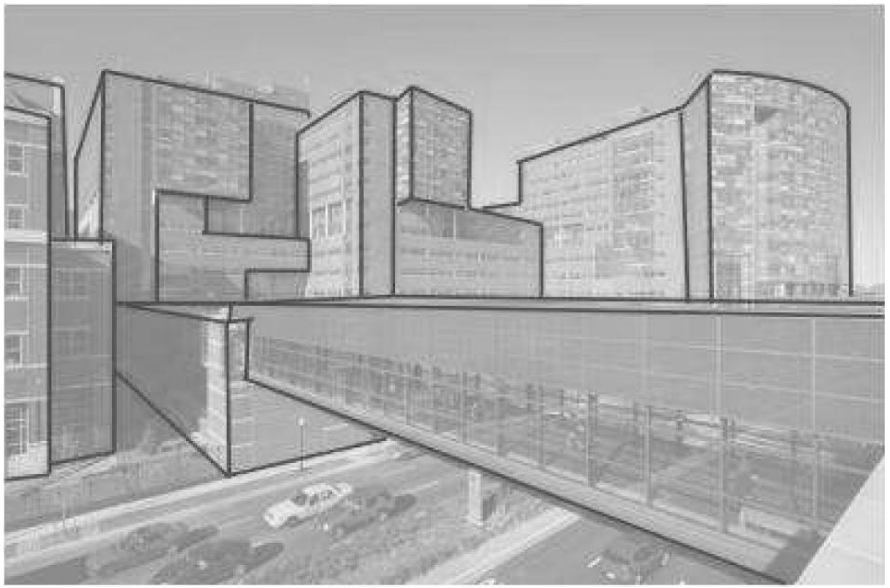


Figure 12. The John Hopkins Hospital - Decorated blocks (Sheth, 2018)

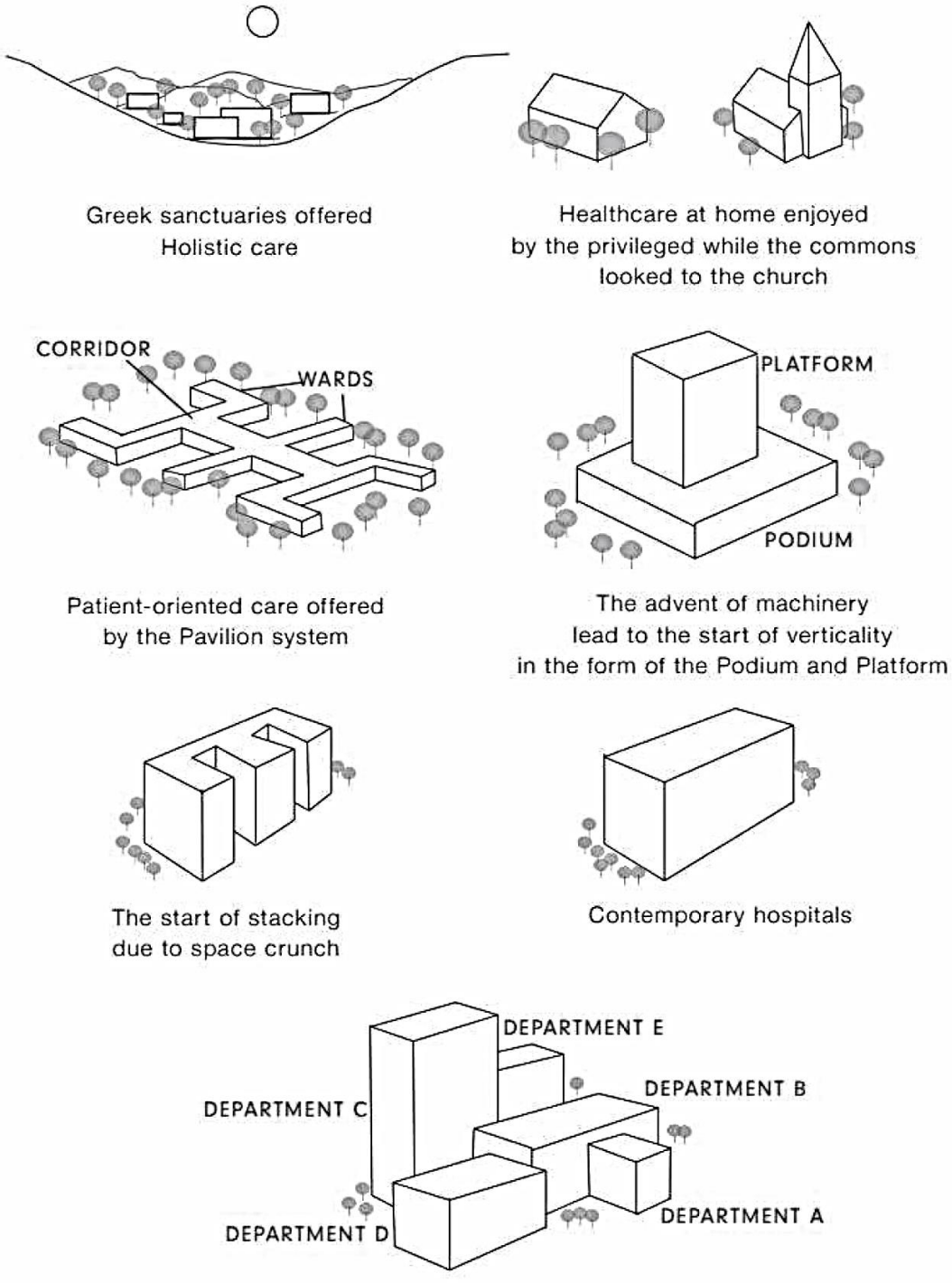


Figure 13. Evolution of healthcare architecture (Sheth, 2018)

The research field of Evidence-Based Design that is relatively new, stemmed from the intuitive hypothesis that makes clear designing the places in which achieving human comfort can be reached which is similar to the Nightingale's principles. (Alfonsi, Capolongo, & Buffoli, 2014)

As we have seen, the evaluation of the healthcare centers and hospitals, the way of looking at the healthcare facilities and human during the history, have been subjected to many changes from religious caretakers to specialists, from a simple home to complex mega buildings with different philosophies in their period. But one thing that has never changed is that these places must prepare the best treatment and healing process as much as they can, for their users that are people from the patients to personnel, families, and visitors. Hospitals are the architectural productions at serve of human hence, this production can never be useful if they can’t give the one that humanity needs. Improving the technology in building industry and medicine should be seen in a hospital that improves the quality and comfort for its user and their community as a full package, thus it needs to consider all the aspects of humanity in order to humanize its spaces. Surveying evolution of healthcare architecture through history demonstrates the importance of giving attention to holistic treatment, before creating the places we call nowadays hospital. (Burpee, 2008)

1.2 THERAPEUTIC ENVIRNMENT

Healing is a property in which the body's condition improves, the disease is cured, and health is restored. Nowadays, the machine world penetrates all areas of human life day by day, thus nervous pressures take on meaning and significance. Mental pressure or "stress" is an internal state caused by physical desires or social situations that is potentially harmful, uncontrollable, or beyond the individual's ability to adapt. It is not possible to evaluate and control mental images and human perceptions without considering the stressful factors of the natural environment. The damage caused by stress and nervous crises in social life has had many physical, psychological, and social consequences at the expense of exorbitant costs, and has led researchers to develop programs for review and retrieval, by combining human beings and the natural environment, the health and mental health of the society should be approached with a hopeful quality. Healing is a broad correction that does not necessarily refer to the treatment of the disease. Rather, it is a general process of healing that considers the soul and the body together. Given that in modern life today, humans spend most of their time in artificial and man-made environments. These physical environments affect human behavior, and good architecture from one place can help strengthen abilities and reduce stress. Today, architects, physicians, nurses, and psychologists refer to the building as a component of the healing process. In this regard, studies specifically show the effect of healthcare on healthy individuals, the treatment process, and the recovery of patients. The non-toxic essence of the environment is critical to the realization of an inherently healing environment. (Nazer Ilkhani & Rahaei, 2015)

From what have been surveyed as the healthcare history and their environment, it is very necessary to take some steps forward and try to create better environments in healthcare facilities.

One of the major challenges that we face in the provision of health care is the gap between patient expectation and affordability which is not just applicable in the first world but in every country that

has a health service. The important objective, therefore, is to leverage as much value as possible to enable the health service to be as efficient as it possibly can. (Nedin, 2015)

One mechanism that we can use to leverage value is integrating the therapeutic environment and of course, that does have many parts; for example sufficient car parking, clear wayfinding, patient privacy and dignity, responsive acoustics, plentiful levels of natural daylight in, interesting and or relaxing views, lower risks of hospital-acquired infection, thermal comfort, environmental control, artificial lighting, art, and music. Together they combine to make an extremely powerful mechanism of added value. The benefits of the mentioned items apply to the four users of the facility namely the patient, staff, visitors, and the local community. The elements of the therapeutic design and those groups that the elements apply to can be included of; higher patient satisfaction, lower patient stress and anxiety, reduction in pain, reduction in hospital-acquired infections, increasing the sleeping quality, slips trips and falls reduction, lengths of stay reduction, medical errors decline, patient communications improvement, patient confidentiality improvement, staff satisfaction and morale increasing, staff efficiency increasing, and staff turnover reduction. In essence, there are a lot of benefits to be gained from the design of a quality environment. (Nedin, 2015)

As it can be understood by reviewing the history of healthcare settings and explaining the previous versions of the therapeutic environment, the elements that should look at today and of course the therapeutic environment goes back in the time of 1855 when Florence Nightingale and other influential characters.

Although it's intuitive, the evidence is very hard to get but we are learning from history here. So now, of course, we come with a difficult but we now have to justify the costs associated with improving the environment in creating the therapeutic environment. And it's only fair that we should try to calculate a return on investment because every dollar that spent on the environment is a dollar that we don't spend on medical equipment. (Nedin, 2015)

The healthcare environments per se are fearful and full of stress. In addition, the patients with the feeling of uncertainty about their health, are struggling with the pain or disease. Their families also worry about them. The complexity of the care center environments can be added further to the traumatic situation that results in the increased level of stress which weakens the immune system of the body and encourage the depression mood and eventually hinder recovery and healing. (Smith & Watkin, 2016)

Based on the conducted researches, in order to improve the patient outcome, four important factors must be considered and implemented when the healthcare environment is designing:

1. Reducing or eliminating environmental stressors such as noise, crowding, odors, pollution, etc.

2. Providing positive distractions for example, view of nature from patient rooms, lobby, waiting and other 'high stress' areas; access to nature by means of healing gardens, chapel or meditation room; artwork, music, pets and other activities or elements that allow for a sense of stimulation which can help nurture a patient's sense of positive well-being.

3. Providing spatial social support where the users can interact with others without difficulty, for example, non-fixed seating, round tables, etc.

4. Offering a feeling of autonomy and self-control, of choosing or adjusting how patients spend hospitalization time, of doing their own work in their own way in the environment such as controlling the light quantity, the level of the noise, visual content, ability to move and locate, etc. (Sheth, 2018)

The concept of therapeutic architecture is a term derived from opposition to the austerity of modern healthcare facilities, implied to an environment that aims at providing a situation, able to promote a healing environment factors through considering natural factors such as sound, light, color, privacy, views, and even smell to affect both positively on physical and psychological patient healing. Despite setting up the functional requirements, medical practices and technologies involved with, patient safety and care

quality, the architecture of a healthcare facility should be designed to be characterized as a psycho-socially supportive therapeutic environment, whereby it embraces also the families and personnel. (Grinde & Patil, 2009)

Patients need to be wrapped around this milieu during hospitalization or treatment, up to the time which totals physical and recovery achievement. Therefore, the healing atmosphere must not be restricted to the place and treatment period. (Sheth, 2018)

Flavio Albanese stated the mind-body-spirit balance as the meaning of wellness. It is very important to study the architecture of healthcare facilities which not only plays an important role to create healing spaces but also plays a great role in the community and ever-progressing technology. (Sheth, 2018)

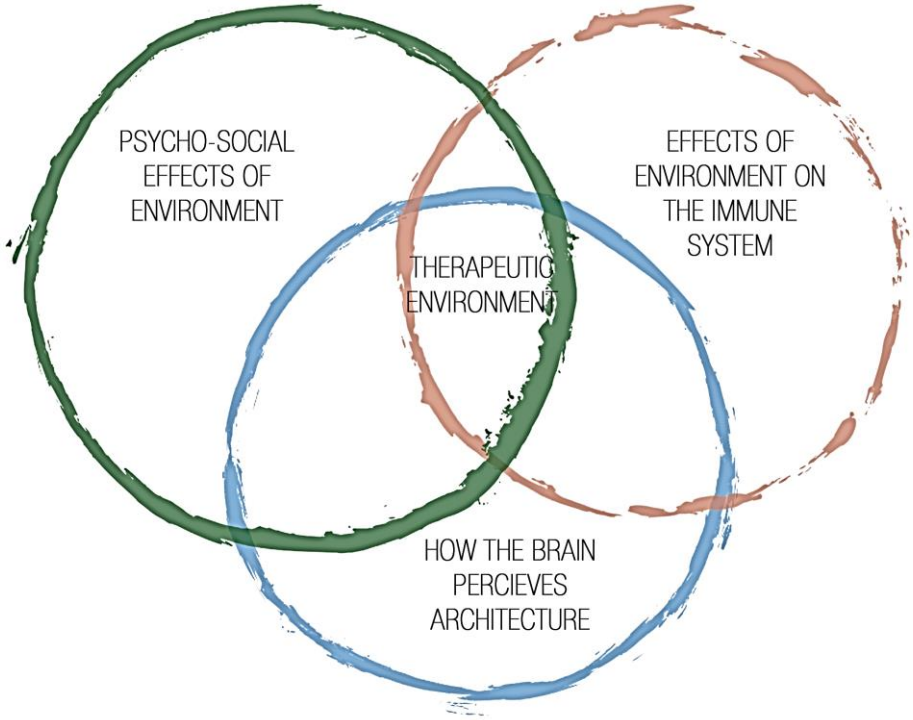


Figure 14. The elements can provide a therapeutic environment. (Sheth, 2018)

1.3 THE CONCEPT OF HUMANIZATION

Human centrality is an approach that focuses on human beings and their honorable survival, attention to human health and its promotion is one of its basis. Hospitals are designed to use medical healing as much as possible. While well-documented, stress, depression, and anxiety have detrimental effects on health, it has become increasingly important today with the advent of the new approach. The origin of any architectural work is based on some foundations; Form, performance, technology, and content can be considered as the architectural basis, each one plays a role in the genesis of an indelible work; Forms in the form and geometry of building and beauty, performance in the use of space and efficiency, content in the identity and theoretical foundations of the work and technology as usual including tools, machinery, and construction techniques are considered as a phenomenon derived from human thought and created for human comfort and tranquility in accordance with the way of thinking and his intellectual foundations. Human transforms the environment according to his needs, values, and goals and is interactively influenced by the transformed environment, especially advanced technology makes a human impact on the environment intensify and accelerate. Some consider these rapid changes in the environment as a destructive factor and believe it will lead to the dissolution of the "human-environment" system, emphasizing that any fundamental and profound change in the natural environment must be executed according to its long-term impact on humans to predict its positive and negative results. (Nazer Ilkhani & Rahaei, 2015)

What distinguishes environmental psychology from other branches of psychology is the study of the relationship between behaviors based on the human psyche and the physical environment. Therefore, the designers' attention to the psychological study of designed spaces has created an inseparable link between environmental psychology and design; as far as the architects realized the need to create a common language between them and psychologists, and sought to build and create new knowledge to create an

environment that could be better known to the public. Modern psychology, assuming the indirect effect of the physical environment on human behavior, which ultimately required itself to examine architectural and urban environments, on the one hand, and on the other hand, paying attention to environmental designers to meet the needs of customers and users of designed spaces, led to the familiarity of psychology with the design profession, and vice versa and as a result, the seed of new knowledge or a new paradigm called "environmental psychology". (Nazer Ilkhani & Rahaei, 2015)

One of the facilities that have a high-level sensitivity for design is medical centers, due to the special conditions of patients in terms of their physical, mental, and emotional. Research has shown that employees of medical centers and hospitals are more exposed to diseases and occupational injuries than employees of other departments. Also, the rate of work-related asthma outside the manufacturing sector is higher among employees in the medical industry than in other groups of workers. Therefore, the architecture of medical centers can play an important role in improving and promoting the safety and health of the work environment for the employees of these centers. (Hasanpour, baqeri, & Almasi, 2012) Now, if we consider illness and the need for medical services as a real and integral part of life, it is inevitable that the need for standard centers that are appropriate to the diseases and needs of the human is an essential part of life. That is why the need to plan, equip, and transform these centers based on new science is felt. It should be noted that an advanced hospital, clinic, or medical center includes a very complex and diverse set of needs, contradictions, equipment, and facilities. By fairly looking at this issue, we find that the purpose of creating architecture is not only to meet its physical and material needs but also to pursue a much higher goal, which is to communicate with the deepest human feelings and emotions. If we consider the attention to beauty and psychological issues in the architectural design along with the factors of efficiency, stability, and economy as one of the duties of the process of creating architectural works, the position of this

important, especially in designing health and medical spaces, requires a more important rank.

1.3.1 ANTHROPOLOGY, HUMAN SCALE AND ARCHITECTURE

Architecture is not just about building. A building is not just architecture and architecture is not just about building something or creating something in the shape of a building cannot be merely architecture. Rather, architecture is what compels the architect to make architecture, the knowledge of human existence and human nature. Because man, from childhood to old age, is shaped inside the container of architecture. To put it more simply: Most of human life is spent in spaces that are the product of architecture, and this requires the architect to study anthropology in order to understand human existential perceptions of space and the existence of time. In this regard, philosophical anthropology discusses this issue with questions from metaphysical phenomenology of the human person and interpersonal relationships. The necessity of recognizing human beings and their nature causes the perception of the impact of environmental actions on human beings and its interaction with the environment. This is very important in the structuring of the spirit of the place and the architectural environment. Because architecture is for man, and man exists as a part of space, time and the existence of a place, and not as an object to an environment in which he is not active. A look that did not happen in the philosophy of modern architecture. The man was assumed to be an object in space, and he considered all the works of modern human architecture as an object, which can only be presented in the environment and with no activity in it. Rather, only the environment should act on human beings, and that action was considered only as a visual environment for human beings, and other human senses neglected. Man's multisensory phenomena were ignored in the modern architectural environment, and how man saw the environment as active and how he acted in that environment was assumed to be insignificant. Today, in architecture, beyond all styles and trends, there is something else. Certainly, today's architectural

discourse is not a concept or a volume or a deviation from the volumes, and even the issues of sustainability, intelligence and energy alone are not the main concerns of architecture. The revival and arousal of the human senses is considered, and the requirement of human pleasure in the environment and the nature of existence is the arousal of sensory perceptions, and this arousal requires the action and reaction of the environment to man and man to the environment. Architecture is not just about building and being a place, but about creating and objectifying human sensory perceptions. (Babakhani, 2017)

But what are the requirements for building on human perception and human scale?

Understanding the human scale in architecture is rooted in the knowledge of humanity itself. Because architecture is for man, and the space of architecture signifies for man, not by man. Changing the comprehension of the human scale concept in architecture from the physical scale of place to the scale of the environmental interaction, causes the architectural view of man to change from a positivist form that only puts physical measurements on the context of scale. In this case, the human scale, both in architecture and urban planning and even in environmental design, will not find a mere definition of René Descartes's mathematical dimension. But the human scale of the environment or place can also take on a non-Descartes concept, and so that the size and scale of the environment is no longer just the size and dimensions of mathematics, but the size and dimensions of the conceptual dimension of the environment and human understanding of that environment , by understanding the meanings of the details of the environment and the extent to which these shapers and their details affect the human psyche, mental and psychological factors of Man on the Environment is part of the human scale in architecture, which means the second dimension of scale in terms of dimensions and size. The result of a change in the view of the human scale in architecture from Descartes' purely mathematical point of view to Husserl's phenomenological view is that the concept and meaning of the human scale is completed, and

from the numerical size and dimensions that only sought human proportions from a positivist point of view to the shape of the human scale that comes in the conceptual and semantic dimensions of the built environment and place. This insight certainly conveys aspects of this meaning to the subject, and this transfer of the environmental concepts of place causes the subject, who is the same human being in that environment, to scale the environment on the basis of its immediate meaning and without confusion on the scale of phenomena. And this will leads the architecture toward a deep-diving inside to reconsider the meaning of human and architecture in order to provide a humanized place. (Babakhani, A look at the human scale in architecture through the lens of phenomenology, 2017)

1.3.2 HUMANIZATION IN HEALTCARE ENVIRONMENT

Examining the topics presented in relation to the main title of this research, which focuses on medical centers, in depth in philosophical terms, justifies the issue of human-hospital interaction and hospital environment. As critics and researchers have pointed out, more and more people are moving away from their human rights in hospital architecture. Therefore, in order to bridge this gap between humans and the environment, the concept of humanization should be applied in such a way that human traits are applied not only from the object's point of view but also from other human perspectives in the environment. (Martos, et al., 2018)

Referring to the Cambridge dictionary the meaning of the word humanize is “to make something less unpleasant and more suitable for people”. In other words; giving or creating human traits to something inhuman. The noun form of this verb, "Humanization" can be referred to as “the process of making something less unpleasant and more suitable for people” that in relation to an environment or space can be explained as; making a place or system more pleasant or more suitable for people. The term of humanization have widely used in various disciplines so that is to say it is a multidisciplinary term that also extensively applied in architecture. (Cambridge Dictionary)

The meaning of the humanization concept has been considered during the last decades as an essential step for perceiving its implication in hospital design practice, therefore, Paying attention to the right meaning of humanistic design approach and to interrogate the language of humanization, in order to better understand it as a design goal is crucial, which has rarely been neglected.

As Victoria Bates says; the humanization term in a wide range of contexts, often referenced as a trend idea about the hospitals, tapped into social, political, intellectual and economic trends around the world instead of its right meaning and implications. So that these ideas restricted the ability to implement humanistic design for the patient, visitor, and staff. Therefore, paying attention to the right meaning of

humanistic design approach and to interrogate the language of humanization, which has rarely been neglected, in order to better understand it as a design goal is crucial. (Bates, 2018)

Figure 15. Men's surgical ward, St Bartholomew's Hospital, London, 1968. (Adams, 2017)

At the beginning of the new era other concepts of humanization of space formed and by reviewing them it can be understood that diverse methods that architects implied in modern hospitals were putting the patient experience at the center of their design strategy which mostly the main purpose of the complex architecture in these buildings was to “normalize” the healthcare environment and making them look normal, rather than being a place for sick people. While putting the patient at the center of the target design strategy was right, but as Annmarie Adams points out good hospital design should inspire wellness and healthcare architecture progresses as inspiration when the architects consider medical technology and landscape rather than as restriction or things to be hidden. (Adams, 2017) Therefore, the concept of humanization of a healthcare service can be evaluated as an essential factor related to the comfort level and user need satisfaction and by evaluating the user’s point of view, upgrading and enhancing the space is more possible aimed at imposing positive intervention and changes toward more humanization and comfort level by the relative authorities. (A. Bellagarda, et al., 2014)

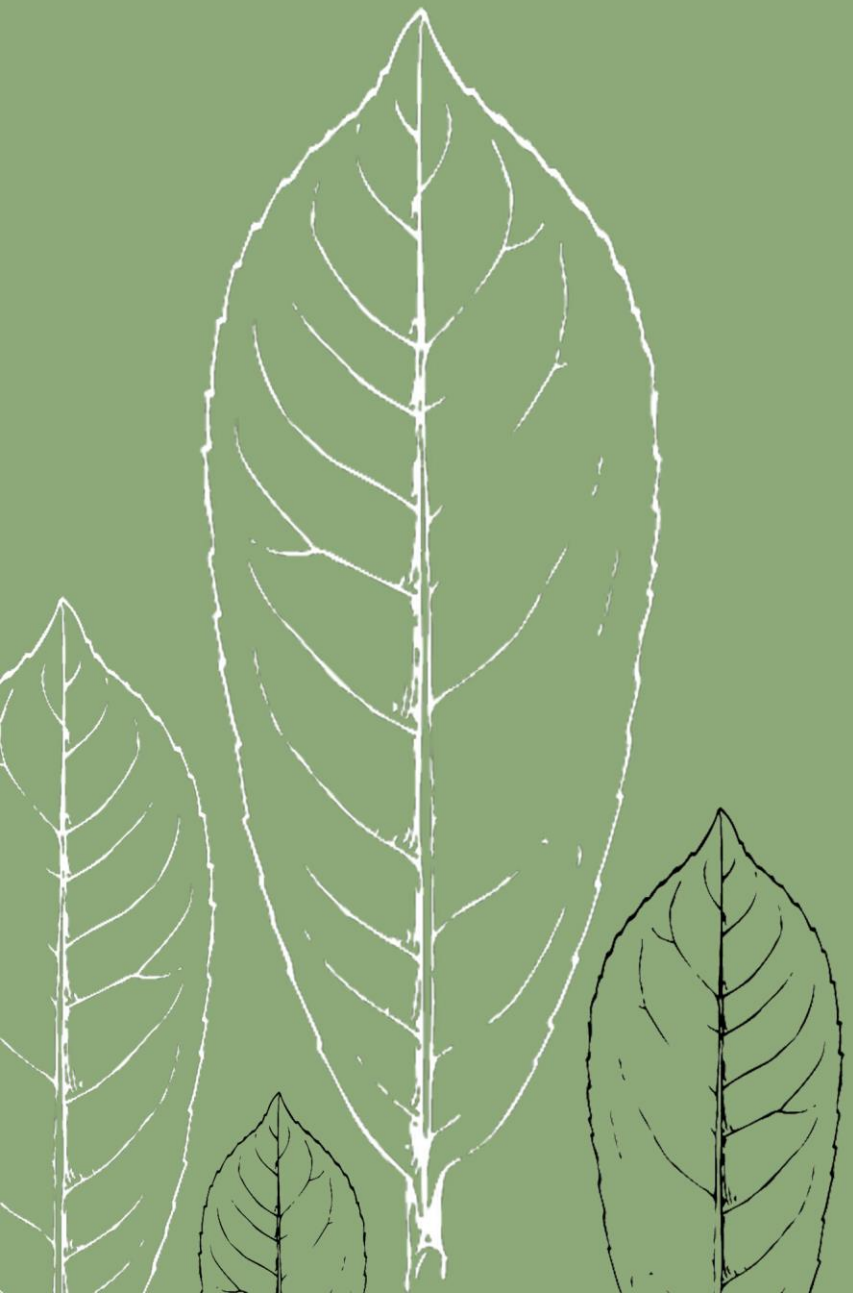
Figure 16. Shopping mall like hospital to normalize the hospital space as routine activity of people. (Adams, 2017)

As Pellitteri and Belvedere state, The humanization of spaces focuses on physical and mental needs of the patient thus it is derived from architectural psychology in which studying the interactive processes between man and environment, is an important factor to determine the quality of hospital as the functional and technological center of medicine simultaneously is the connector of human and environment. (Pellitteri & Belvedere, 2010) The quality that is closely related to health, can be achieved by focusing the human needs and understand their interaction with the environment, a matter which always was neglected. (Pellitteri & Belvedere, Humanization and Architecture in Contemporary Hospital Building, 2011)

This is obvious that in an institute as complex as hospital the patients and visitors are more sensitive to the quality of design so they are more affected by the humanization of those dedicated space than staff. So perceived hospital environment quality will be improved when a degree of humanization increases in space. Perceived hospital environment quality will be improved when a degree of humanization increases in space. (Fornara, Bonaiuto, & Bonnes, 2006)

Hospitals are places in which solidarity, equity, and participation must be found as the conditions of effective enjoyment of right in the space. Hence, a good architecture can promote effective enjoyment of social rights by emphasizing the right to health in the hospital space. Humanization of hospital spaces also as Torricelli, Setola, and Borgianni explain, is not only called to reduce and remove the disease but on one hand, they have to be the provider of health rights services for community in order to answer the new social needs for citizens. (Torricelli, Setola, & Borgianni, 2013)

It is clear that simply designing a functional and therapeutic set is not enough, and other factors are involved in achieving the goals set. Elements that may be seemingly intangible but directly affect the quality of spaces and the patient's mood; Items such as harmony, variety, sense of control over space, etc., which are often less considered in the design of hospitals. (Nazer Ilkhani & Rahaei, 2015)



Chapter 02

Theory of Biophilia

By introducing the power of nature to heal, argued in the Medical Dictionary in 1839, the attitudes toward nature's influence on human health completely changed. In such a sense that many illnesses can be cured without the help of medicines, simply by paying attention to air quality, food, rest, physical activity, and state of mind. Since that time, the therapeutic environmental features, in different stages, debated taking advantage of its benefit, healing the individuals, and recovering them from health difficulties. In the twentieth century, Ulrich in his article with the name of Health Benefits of Gardens in Hospitals, by studying the patients exposed to natural features or even nature itself, grown-up this assumption that patients with access to view nature are more capable to recover from their disease, and this resulted into a growing body of researches around the benefits of nature in hospital settings which led to redefining a new design approach that fulfills the psychological well-being and improves patient health. (Ulrich, 2002)

The challenges of the twenty-first century related to the health of populations in the global context did face different relevant sectors to change their approach in their service organization considering human fundamental needs, not only therapeutically, but also from the entire point of view. This caused more attention to the context of humanizing these services and because the architecture plays a significant role in setting up the buildings and spaces of these centers, designing healthcare facilities in a humanized way became criteria that desired a new language of architecture to improve the quality of spaces. (Gullone, 2000)

In the same vein, employing some natural factors such as contacting with it, contribute to hospital spaces can empower the patients by ameliorating their well-being through positive interaction with the environment to apply the humanization approach. However, deepening into this subject in order to understand the human-nature relationship is fairly necessary to not only survey the impact of nature on health but even can change the vision of medicine and healthcare environment regarding this approach. (Totaforti, 2018)

2.1 BIOPHILIA THEORY

The persistence of natural themes in human artifacts and historical places, from early hut to delicate, leafy filigrees, demonstrate that natural-based design is not a new phenomenon. Even, it is seen as a scientific and intuitive field of human and neural science presenting that communication with nature is essential to maintaining a healthy existence as an urban species. Before and even after the Industrial Revolution, the vast majority of humans owned agricultural land and spent most of their lives in the wild. With the increase of urban population in the nineteenth century, worries about health issues raised and reformists tried to create large public parks such as Central Park in New York, and started campaigns to recuperate health and decrease the stress caused by urban life. In the mid-19th century, western attitudes toward nature changed and topics related to nature, including natural landscapes, gradually became popular art subjects, and going to the mountains or the beach for fun was a growing trend. It was also believed that in the design of the hospital, sunlight and natural landscape is important. As Dr. Thomas Kirk Bride who "…believed that the beautiful setting…restored patients to a more natural balance of the senses". (Browning, Ryan, & Clancy, 2014)

The term Biophilia coined and popularized by biologist Edward O. Wilson in his book in 1984, with the definition of "innate tendency to focus on life and lifelike processes". (Locklear, 2012) Biophilia firstly used by psychologist Erich Fromm with the meaning of "love of life or living systems" to explain the psychological orientation to attract living things. Wilson described the innate affiliation of the human being to the various living organisms and other forms of life, due to the common biologic root derived from nature in each of them. The term biophilia unlike is used in opposition to the phobia in the sense of incompatibility and fear that many people have from their surrounding environment. (Biophilia hypothesis, 2020) Generally, the Biophilia hypothesis is a concept that has derived from the science of biology and psychology and has conformed to the neuroscience,

endocrine glands and, architecture that all the desire is to make reconnect with nature and natural systems. The architecture and building industry both played an important role to create an illusion of separation between parks, jungles, forests, and natural reserves with their predictable and non-harmony with nature. Additionally, the quality made by modern architecture emphasized on this illusion separation for people. In fact, the linkage between man and nature is not a subject/ object relationship, because the existence of human beings is rooted in that same nature that is being sought to make an object from it. Therefore, the approach of Biophilic design can be defined as an attempt to transfer the inner tendency of man towards natural systems and processes. In another words, Biophilia and Biophilic design are the results of human relationships with the environment in a non-disruptive way, which is based on three basic conditions: security, justice, and freedom. (Totaforti, 2018)

Figure 17.Reach (McAllister)

Mitigation of microclimate effects in outdoor spaces: in the overheated season: reducing air temperature, improve humidity through shadowing, evapotranspiration of plants, improved albedo (portion of shortwave solar radiation reflected) of the ground and of the roofs (green roofs). On the under heated season (winter) the leafs are falling and the desired solar radiation is allowed.

2.2 GREENERY IN HOSPITALS

Benefiting from the plants and gardens and their positive influence on human health dates back to thousand years ago, prominently in both eastern and western cultures. For instance, monasteries created elaborate gardens to utilize its advantages for providing a pleasant and comforting distraction, and in the 1800s generally from Asia to Europe and America creating gardens for hospitals was a common and prominent matter. With the passage of time and during the early decades of 19 century, hospital gardens got less prevalence and by the advancement in technology and medical knowledge, concentrate on greenery transformed to functionally efficient setting in order to reduce the level of disease. (Ulrich, Health Benefits of Gardens in Hospitals, 2002)

For much of the 20th century and with the global expansion of functional efficiency and priority over reducing infection risks and increasing efficiency and adherence of the building industry and architecture with this trend, the approaches followed resulted in sterile, lab-like spaces were often devoid of natural light and air that nowadays are unacceptable, stressful, and unsuitable for the mental and emotional needs of hospital consumers. Less attention was paid regarding patients' emotional or psychological needs and nature and gardens, which had been integral to healing for centuries not even were designed out but also, most of those spaces had undesirable and bad effects on health. Also today the high level of stress and pressures concerning patients, visitors, and staff is very high in the hospital spaces which are intrinsically stressful, little actions and attention were given toward ameliorating the environment that can help

users to stay calm and relax. (Ulrich, Health Benefits of Gardens in Hospitals, 2002)

However, an increased awareness and more holistic understanding of sickness and health, and the role of nature in patient recovery has fostered in recent years in the healthcare communities to create efficient and hygienic environments that also have pleasant and stress-reducing properties.

An important motivator for this awareness is the major advances in body-mind medicine. The important conducted research has now declared that stress and psychosocial factors can affect patients' health. This knowledge strongly suggests that the psychological or emotional needs of patients, along with traditional concerns such as exposure to infection and functional efficacy in hospital design governance, should be a high priority.

It is mentionable that the conditions or experiences shown by medical researchers to reduce stress and health, such as pleasant distraction and social support, should be considered in the creation of new medical centers and with the advent of Biophilic design, humans have once again realized that they have a fundamental need for meaningful communication with nature. (Ulrich, Health Benefits of Gardens in Hospitals, 2002)

Figure 18. The garden of Charterhouse Hospital, 1770 (Toms)

2.2.1 DESIGN BASED ON BIOPHILIA

Nature in space deals with the direct, physical and transient presence of nature in a place or place. This includes the life of plants, water and animals, as well as the breeze, sounds, smells and other natural elements. Common examples include potted plants, flower pots, bird butterflies, butterfly gardens, water features, springs, aquariums, backyard gardens and green walls or plant roofs. The strongest nature in space experiences is achieved through the creation of meaningful and direct communication with these natural elements, especially through diversity, movement and multisensory interaction. By expanding this subject and according to the Biophilic design book written by William Browning and his colleagues, nature in the space is consist of these principles; (Browning, Ryan, & Clancy, 2014)

1. Visual Connection with Nature.

2. Non-Visual Connection with Nature.

3. Non-Rhythmic Sensory Stimuli.

4. Thermal & Airflow Variability.

5. Presence of Water.

6. Dynamic & Diffuse Light.

7. Connection with Natural Systems.

Figure 19. Canopy trees and water features (Browning, Ryan, & Clancy, 2014)

Natural analogy deals with organic, non-living, and indirect evolution of nature. Objects, materials, colors, shapes, sequences, and patterns found in nature appear as works of art, decorations, furniture, decorations, and textiles in the built environment. Imitations of shells and leaves, furniture with organic forms and natural materials that have been processed or extensively modified (e.g., wooden boards, granite tablecloths), each have a direct connection with nature: while they are real, they are just like the ones in their natural state. The strongest natural analog experiments are achieved by providing information richness in an organized and sometimes evolved way; (Browning, Ryan, & Clancy, 2014)

8. Biomorphic Forms & Patterns.

9. Material Connection with Nature.

10. Complexity & Order.

Figure 20. Biomorphic form as natural analogy in architecture design. (Browning, Ryan, & Clancy, 2014)

Nature of the space deals with our innate desire to be able to see beyond our surroundings is accompanied by fascination with little danger or uncertainty, vague views and amazing moments, and sometimes even the inductive feature of phobia when it comes to the safety element. The strongest experiences of nature are achieved through the creation of conscious and attractive spatial settings that are in harmony with the patterns of nature in space and natural analogues; (Browning, Ryan, & Clancy, 2014)

11. Prospect.

12. Refuge.

13. Mystery.

14. Risk/Peril.

Figure 21. Fort Worth Water Garden as the nature of the space factor. (Browning, Ryan, & Clancy, 2014)

2.3 EXAMPLES OF BIOPHILIC DESIGN IN HEALTHCARE FACILITIES

Today, many successful design examples can be found all around the world by applying the approach of Biophilic design not only in building scale but in the wide range of urban scale. Singapore can be named as one of the leading countries in the field of connecting the buildings and urban fabrics with nature and greenery.

In this part, some of the great examples by utilizing the Biophilia hypothesis and Biophilic design in the healthcare facilities and hospitals are discussed in order to clarify the application modality of this theory.

2.3.1 KHOO TECK PUAT HOSPITAL

A well-known example of a hospital with the most Biophilic characteristics might be the Khoo Teck Puat Hospital (KTPH) in Singapore. According to the experts, in no other healthcare institution of this scale are elements of form, space, and landscape so explicitly tied to the goal of human well-being—the very definition of Biophilic design. The main path in this hospital project from the starting point has been providing a healing environment, the idea that is linked to the biophilia from a psychological research field in order to establish integration of plants and architecture. (Kishnani, Singapore's Khoo Teck Puat Hospital: Biophilic Design in Action, 2018)

This integration of vegetation and architecture has increased the biodiversity of the local ecosystem, bringing butterflies and bird species; the rooftop of the hospital is also used by local residents to grow produce. Unlike many other hospitals, 15% of visitors come to Khoo Teck Puat for recreational reasons such as gardening or relaxing. The design behind this

hospital was to increase the productivity of its doctors, wellbeing of its visitors, and increase the healing time and pain resilience of its patients. To do this, the designers incorporated greenery from the hospital's courtyard to its upper floors, where patients have balconies that are covered in scented foliage. The hospital is centered on the Yishun pond, and like Frank Lloyd Wright's Fallingwater, the architects made this natural feature part of the hospital by having water stream through its courtyard, creating the illusion that the water was “drawn” from the pond. The hospital also utilizes natural ventilation as much as possible in common areas and corridors by orienting them in the direction of the north and southeast prevailing winds; this has reduced energy consumption by 60% and increased airflow by 20-30%. This creates thermally adequate environments for patients and medical staff alike. Using Kellert's strategies above, it is apparent that most of the strategies used for Khoo Teck Puat are direct nature experiences. The hospital also uses transitional spaces to make occupants more connected to the outdoors and has organized complexity throughout its overall architectural design. KTP has created a sense of place for occupants and neighbors, as it acts as a communal place for both those who work there and live nearby. (International Living Future, 2018)

Here is a short overview of the Biophilic endeavor, which extends to five principles:

- Sight, visual access to greenery and water;

- The smell, selection of scented plants;

- Sound of falling water;

- Diversity of plants, birds, and butterflies;

- Community, public space situated within blue-green areas.

Figure 22. Landscape around the Khoo Teck Puat Hospital
(International Living Future, 2018)

Figure 23. Courtesy of Khoo Teck Puat Hospital. (First Annual Stephen R. Kellert Biophilic Design Award Goes to Khoo Teck Puat Hospital, 2017)

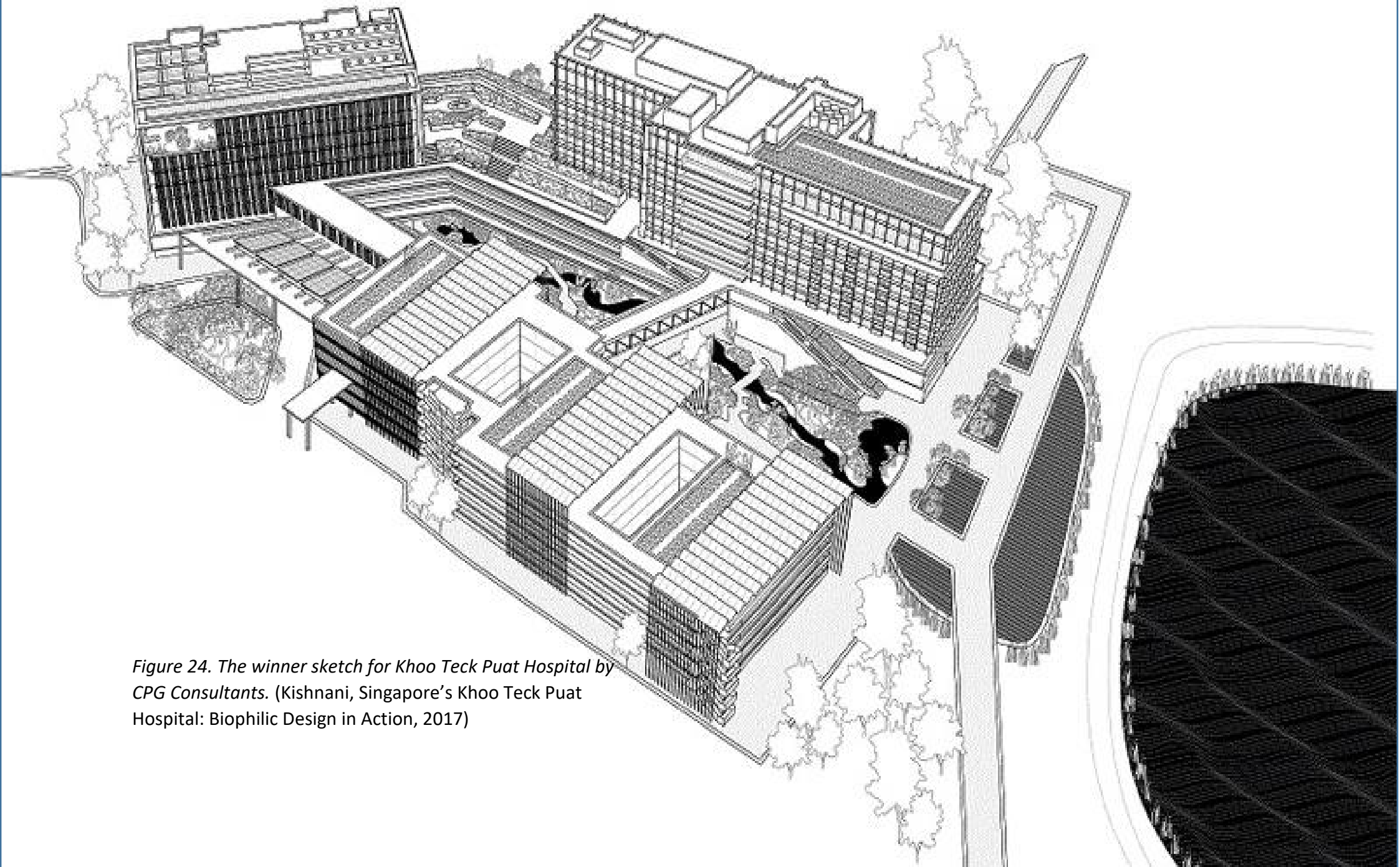


Figure 24. The winner sketch for Khoo Teck Puat Hospital by CPG Consultants. (Kishnani, Singapore's Khoo Teck Puat Hospital: Biophilic Design in Action, 2017)

2.3.2 ÖSTRA PSYCHIATRIC FACILITY

The case study of ÖSTRA HOSPITAL as a psychiatric facility located in Göteborg city of Sweden, designed by White Architects team, is examined as an example to explore the strategies utilized to create a Biophilic experience during the treatment, consist of the arrangement of departments, indoor and outdoor access to nature, and different community environments by considering the diverse needs of users specifically patients and personnel, in order to provide an environment for all occupants. The center is designed to create a therapeutic environment and support communication with nature, fulfilling the safety and security needs of a psychiatric center. Professionals should be able to monitor patients and ensure their safety at the facility. Despite these challenges, White architects had combined access to outdoor spaces while meeting safety requirements. (Nestor, 2017)

The division of hospital space on a departmental scale is an example to induce the complexity and order through stimuli the sensory information that simulates a spatial hierarchy resembling that viewed in nature. Within each department, it was important for designers to create a layout that allows patients to navigate and feel a sense of ownership over their environment. Either individual or double units, all of the rooms have access to natural daylight and are part of a spatial grouping of rooms within the larger department. Each cluster of patient rooms also has access to a semi-private circulation and sunroom. From this outer hallway, the department transitions inwards to the semipublic communal space created by the light courtyard. This transition from private/ personal (individual) to semi-private (family), and semi-public (tribe) breaks the department into various environments and allows patients to participate in all three realms depending on their preference. Patients can choose where and how to interact with others, adding to the sense of normalcy and independence. (Nestor, 2017)

Figure 25. ÖSTRA PSYCHIATRIC FACILITY (Östra Psychiatry Hospital, 2006)

The design method of Östra facility is based on approaches to provide access to outdoor space and access to natural views from inside for its all users. Therefore, three central courtyards are defined as the place to provide not only the above feature but also give direct and indirect access for the patient rooms through which the natural light catered. The considered features toward visual connection to nature outside of the buildings work as a stimulus to encourage patients and other occupants to go outside and doing physical activity which can make them able to feel the sense of independence and self-control plus the benefits of exposing to nature. (Nestor, 2017)

Another mentionable feature of this facility is the dynamic and diffuse light factor that works as a simulation of different light intensity and shadow that and by changing during daytime as a similar condition to nature. Several studies conducted to allow us to find the benefits of natural light and well-diffused lights on the mood and circadian system of the body, and it is what the designers considered in this center.

The sunrooms designed beside the operable window walls in each room give the patient an opportunity to individually adjust the level of internal light according to their preferences. In addition to that, the light entered from the central courtyards in each department smoothly shines the interior space where fewer windows are available and this happens also to the other places such as the dining area and corridors. (Nestor, 2017)

Figure 26. View toward the courtyard inside the space of ÖSTRA Hospital. (Nestor, 2017)

Figure 27. ÖSTRA PSYCHIATRIC FACILITY (Östra Psychiatry Hospital, 2006)

2.3.3 MEYER PEDIATRIC HOSPITAL

Meyers Children's Hospital is located on the outskirts of Florence, Italy. The hospital currently occupies 31,000 square meters of land and has three floors and 150 beds. In 2002, the hospital was supported by the European Commission. The hospital uses sustainable design to improve its patients. The building is a 20th-century building nucleus whose wings have just been designed; Features such as the use of natural light, a wide green roof and open spaces are the main features of this design. At the hospital, many efforts were made to provide comfort for young patients, said Romano Del. It is alleged that the ambassador provided the information to CSPE. While the rough structure of the hospital has the least impact. Patients go through a covered path to reach the main atrium. This path is covered with many plants (natural light is used in space and atrium columns look like trees. Glass of higher rows with cells the sun has been covered, which, in addition to saving energy, will also be effective in reducing goodness. The new building is located in the heart of the hill, which has been combined with its own landscaping; the effect is further enhanced by the presence of a green roof. The upper atrium has access to the green roof, which directs children to the outdoor area. (Sodagar & Mafakher, 2016)

Figure 28. Meyer hospital corridor (Ciampi, n.d.)

Figure 29. Meyer Pediatric Hospital (Meyer Pediatric Hospital, 2009)

Figure 30. The Meyer Children's Hospital in Florence (Ciampi, n.d.)

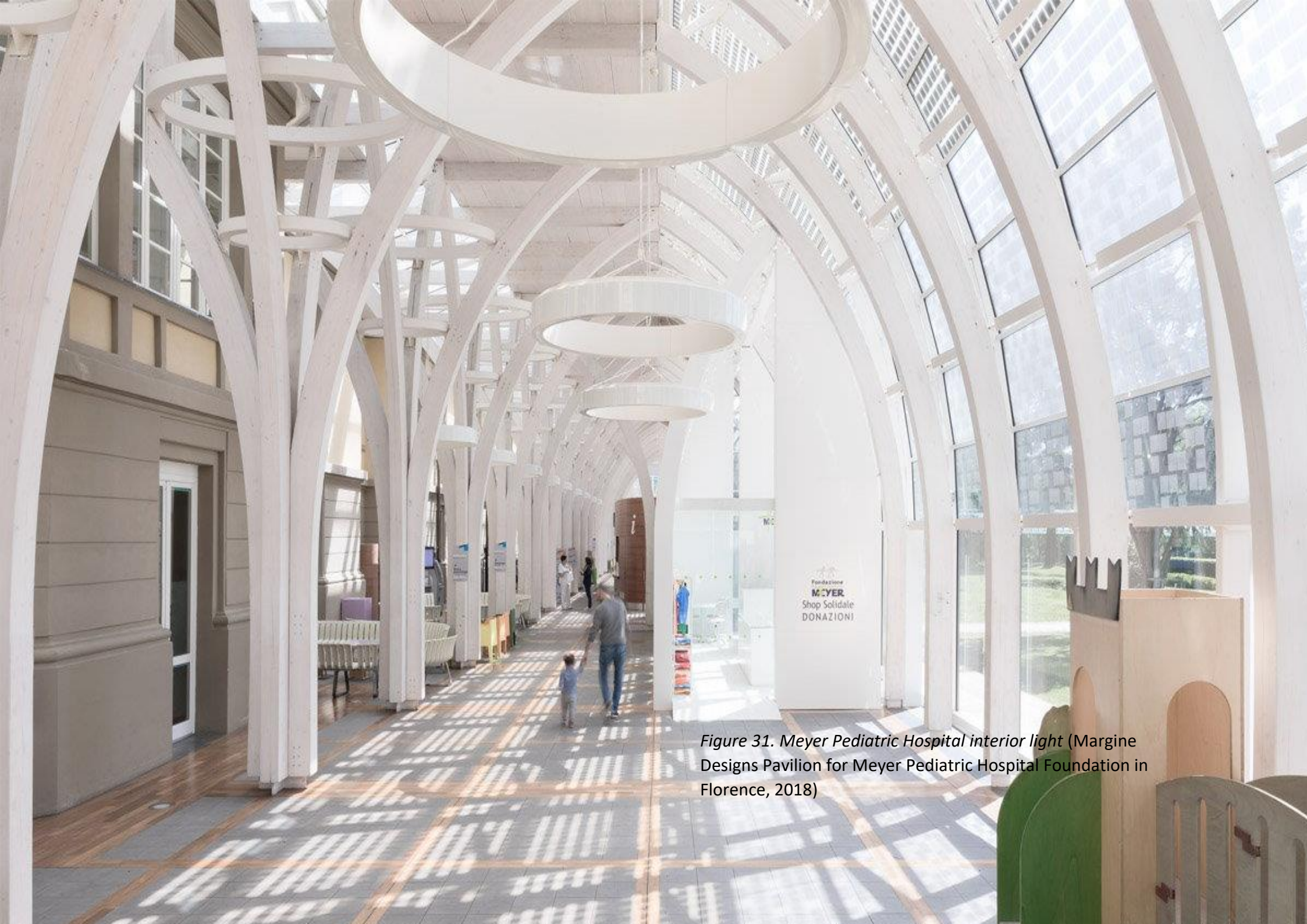


Figure 31. Meyer Pediatric Hospital interior light (Margine Designs Pavilion for Meyer Pediatric Hospital Foundation in Florence, 2018)

Figure 32. The Meyer Children's Hospital in Florence (Ciampi, n.d.)

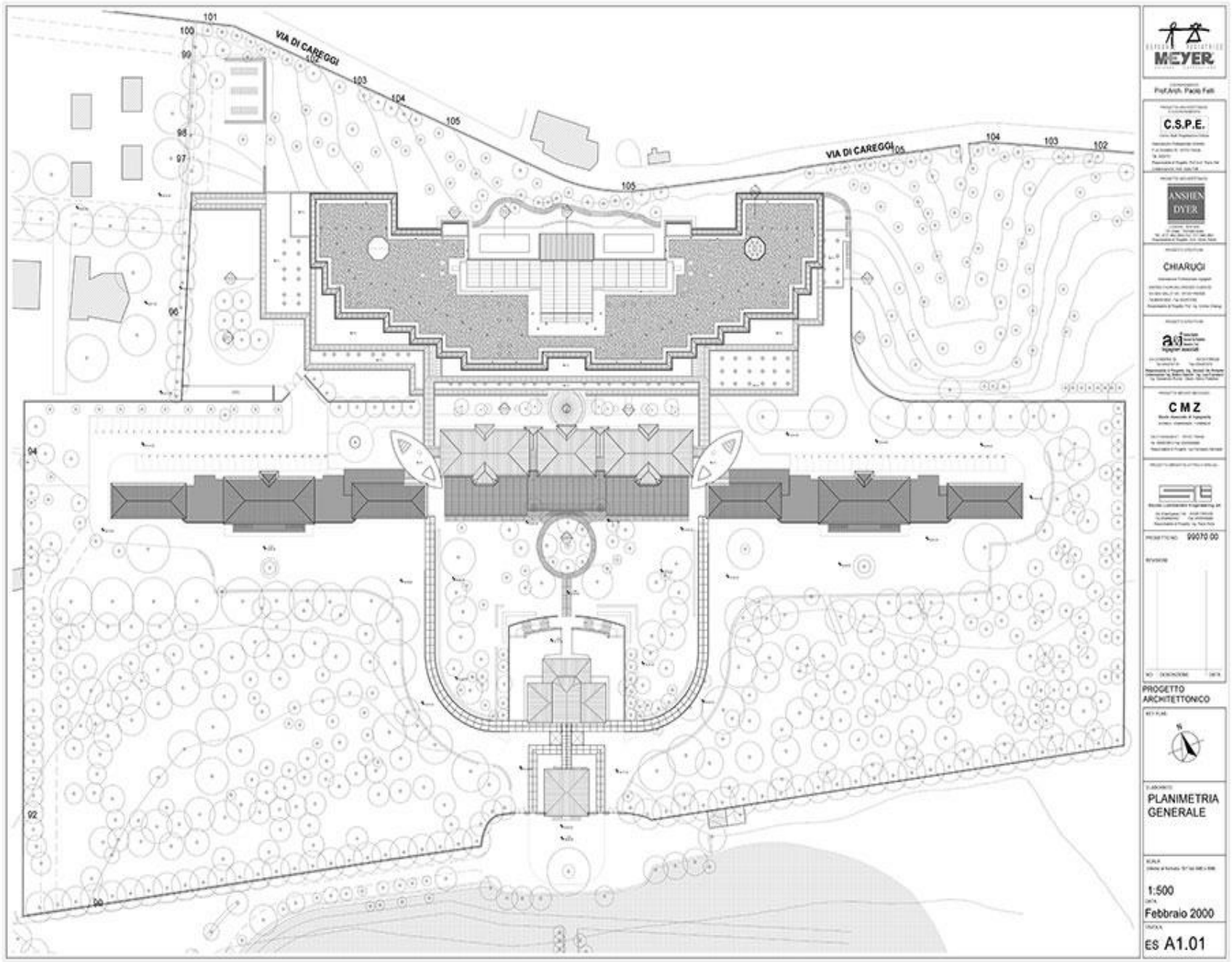


Figure 33. Meyer Pediatric Hospital (Meyer Pediatric Hospital, 2009)

Chapter 03

Biophilia and Humanization

3.1 TOOLS AND METHODS OF BIOPHILIA FOR HEAKTHCARE HUMANIZATION

In this section, the methods and tools offered by the Biophilic principles are presented in order to reach the highest level of quality in the environments, specifically in the healthcare facilities, toward health and well-being of the user in the beneficial experience through space, and applying the concept of humanization in such kind of care centers. Therefore, this part will rely heavily on a review of previous literature from Biophilic design for healthcare facilities. This might help us to have a clear prospect toward the benefits that can be achieved through connecting with nature.

3.1.1 VIEWING NATURE IN HEALTHCARE ENVIRONMENT

Evidence is proving that the view of nature reduces stress of patients and ameliorates the mental health while helping the healing process. In this part the benefits of this subject is deeply discussed.

A) Visual connection with nature

Views of nature reduce patient stress and improve mental health while facilitating healing.

Ulrich (1984) found that after gall bladder surgery, patients with a view of nature spent less time in the hospital and needed less pain medicine than people without a nature view. (Ulrich, View through a window may influence recovery from surgery, 1984)

On days when a nature video was played in the waiting room at a blood donor center, blood donors had lower pulse and blood pressure readings than on days when ordinary daytime television or videos of urban scenes were played. (Ulrich, Simons, & Miles, Effects of

environmental simulations and television on blood donor stress, 2003)

Wang, Anthony, and Kuo (2014) emphasize on the positive influence of window view and daylight to the patient's overall well-being. They studied the women in the Cesarean section of the hospital to confirm that, more natural views through the window in addition to more daylight exposing can play a significant role to reduce the betterment time with less perceived pain. (Wang, Anthony, & Kuo, 2014)

Displaying of arts representing nature and relevant can also be advantageous to healthcare environment.

Ulrich and Gilpin (2003) propose to use some realistic art in healthcare environments in which the images of the natural landscape and elements with trees or flowers in a wide-open perspective view or with a sunshade and water element to make the occupants calm from nerve-wracking thoughts. They also suggest not to use the art with an abstract concept that can be minatory to the patient to avoid making their mind more conflict. (Ulrich & Gilpin, 2003)

Anthropological researches identified health positive outcomes by improving patient satisfaction, Considerable reduction in nervous behavior through experiencing and using artworks in hospital spaces which contributes. Nielsen, Fich, Roessler and Mullins present the results analysis of the interaction between people and space when an appropriate artwork is presented demonstrates that art can work as a positive distractor that increases physical activity, level of socialization, safety, security and, the comfort through creating a homelike atmosphere that diminishes pain, anxiety, fatigue, and stress from uncomfortable situation of illness. (Nielsen, Fich, Roessler, & Mullins, 2017)

Diette (2003) examines the influence of natural sights and sounds as a Non-pharmacological method on patient's experience under Flexible Bronchoscopy procedures. The result of his analysis revealed that the use of natural sights can be significantly functional to accelerate the recovery for the patient that experienced this distraction therapy. Patients with the experience of natural sights, sounds and images have

been able to control the pain with less anxiety and overall satisfaction during Flexible Bronchoscopy procedures unlike those with the blanked environment. (Diette, Lechtzin, Haponik, Devrotes, & Rubin, 2003)

B) Heart Rate Responses to Nature Views

Nature causes beneficial reactions in the cardiovascular system in the body.

Laumann, Garling, and Stormark (2003) present that watching nature or images and videos related to nature have a great impact to reduce and proofreading heart rate specifically when the rhythmic expansion and contraction of the heart raised due to psychological exhaustion or stress. Unlike the people who are looking at urban pictures. (Laumann, Gärling, & Stormark, 2003)

Hartig, Evans, Jammer, Davis, and Garling (2003) tracked the healing process of the people in the natural and urban environments to discuss the restorative environmental promoters. They believe that stress recovery in individuals to be attained rapidly by descending the diastolic blood pressure which happens when they are exposed to nature, physically or through the window, compared to those in an urban atmosphere or windowless spaces. (Harting, Evans, Jamner, Davis, & Gärling, 2003)

C) Effects of Nature Views on Mood

Visual contact with nature ameliorate the mood and the state of mind

Obviation from stressful and Unfavorable circumstances and vice versa, seeing a favorable natural prospect has been linked to the positive enhancement and eliminating the negative effect. (Beute & de Kort, 2014)

Generally, the positive mood will be increased, when a movie or a film of nature and natural elements is watching, in comparison to the scenes in which the

urban environment is watched. (Beute & de Kort, 2014)

The physiological recovery process rapidly occurs when a movie related to the natural world is seen after a movie the sense of stress. Generally, findings demonstrate that the human body reacts more positively to the videos in which less urban scenes and anger are played which consequently improve the mood and state of mind. (Ulrich, Wellness By Design: Psychologically Supportive Patient Surroundings, 1991)

D) Experienced Stress and Nature Views

View of nature considerably decreases the level of stress.

Viewing a nature-themed image of a natural landscape can reduce the stress level of work for the police officers and other staff of prison when they work under the pressure than the blanked wall. (Farbstein, Farling, & Wener, 2012)

The measured stress level and anxiety of the painters with abstract concepts is generally high, compared to those painters that natural landscape is their art subject. (Kweon, Ulrich, & Walker, 2008)

E) Viewing Nature and Professional Performance

In the following literature review, there are some findings related to the skilled occupant's operation but not dedicated to the personnel of the healthcare facilities and hospitals. What is argumentative is that hospitals as institutions have always been workspaces for their staff, therefore, this issue can be directly linked to the individuals who are performing there. Collected results can be considered for the physiological and psychological aspects of the workers involved with the patients there.

According to the experimental study done by Beute and de Kort (2014), the presence of natural view, whether natural or artificial like images, meliorate the concentration of the workers. Even by simply looking at natural view, fatigue due to hardworking time can

be reduced which eventually leads to performing efficiently. (Beute & de Kort, 2014)

Examination of the results confirms that the level of tranquility in the hospital staff specifically in the MRI sector, by looking at nature, significantly increased while the stress and fatigue caused by focusing at work reduced and prevents personnel from causing errors. (Kim, Jeong, Baek, Kim, & Sundaram, 2010)

Exposing to the green areas can highly impact the student's focus on their activities and study exercises. Li (2014) confirms that the educational performance in the students with the urban view instead of another group of students with a natural perspective is lower and that is referred to as the low attentional functions. (Li, 2014)

F) Effects of Nature Views on Self-control and Pro-Social Behavior

In addition to the physiological and psychological health benefits of being exposed to nature, the improvement in social communication on one hand and raising self-control, on the other hand, is mentionable.

After diminishing the energy due to do some mental activities, inhibitory control aspects which are derived from decreased cognitive functions, effect on human behavior, sentimentalities and thoughts. In order to retrieve the self-control in people, the author suggest to look at the nature images and environments. (Beute & Kort, Vitalize me! Overcoming ego-depletion by viewing bright and sunny nature, 2011)

Zhang, Piff, Iyer, Koleva, and Keltner state in a report that, being exposed to nature and natural elements such as water, natural prospect, sky, trees and so on, encourage people to not only improve their personal behavior but also more communicative and social consist of helping, volunteering, sharing and, cooperating which entirely so-called Prosocial behavior. (Zhang, Piff, Iyer, Koleva, & Keltner, 2014)

3.1.2 USING NATURAL LIGHT IN HEALTCARE SPACES

According to the conducted researches, natural light and even artificial light in a right way can accelerate the healing process of patients. In this part the benefits of this subject is deeply discussed.

A) Natural Light

It seems like natural light as a great resource has been concerning more than before in healthcare environments. Cardiac patients, surgical patients, mental health patients and the personnel of these places are benefiting from this source by its positive influences on them.

Browning, Ryan, and Clancy in the book of fourteen patterns of biophilic design (2014) convey the importance of lighting to effectuate the positive psychological and physiological response and sustaining the circadian operation, through setting the dynamic and diffuse light to simulate nature condition. The importance of lighting to stimulate the sense of time and movement has been emphasized by authors. They describe the reaction of the human body to the different color spectrum of sunlight form yellow, blue and red on body temperature, heart rate, and the circadian system to adjust the melatonin and serotonin hormone secretion, which effect on sleep quality, mood, alertness and depression and etc. They propose also to employ diffuse lights in the right way to create a pleasing environment and even using light and shadow movement occurring in trees and water reflection to attract attention and calming. (Browning, Ryan, & Clancy, 2014)

According to obtained results through a questionnaire examination and subjective judgment, Alzubaidi, Roaf, and Banfill (2013), survey the impacts of daylight on patients' comfort and their recovery period, and present the preferences of hospital staff caring for them. They point out that the lighting regime, among other stress reducer factors in hospital spaces, owing to the visual and biological influence on the human body, plays a great role to improve these environments which are stressful places per se.

Physiologically, stimulating circadian and visual system which improves the immune system body and mood. Psychologically, in a brighter ward, diminishes the sense of pain thus, analgesic consumption decreases and by making better emotion and behavior in patients, sociability enhances. The authors confirm that increasing the patients' comfort affected by good daylight, leads to more comfort for staff, particularly nurses as the major greater part, enable them to perform optimally and more easy to care, to treat and to diagnose the illnesses in a healthcare facility. Additionally, daylight provides opportunities for the personnel to monitor the patient's condition more accurately than artificial light, to recognize the progress or regress through their skin color that speeds up the recovery time which results in less hospitalization period. Alzubaidi, Roaf, and Banfill emphasize that according to the health benefit and importance of the natural light, both for healing patients and staff's workplaces, decision-makers and architects should take it on board to create a better environment. (Alzubaidi, Roaf, Banfill , Talib, & Al-Ansari, 2013)

Wang, Anthony, and Kuo (2014) studied the positive effects of window view and daylight on the patient's well-being. Studying the women's health in the Cesarean section of the hospital to confirm that, more access to natural light through the window and more daylight exposing can play a significant role to reduce the betterment time with less perceived pain. (Wang, Anthony, & Kuo, 2014)

The survey conducted by Walch, Rabin, Day, Williams, Choi, and Kang (2005) in the patient recovery process after the spinal operation reveals that the degree of painkiller consumption is remarkably reduced when the ward is brighter and the patients feel less stress. Hospitalization time of the patient exposed to daylight is less than those with no accessibility. (WALCH, et al., 2005)

The observed length of hospitalization between almost 600 inpatients struggling with unipolar and bipolar depression, shows that those bipolar patients in the

wards with access to the morning sunlight, because of relieving symptoms depression, have less hospitalization period in comparison with the patients with less or no access to daylight. (Benedetti, Colombo, Barbini, Campori, & Smeraldi, 2001)

B) Hormonal Effects of Natural Light

Experiencing natural light has an influence on our body's chemistry.

J. Genuis (2006) studies the effects of sunlight on human well-being and health through the human body to state that exposing the natural light improves various skin conditions by Vitamin D production which nowadays, its deficiency as a common problem in the first world causes cancers, hormonal problems, and autoimmune disorders. He mentions that getting exceeded sunshine may cause types of problems itself. (Genuis, 2006)

Presence of Vitamin D in the body system reduces the risk of diseases such as cancers and heart diseases and experiencing the daylight and absorbing it by the skin provides an adequate amount of this Vitamin. (Kauffman, 2009)

When the sun touches the skin surface of the body, the level of small messenger molecule, nitric oxide be changed in the skin and blood which can help to decrease the blood pressure and reduce the risk of strokes and heart attacks. (Feelisch, 2014)

J. Genuis claims that the amount of serotonin hormone secretion, known as a contributor to provide a better feeling of well-being and happiness in the brain, is directly related to the sunlight exposing time and the level of luminosity. Regarding this matter, raising human activity, sleeping better and positive insight achieve. (Genuis, 2006)

The reaction of the human body to the different color spectrum of sunlight form yellow, blue and red on body temperature, heart rate, and the circadian system to adjust the melatonin and serotonin hormone secretion, which effect on sleep quality,

mood, alertness and depression and etc (Browning, Ryan, & Clancy, 2014)

C) Mood Effects Linked to Natural Light

The relationship between being in a day lit space and mood is both intuitive and supported empirically.

J. Genuis (2006) studies the effects of sunlight on human well-being and health through the human body to state that exposure to daily sunlight prevents mood disorders, diseases and also has positive effects on the human body and health, although its absence, even caused by seasonal reasons, can cause depression and a rise consumption level of antidepressants, like what is happened in the US and Canada up to 300% from 2002. (Genuis, 2006)

Obtained results through a questionnaire examination and subjective judgment, Alzubaidi, Roaf, and Banfill (2013), shows that the lighting regime, physiologically stimulate circadian and visual system that improves the immune system body and mood and improve the emotion and behavior in patients. (Alzubaidi, Roaf, Banfill , Talib, & Al-Ansari, 2013)

Kaida, Takahashi, and Otsuka through styling the people in the room state that, being in a brighter room with 3,000 lux ameliorate the people's mood. The occupants of the rooms with less illumination had less improvement in their overall mood. (Kaida, Takahashi, & Otsuka, 2007)

D) Natural Light and Circadian Rhythms

Balance in circadian rhythms operate simultaneously with the day and night cycle helps us to control the stress.

Browning, Ryan, and Clancy state that natural light effectuate the positive psychological and physiological response and sustain the circadian operation, through setting the dynamic and diffuse light to simulate nature condition or let the light come inside the space. The importance of lighting to stimulate the sense of

time and movement has been emphasized by authors. (Browning, Ryan, & Clancy, 2014)

Balance in the body circadian rhythm can be coordinated with the physical locality of the human through access to daylight. Establishing equilibrium in the rhythm of the circadian system help to control the stress level. Incoordination in this system can raise the stressful experience which leads to a negative impact on psychological and physiological well-being. (Boyce, Hunter, & Howlett, 2003)

Circadian system coordinate with the right physical location of the body is not only connected to mental stress and discomfort but also influence on cognitive functions and mood. (Beute & de Kort, Natural resistance: Exposure to nature and self-regulation, mood, and physiology after ego-depletion, 2014)

E) Natural Light and Obesity

Spending time in spaces that are naturally lit can be good for our weight control.

In the spaces characterized by the possibilities to access the natural light, people are more capable to regulate their sentiments, thoughts, and behavior which leads to improve the self-control in them. (Beute & de Kort, Natural resistance: Exposure to nature and self-regulation, mood, and physiology after ego-depletion, 2014)

F) Natural Light and Mental Illness

Better mental wellbeing has been linked to more time spent in natural light.

Being present in spaces with daylight is a very important factor for depressed people. In the same vein, the researches have confirmed that lack of daylight for the people with depression in a room impair the capability of short-term recall and temporal orientation in them. (Kent, et al., 2009)

Depression in adults is connected to the level of sunlight exposure in the interior spaces, in such a way

that increases the level of daylight raises the depression decline. (Sansal, Edes, & Binatli, 2012)

G) Natural Light and Workplace Satisfaction

Natural light in workspaces has a positive impact on the people and their satisfaction.

Investigations confirm that increasing the patients' comfort affected by good daylight, leads to more comfort for staff, particularly nurses as the major greater part, enable them to perform optimally and more easy to care, to treat and to diagnose the illnesses in a healthcare facility. Additionally, daylight provides opportunities for the personnel to monitor the patient's condition more accurately than artificial light, to recognize the progress or regress through their skin color that speeds up the recovery time which results in less hospitalization period. Alzubaidi, Roaf, and Banfill emphasize that according to the health benefit and importance of the natural light, both for healing patients and staff's workplaces, decision-makers and architects should take it on board to create a better environment. (Alzubaidi, Roaf, Banfill , Talib, & Al-Ansari, 2013)

The satisfaction of the workers in the works spaces is directly connected to the daylight of the space. (Boyce, Hunter, & Howlett, 2003)

3.1.3 UTILIZATION OF PLANTS IN HEALTHCARE FACILITIES

Exposing to nature can be beneficial to the people who are struggling with the high pressure and stressful situation of life. It is also proved that being in nature even small part of nature as some indoor plants can be effective in the case of stress and anxiety

A) Plants and Health

The investigations and evaluations in the field of plants and their effects on health and wellbeing do not date back to a long time ago, but this subject is increasingly going to develop specifically on healthcare facilities and hospitals with a high degree of priority. Based on the self-report researches, plants, vegetation or other types of greenery play a significant role to positively impact the occupants.

Belčáková, Galbavá, and Majorošová emphasize the need for green vegetation spaces as a supplement to treatment in healthcare facilities and environmental design for a hospital by examining the physical and psychological effects of healing and therapeutic garden on the requirements of patient, staff, and visitors in a case study of a Slovakian hospital. They found that the presence of green vegetation instead of having only a matter of aesthetics, provide opportunities for socializing, sense of control, physical movement, access to nature and general positive distraction that all can prevent disease by fulfilling the comfort and anti-stress situation. (Belčáková, Galbavá, & Majorošová, 2018)

The experimental results in heart surgery and gall bladder units and states that recovery outcomes in patients with a view to nature or even relevant artworks about nature notably improved by making shorter hospital stays, fewer suffering from post-surgical complications and the fewer dose of strong normative drugs. (Ulrich, Health Benefits of Gardens in Hospitals, 2002)

Plants also can make a waiting room more attractive by the improvement of indoor air quality by adding oxygen during the photosynthesis process and adding humidity via transpiration which generally removes

87% of the known pollutants like benzene, formaldehyde, and trichloroethylene presented indoor spaces within 24 hours. (Baldwin, 2016)

Generally, gardens within a hospital complex is highly beneficial, establishing an appropriate environment for relaxation and social interaction and escaping from stressed activities inside for patient, their friends, and personnel. These benefits are provided by direct contact or even view toward the natural component of courtyard, cooler and comfortable microclimate temperature comparing outdoor space, spending time to relax, positive and better feeling to calm and refreshing cognitive functions and comfortable. (Mat Idris & Sibley, What are Users' Perceptions of the Hospital Courtyard Garden and How Satisfied are they with it?, 2019)

Examination of the patients in hospitals reveal that having the opportunity to access the greenery or plants in healthcare facilities, accelerate recovery can be achieved by inducing positive changes in blood pressure, cardiac activity, muscle activity and, electrical activity in the brain of the patients. (Belčáková, Galbavá, & Majorošová, 2018)

Viray (2018) examines the hospital green roofs to express that green roofs can optimally be designed in order to promote horticultural therapy as the human-nature interaction of healthcare facilities. Green roofs despite providing various ecosystem services provide benefits as a therapeutic landscape in hospitals for the users who may not be able to access the ground floor for many limitations. Also the results from post-occupancy evaluation among patients, visitors and staff, demonstrate a high rate of satisfaction. Green roofs provide a place for solace and respite and even if they are not physically accessible, they prepare visual access to nature instead of a bare roof, the nature which reduces the time of hospitalization, use of medication and recovery promotion. (Viray, 2018)

Simply looking at nature scenes, only three to five minutes, physiologically heighten sympathetic nervous system with positive changes in blood pressure, heart activity, muscle tension, and brain electrical activity. (Ulrich, Health Benefits of Gardens in Hospitals, 2002)

B) Plants and Pain

Existing the plants in the space raise our experience of pain.

The pain threshold in people is linked to the presence of plants placed in a room. The threshold of pain degree in individuals raises when the plants placed in the room. This is also true in opposition, therefore the absence of plants in a room reduces the pain threshold in people. (Lohr & Pearson-Mims, 2000)

The experimental results in heart surgery and gall bladder units and states that recovery outcomes in patients with a view to nature or even relevant artworks about nature notably improved by making shorter hospital stays, fewer suffering from post-surgical complications and the fewer dose of strong normative drugs. (Ulrich, Health Benefits of Gardens in Hospitals, 2002)

C) Plants and Perceived Health

Being in a space with plants has been linked to improved perceptions of our own health.

Respect to the design quality of green central courtyards include accessibility from different points and visibility and wayfinding which increase the awareness of the user from their problems and situation in the moment, benefits of natural spaces for their future designs improves the quality of the user satisfaction in this buildings. (Mat Idris & Sibley, What are Users' Perceptions of the Hospital Courtyard Garden and How Satisfied are they with it? , 2019)

Stewart and Abudayyeh through a synthetic biology approach propose indoor plants within interior design and recruiting them as functional health monitors to benefit human occupants as Phytosensor technology. Due to the biochemical organism of plants, they can work as building biosensors in order to react against the indoor contaminants detecting invisible harmful microbial factors, such as molds and fungal genera which release VOCs that affect leaf structure and seed

germinating process which eventually result in Sick building syndrome and occupant's discomfort. This Phytosensor technology allows us to see the combination of a synthetic biology system with interior design in order to monitor the changes in colors and fluorescence in plants, caused by harmful interior microbiome that make us aware of warning messages of plants. They also add that these biophilic houseplants walls are not restricted to the VOCs but also capable of detecting odors, viruses, and influenza, thus, they can be set for hospital and healing centers environments. (Stewart Jr, Abudayyeh, & Stewart, 2018)

Indoor planting or the presence of plants and greenery inside the spaces in the residential rehabilitation center enhanced the perception of the pulmonary patients from their well-being and health situation. (Raanaas, Patil, & Harting, 2010)

Kowalski in his book, proposes indoor vegetation, in addition to other applicable ventilation systems, can contribute to reduce the airborne pathogen level in the hospital environments as green building technology that also lead to increase the sense of well-being by its positive impacts on the psyche of the occupants. According to the microbiological data, the author states that living vegetation as a surface or an extent place plays a biofilter role by absorbing microbes or dust suspended in the indoor air and, generating oxygen which has an oxidative effect on microbes. In addition to plants that operate against some harmful bacteria for mammalian, symbiotic microbes present in their soil also have disinfection influence on air. Kowalski adds that the houseplants contrary to their potential to produce fungal spores have no increased effect on the concentration of airborne to the indoor environment but in some cases, the soil pot may cause the allergies. (Kowalski, 2011)

D) Plants and Mood

Mood improves in when plants are present.

The green space affects in hospital spaces can be seen on behavioral improvement, better pulse, blood pressure, and overall mood of patients can be seen in

an Alzheimer's patient exposed to nature while the same green area can accelerate the recovery period on a patient after surgery. It is noticeable that plants might be influenced differently on the patients with their particular condition or disease which depends on the type of illness and the time that a patient is exposed to that nature. (Belčáková, Galbavá, & Majorošová, 2018)

The presence of plants as indoor or outdoor gardens psychologically raise the positive feeling level, reduce negatively toned emotions and work as pleasure distraction by sustaining attention for users, therefor plants can restore or recover from acute stress by making changes on psychological and physiological system in the patients, non-patients, and staff. (Ulrich, Health Benefits of Gardens in Hospitals, 2002)

Plants can makes people less anxious and feel better in hospital waiting rooms. Considering color psychology of plants can reduce anxiety and increase relaxation. According to experts, mixing textures and colors in light blue and white would be best for anxiety reduction because light blue have more calming effects and relaxation while white blooms promote the message of cleanliness, orderliness, and precision. (Baldwin, 2016)

E) Plants and Professional Performance

There are a lot of advantages given by the greenery and plants in the workspace that can positively impact the performance of the workers.

Gardens whether interiorly of exteriorly foster access to social support and privacy and provides opportunities for staff also to escape from stressful workplace pressure and all of these factors result in user satisfaction with a significant positive effect on the overall quality of care. (Ulrich, Health Benefits of Gardens in Hospitals, 2002)

Shibata and Suzuki in their investigation declare that the creativity improvement in people performing a study is increasingly enhanced when the plants and greenery pots are available in the environment that a specific activity is being done. (Shibata & Suzuki, 2002)

The presence of the plants ameliorates the cognitive functions to perform an education operation for the people in the environment. (Raanaas, Patil, & Harting, 2010)

By doing an examination of the workplaces with or without plants' existence, Nieuwenhuis and his team learned that adding the vegetation pots or plants in an office that previously were empty of greenery acts as an enhancement factor of satisfaction level for the operators and it leads to high actual and perceives productivity up to 15% which means furthering faster and precise the tasks with fewer mistakes. (Nieuwenhuis, Knight, Postmes, & Haslam, 2014)

3.1.4 WOOD AND OTHER NATURAL ELEMENTS IN HEALTCARE FACILITES

Conducted research is illustrating that employing the natural material and the furniture or designing by natural materials such as wood increase the level of psychological comfort if the environment. Therefore in this part the benefits of using the natural materials is discussed.

A) Wood and Healthcare Settings

The usage of natural materials such as wood in healthcare facilities was often compound with the other types of natural materials and nowadays this subject is being widely spread more than before and researches have conducted toward its beneficial relationship in this particular environment.

The measured degree of secretion of cortisol hormone in patients hospitalized in isolation rooms constructed by cedar wood and rice straw demonstrate, the lower level of stress experienced compare to those in a room built by no wooden or natural material or concrete wall. (Ohta, et al., 2008)

In the communal spaces of care homes equipped with the furniture in which the natural materials (wood, cane) have been used to create, the general intellectual well-being of the occupants living or working there enhances in contrast with the furniture

devoid of those natural materials. (Weenig & Staats, 2010)

Natural materials used to create furniture of the assisted living rooms for the patient's families and patients themselves, evocate the home atmosphere more instead of the real character of a hospital for them. (Marsden, 1999)

B) Psychophysiological Response to Wood

Conducted researches on the psychophysiological benefits and effects of wooden materials used in the different environments and spaces despite the newness of this topic reveal that positive influences of applying the wooden elements are remarkably considerable on human mind-body systems.

Kelz by conducting an examination on Austrian students and their classrooms during a year found that richness of the wooden elements in those spaces led to parasympathetic nervous system activation. High activity in the nervous system is an indication resultant in increased heart rate variability of the students which generally shows a significant reduction in the stress level and improvement of the functionality and health in them. (Kelz, Grote, & Moser , 2011)

The human response (specifically in terms of heart rate and blood pressure) to the wood applied in the residential space has been surveyed by Tsunetsugu and his team and according to the achieved results, they found that those in the room containing wooden elements have less blood pressure and heart rate after entering to the specific space. But in a comparison with the room with no wood, results show that blood pressure and heart rate increased in occupants after coming inside and when they faced no wooden elements in there. (Tsunetsugu, Miyazaki, & Sato, 2002)

This time Tsunetsugu and his team studied the participant's responses to the three different categories of rooms that in each of them the amount of applied wood on surfaces was different in 0%, 45%, or 90%. In this study, they measure the level of the heart rate and blood pressure in individuals and the

outcomes showed that the range of heart rate and blood pressure in the room with 90% of the wood compare to the room with 0% was lower. But the most preferred room from the participant's point of view was the one with 45% coverage of wood and on average, they have declared the most level of comfort and less stress in it. (Tsunetsugu, Miyazaki, & Sato , Physiological effects in humans induced by the visual stimulation of room interiors with different wood quantities, 2007)

Sakuragawa and his team investigated just the visual influence of a wooden wall in comparison to the steel one on people. Looking at the wooden finishing layer wall remarkably reduced the blood pressure in them but fact is true if they do like the wooden wall, and if they do not like it, the result would be unchanged.

On the other hand, the steel wall in the facade couldn't have any impact on the blood pressure of the viewer but if the people dislike it, the blood pressure level consequently raises. (Sakuragawa, Miyazaki, Kaneko, & Makita, 2004)

C) Other Natural Elements - Visual Fractals

The universe contains dimensions and all the natural phenomena in this universe are fractals that are unknown to us or visually rare to identify, but incapability to see this geometrical basis does not mean to be apart from or unaffected by it. Many of fractals are visible to us clearly like the plants, clouds, stone pores and etc. Fractal is a curve or geometrical figure, each part of which has the same statistical character as the whole.

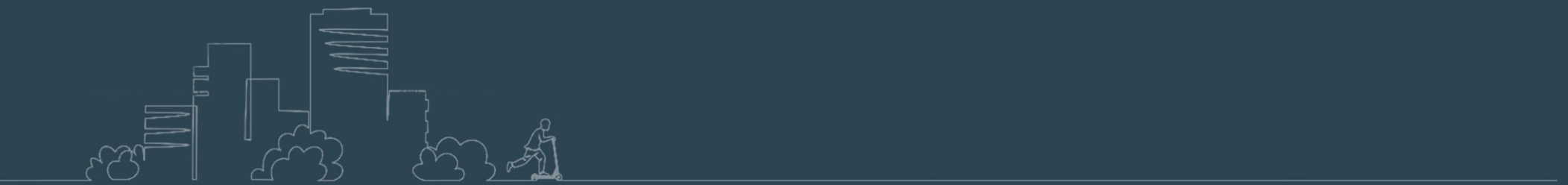
Positive reactions in a human occur when he looks at the clouds, plants or other fractal elements found in nature. Watching them in or out of spaces human works or lives, makes him more relax and it raises the cognitive functions by affecting the psychological factors which result in mental and physical health. (Joye, 2007)

Natural elements or even images from nature like plant images or natural symbols with their fractal geometric features, mathematically defined in natural patterns, work just as well as real plants by powerful

affecting psychological mechanisms to reduce patient anxiety in the hospital spaces. Following this theory studied on 166 patients with open-heart surgery, other aspects of nature such as trees or rocks, whether real or artificial, have a significant influence on less postoperative anxiety, especially in the patients who were shown a nature picture dominated by water. (Baldwin, 2016)

Chapter 04

Design Intervention



4.1 THE CASE STUDY OF SAN LUIGI GONZAGA HOSPITAL

In this chapter, the case study of San Luigi Gonzaga Hospital, its current situation, and its functionalities are examined. Moreover, some examples and observed case studies which are notable in this particular field are mentioned to provide a better intuition.

4.1.1 History of the Complex

The beginning of the history of "San Luigi Gonzaga" has a precise date: March 26, 1818. That day, in the presence of the King and the authorities of the Municipality, work began on the hospital "specialized" in the treatment of lung patients, at the time, for the most part, suffering from tuberculosis. The need for a specialized hospital was acknowledged by the Opera Pia San Luigi Gonzaga.

The hospital was built in 1826, in a location that was not the current one. In fact, it was originally located in Turin, in the Valdocco area, in the current headquarters of the State Archives. The place for the new construction was identified between Via delle Ghiacciaie, Via del Deposito, Via Santa Chiara and Strada Valdocco, respectively the current Via Giulio, Via Piave, Via Santa Chiara and Corso Valdocco.

The project was entrusted to Giuseppe Maria TALUCCHI, among the few exponents of Piedmont Neoclassicism, who created, among other things, the facade and the rotunda of the courtyard of the Albertina Academy, the completion of the College of Nobles of Guarini, later headquarters of the Academy of Sciences, as well as the entrance portal of the University of Via Verdi. (Azienda Ospedaliero-Universitaria S.Luigi Gonzaga, 2005)

In 1903 the hospital reached the maximum capacity of 243 beds; however the continuous progress of science in the treatment of lung diseases led the Administration not to carry out further extensions, but to build a new hospital intended solely for the treatment of patients suffering from tuberculosis.

The foundation stone of the new hospital was laid in 1904, while the transfer from the Valdocco region to the ultra-modern 1000-bed suburban sanatorium in the Corso Orbassano area in Turin, the current headquarters of the FIAT Mirafiori factory, takes place in 1909.

The new San Luigi Gonzaga hospital was born in Tre Tetti, an agglomeration of three single-storey houses that interrupted the desert road that led to Orbassano.

In 1970, finally, the San Luigi Gonzaga Hospital was transferred again, going to occupy the current site. The original value of the sanatorium is evident, in fact, from the pavilion structure, with large sunny terraces and long connecting corridors, as well as from the vast park surrounding the hospital.

At the beginning of the 90s, the installation of the University of Turin, through the acquisition of high professionalism, has produced a significant expansion of skills and specialties giving a strong boost to the life of the hospital. Consequently, from purely pneumological, the San Luigi has been transformed into a modern multi-specialist complex.

In the following years, the institution of the II Degree Course in Medicine and Surgery, the Degree Course in Nursing (CLI) and some Postgraduate Specialization Schools further widened the collaboration between University and Hospital allowing to reach high levels of development through the integration between scientific research, assistance and professional training, characterizing the hospital, which in the meantime has become "with national relevance, as a real " teaching hospital ". (Azienda Ospedaliero-Universitaria S.Luigi Gonzaga, 2005)

With DPGR No. 99 of 17 December 2007, the San Luigi Gonzaga Hospital Company, has taken on the qualification of “University Hospital Company “since 1 January 2008. (Azienda Ospedaliero-Universitaria S.Luigi Gonzaga, 2005)

The San Luigi Gonzaga Hospital-University is characterized by medical-surgical activities that place

it in a prominent position in the Piedmont healthcare landscape.

Over the years, the initial vocation for the treatment of lung diseases has undergone profound evolutionary transformations that have led "San Luigi" to a present and a future strongly characterized by an offer of high quality polyspecialistic health interventions.

The "Alessandro Bertinaria" Anti-Doping Regional Center is also highlighted within the hospital, created on the occasion of the "Torino 2006" Winter Olympics and intended to represent a center of excellence and training in the field of Toxicology and the Neuroscience Research Center of the Cavalieri Ottolenghi Foundation, recently inaugurated.

Since 1 October 2008, the health facility has been the seat of the San Luigi Gonzaga Faculty of Medicine and Surgery.

Figure 34. Arial view of S. Luigi Hospital (Orbassano, l'ospedale S.Luigi si adegua all'emergenza sanitaria, 2020)

This result is the result of the strong collaboration between the Health Authority and the University, which has led to the achievement of high-level scientific results and, in particular, to the development and integration of scientific research, healthcare and training, all aimed at achieving a only primary objective: patient care. (Azienda Ospedaliero-Universitaria S.Luigi Gonzaga, 2005)

4.1.2 Structure and Departments

The hospital has a structure consisting of three pavilions, each of four floors, connected by long corridors. A fourth pavilion is instead intended for services. This is a conformation permitted by the territory in which the hospital is located, an area almost devoid of other constructions and about a kilometer away from the nearest urban center. In fact, the hospital has a considerable horizontal extension and the distance between the two ends is about five hundred meters. (Ospedale San Luigi Gonzaga)

In addition to the aforementioned pavilions, there is one dedicated to the outpatient clinics and also a first aid pavilion, the anti-doping center building, a three-storey building housing the biological center and a circular building housing the university center. There is also a biomedical library.

The hospital includes the following departments located in the various pavilions:

- Developmental and non-respiratory age allergology
- Hospital anatomy and pathological histology
- University anatomy and pathological histology
- Anemias and coagulopathies
- Hospital anesthesia and resuscitation
- University anesthesia and resuscitation
- Cardiology
- Microcythemia center
- Sleep center
- SQUID center
- General hospital surgery

- University general surgery
- Thoracic surgery
- Respiratory diseases clinic
- Multidisciplinary day hospital
- Dietetics and clinical nutrition
- Technical nursing and rehabilitation management
- Health management department
- Psychiatric emergency
- Endocrinology
- Pharmacy
- Gastroenterology
- Medical genetics
- Geriatrics
- Oncological gynecology
- Immunohematology and transfusion – AVIS
- Analysis laboratory
- Emergency Medicine
- Internal medicine I endocrinological address
- Internal medicine II with hematological address
- Internal medicine III with metabolic focus (diabetology and dysmetabolic diseases)
- Nuclear medicine
- Neurology
- Ophthalmology
- Dentistry
- Medical oncology
- Pulmonary oncology
- Orthopedics and traumatology
- Otolaryngology
- Pediatrics
- Pulmonology I
- Pulmonology II - Respiratory pathophysiology
- Pulmonology III – Bronchology
- Pulmonology IV
- Psychiatry
- Radiology
- Radiotherapy
- Functional recovery and rehabilitation
- Multiple sclerosis and clinical neurobiology – CR and MS
- Pain relief and palliative care
- Urology
  (Ospedale San Luigi Gonzaga)

4.1.3 Site Location

The hospital is located beyond the south-western outskirts of Turin, in the municipality of Orbassano and the nearest inhabited center is the municipality of Beinasco. Two important roads leading to the city of Turin allow to reach the structure and place it indirectly in connection with the Piedmont's capital: Corso Allamano, to the north, and Corso Orbassano, to the southeast. Another important route from which you can reach the hospital is the south ring road of Turin via the SITO exit. As for public transport, the hospital is reached by two suburban bus lines (43 and 48) that connect it with the same capital and by an urban line in the municipality of Orbassano.

Figure 35. Arial view of S. Luigi Hospital. 3D view from Google earth

Figure 36. University Hospital San Luigi Gonzaga (Regional Multiple Sclerosis Centre, AOU San Luigi Gonzaga Orbassano, Turin, Italy, 2019)

Site Analysis

4.2 SITE ANALYSIS

In this section, the current state of the San Luigi Gonzaga Hospital area is analyzed and studied from the different points of view and context to have a better understanding of the characteristics of the site and it's around area. The result of this analytic process presented in graphs in order to show the feature of the site which allows us to develop and apply our design task in the right way.

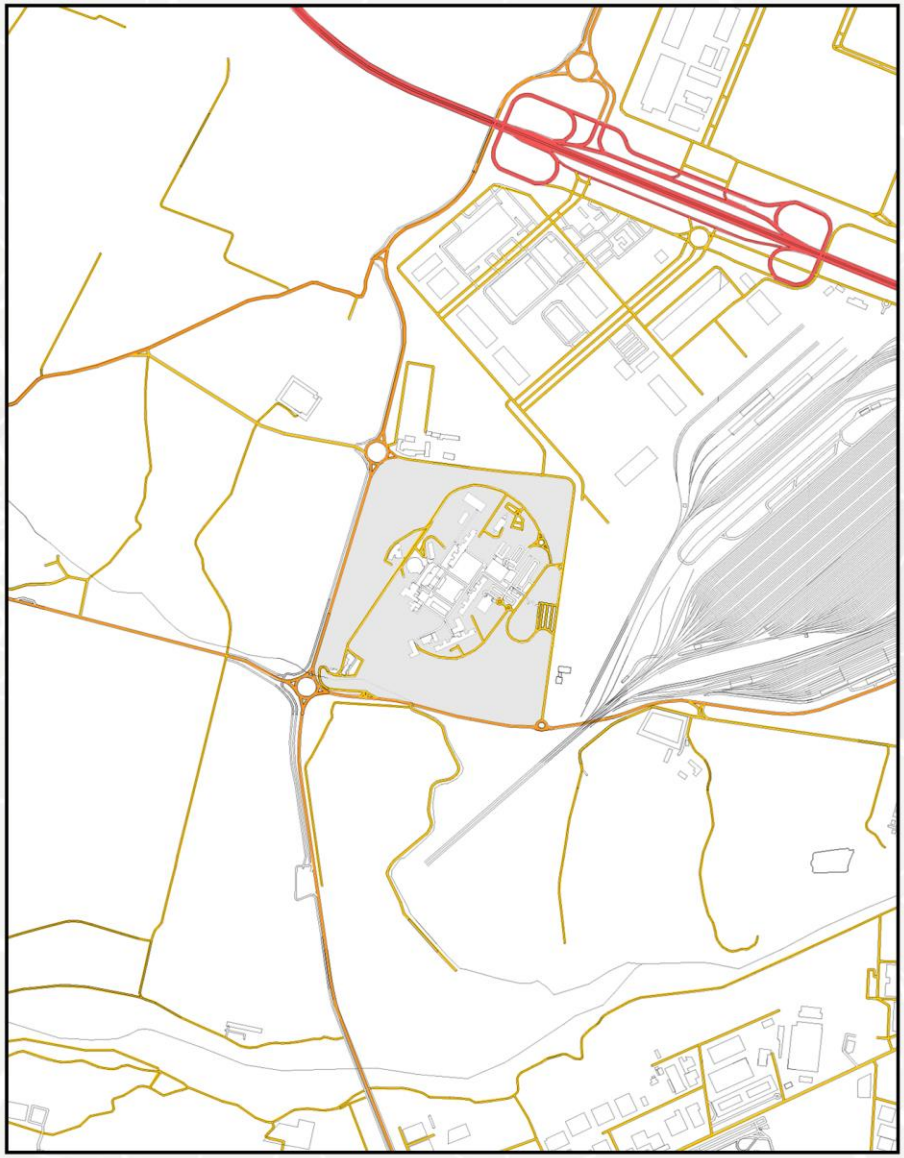
Piedmont Province in Italy

Turin Metropolitan City

Piedmont’s Capital

Orbassano Municipality

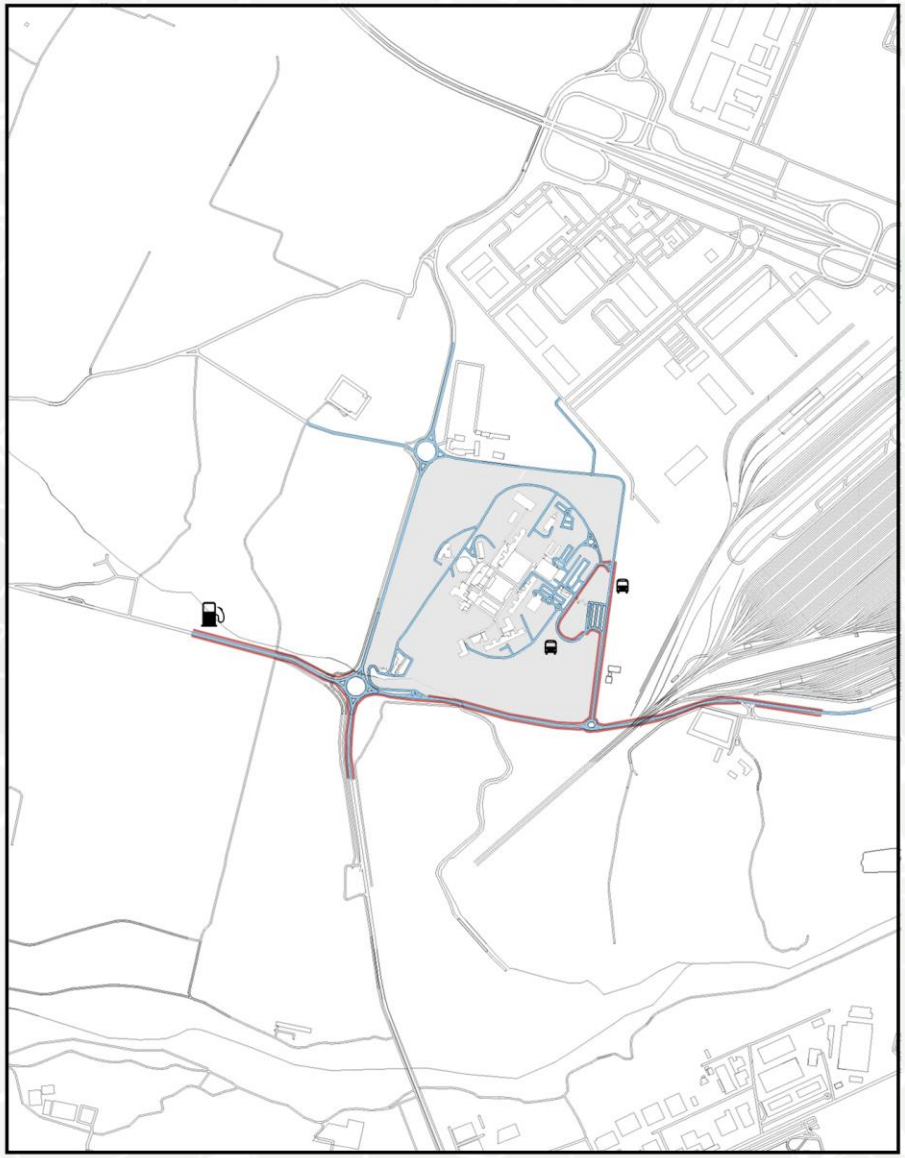
San Luigi Gonzaga Hospital Site and
the Dense Street Pattern



Intercity Routes

Main Routes

Street Pattern



Private car access

Public Transport

Routes and Intersections of the Area

The area has curvilinear street and also straight linear patterns oriented from the cities around that among them, an intercity route connects Turin to Rivoli and Orbassno where the hospital site is located in between with enough distance from it.

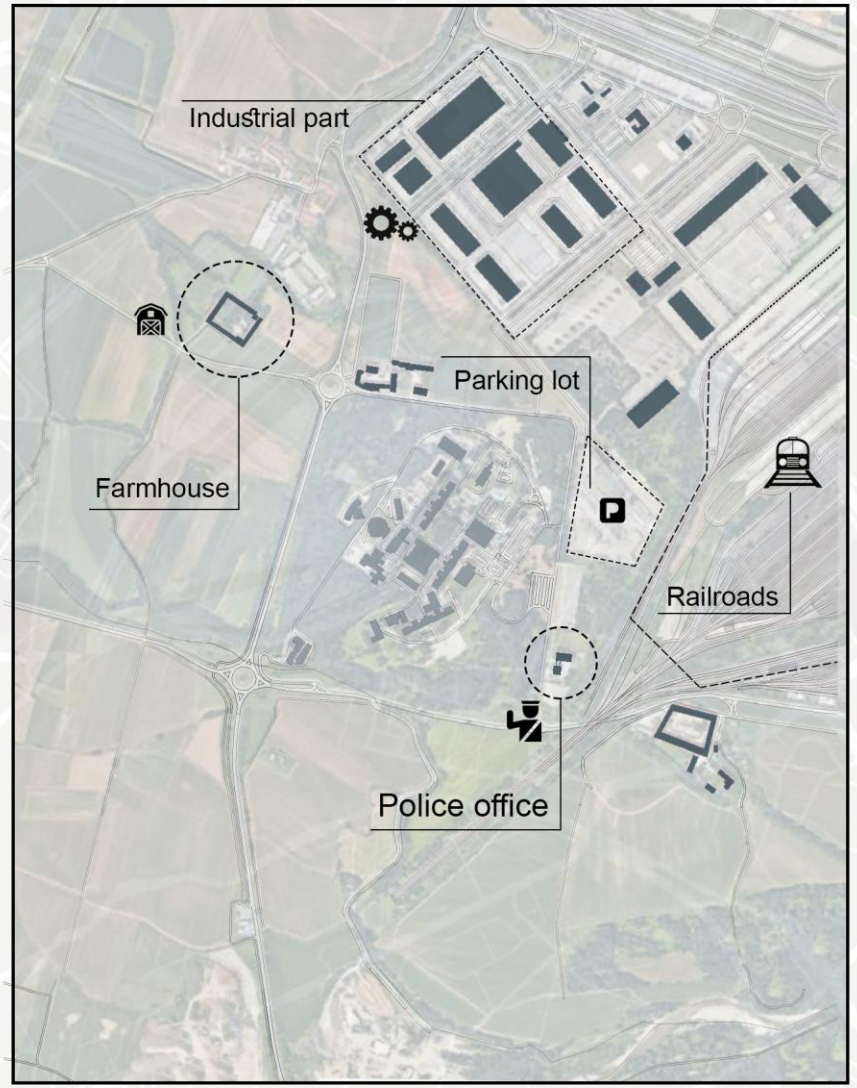
The start-end railroad station found near to the site from the east is a mentionable place which is related to the transportation tools. The main roads are the connectors of the locals with each other while they can be functional to join the suburb zones. Sidetracks are also linking the farms and Cascinas to each other which are intersected with the main roads.

Accessibility

There are four vertices around the site that create a rectangular shape of the site and through them, there are two access roads into the site that among them one entrance with two bus stations to Turin for a two-way trip.

Density of Built and Unbuilt Areas

The selected area in the figure is almost unbuilt location placed in the suburb zone of Orbassano city, mostly covered by farmlands, roads, and green spaces which means not buildings are constructed there, while the rest of the area is built Industrial building (specialized offices in the repair of automotive tires), Parking lots, Railroads (Goods transport company), Farmhouses (Cascine), Financial police office.



Green Areas

Instead of the complex site itself which is fully covered by greenery and trees, Almost most of the lands around the site are covered by green areas in which the farmlands are spread from North West near to the Rivoli city to the east side of the Rivalta di Torino and continue toward the North and Northeast of the Orbassano city. In addition the SanLuigi site itself is surrounded by three sides from North, West, and South.
In between, trees scattered can be seen in the borders of the farmlands and Cascinas.

Canal Network

In the southwest of the San Luigi Hospital site, a thin waterway with the name of Garasso di Rivoli is connected to the Sanguine Torrent canal almost from Northwest, near to Ricoli city which leads to the Po rover passing through the Metropolitan City of Turin.

Figure 37. S. Luigi Hospital environment | Photo by R. Pollo

Figure 38. S. Luigi Hospital environment | Photo by R. Pollo

Sun Path

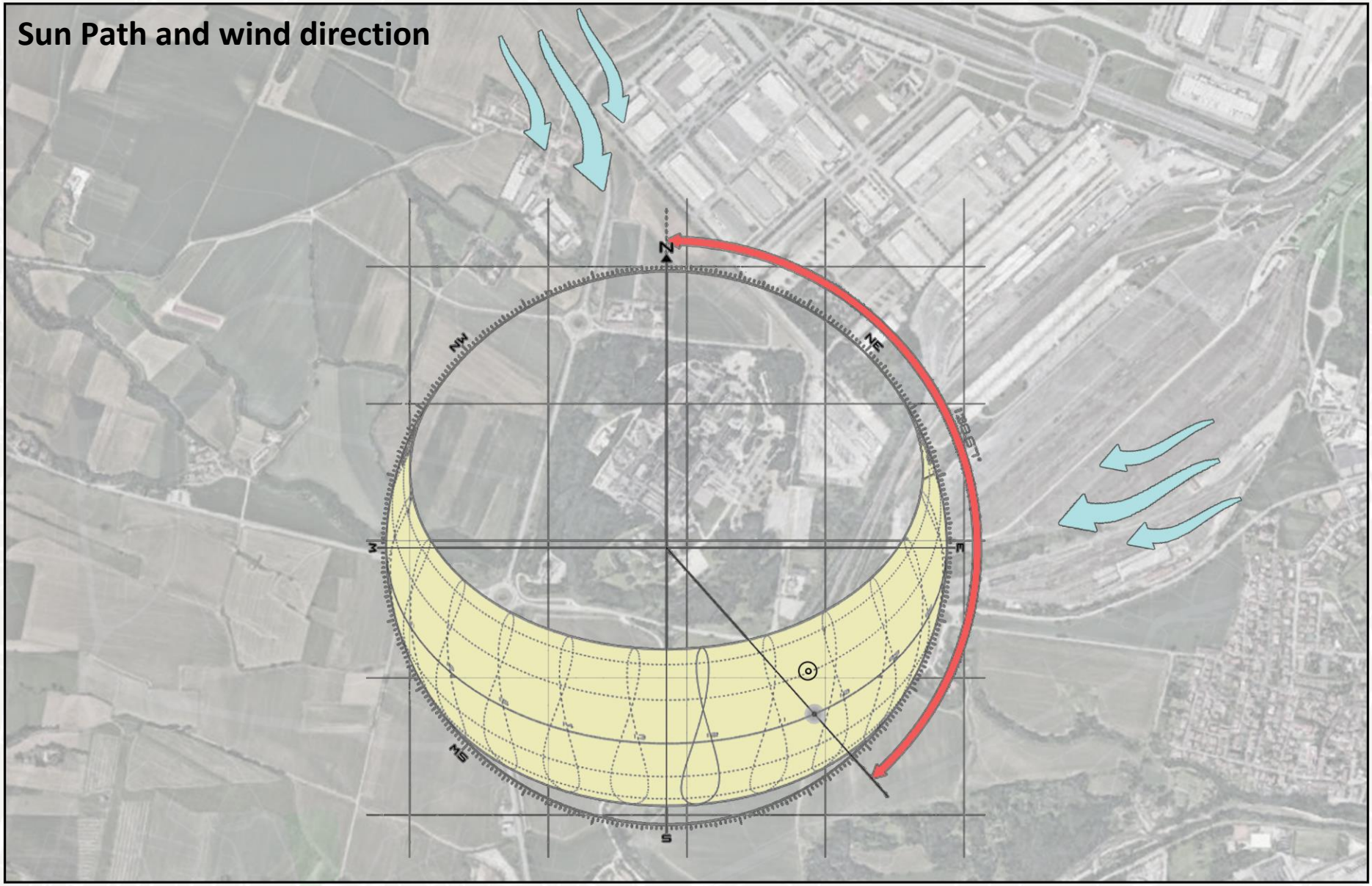
The summer orientation to the site centrality in warmth seasons forms the shown figure which needs to be considered when designing to maximize solar light and heat gain.

Wind Direction

The average hourly wind speed in Turin and cities around experiences mild seasonal variation over the course of the year.
The windier part of the year lasts for 4.2 months, from February 2 to June 8, with average wind speeds of more than 4.4 miles per hour. The windiest day of the year is March 28, with an average hourly wind speed of 4.9 miles per hour.
The calmer time of year lasts for 7.8 months, from June 8 to February 2. The calmest day of the year is November 30, with an average hourly wind speed of 3.9 miles per hour.

The wind direction shown in the figure is to emphasis on the attention when the design phase is proceeding. Therefore, the summer wind needs to be used for ventilation and winter wind needs to be reduced.

Sun Path and wind direction



PAVILION 1

P-1 TECHNICAL ROOMS
PT PSYCHIATRY/AMBULATORY OCULISTICS/PHSYCHIATRY AMBULATORY
P1 NEUROLOGY AMBULATORS/C.R.E.S.M./INTERNAL MEDICINE 1
P2 NEUROLOGIA GERIATRICS/EMERGENCY MEDICINE
P3 IMMUNOHEMATOLOGY MICROCYTHEMIA/MEDICAL LABORATORIES INTernal 2
P4 D.H. INTERNAL MEDICINE 2

PAVILION 2

P-1 TECHNICAL ROOMS
PT ANESTHESIA REANIMATION
P1 DIALYSIS / NEFROLOGY/D.H. UROLOGY/SURGERY
P2 THORACIC SURGERY/M.A.R. 5/D.H. M.A.R. 5
P3 IGENERAL SURGERY 2 / INTERMEDIATE TREATMENTS / GASTROENTEROLOGYUROLOGIA/CHIRURGIA GENERALE 1
P4 ORTHOPEDICS D.H. ONCOLOGY

PAVILION 3

P-1 TECHNICAL ROOMS
PT HEMODYNAMIC CARDIOLOGY/UTIC/ANTALGIC THERAPY
P1 SLEEPING AMBULATORS/D.H.M.A.R.1/CARDIOLOGY AMBULATORS/ AMBULATORS AND D.H/INTERNAL MEDICINE 3
P2 INTERNAL MEDICINE 3/D. H. MULTIDISCIPLINARY
P3 M.A.R. 2/PHYSICAL AND REHABILITATION MEDICINE/ D.H.PHYSICAL AND REHABILITATION MEDICINE
P4 M.A.R.1 / M.A.R. 5/CYSTIC FIBROSIS/ALLERGOLOGY/D.H. M.A.R. 1-2-5

CENTRAL AMBULERS

PT ODONTOSTOMATOLOGY AMBULERS/SURGERY

PAVILION CURE

P-1 TECHNICAL ROOMS
PT DIAGNOSTIC RADIOLOGY/OPERATIVE CENTER/STERILIZATION CENTRAL
P1 NEUROLOGY AMBULATORS/C.R.E.S.M./INTERNAL MEDICINE 1
P2 ENDOSCOPIC CENTER/PHARMACY
P3 ILABORATORY ANALYSIS / PATHOLOGICAL ANATOMY

CUCINA

PT CUCINA
P1 CUCINA

OFFICE BUILDING

P-2 TECHNICAL ROOMS
P-1 ARCHIVES / WITHDRAWAL CENTER
PT CONTACT CENTER/C.U.P./D.E.A./RECEPTION
P1 OFFICES
P2 OFFICES

THERMAL CENTER

CHURCH / CONFERENCE ROOM

PT CHURCH / CONFERENCE ROOM
MIXED FLOOR UNIVERSITY SECRETARY
P1 BUSINESS TRAINING CENTER
P2 UNIVERSITY CHAIRMAN

PREVENTIVE MEDICINE / LIBRARY

P-1 PATHOLOGICAL ANATOMY DEPOSIT
PT LIBRARY

PHARMACY STORAGE

P-1 PHARMACY STORAGE/ TECHNOLOGICAL CENTERS

RADIOTHERAPY

HOSPICE

EMERGENCY BUILDING

MORGUE PAVILION

ANTIDOPING REGIONAL CENTER

GARAGE

ANIMAL HOUSE

INTRAMOENIA

NEWSSTAND/FLOWER SHOP/CAF

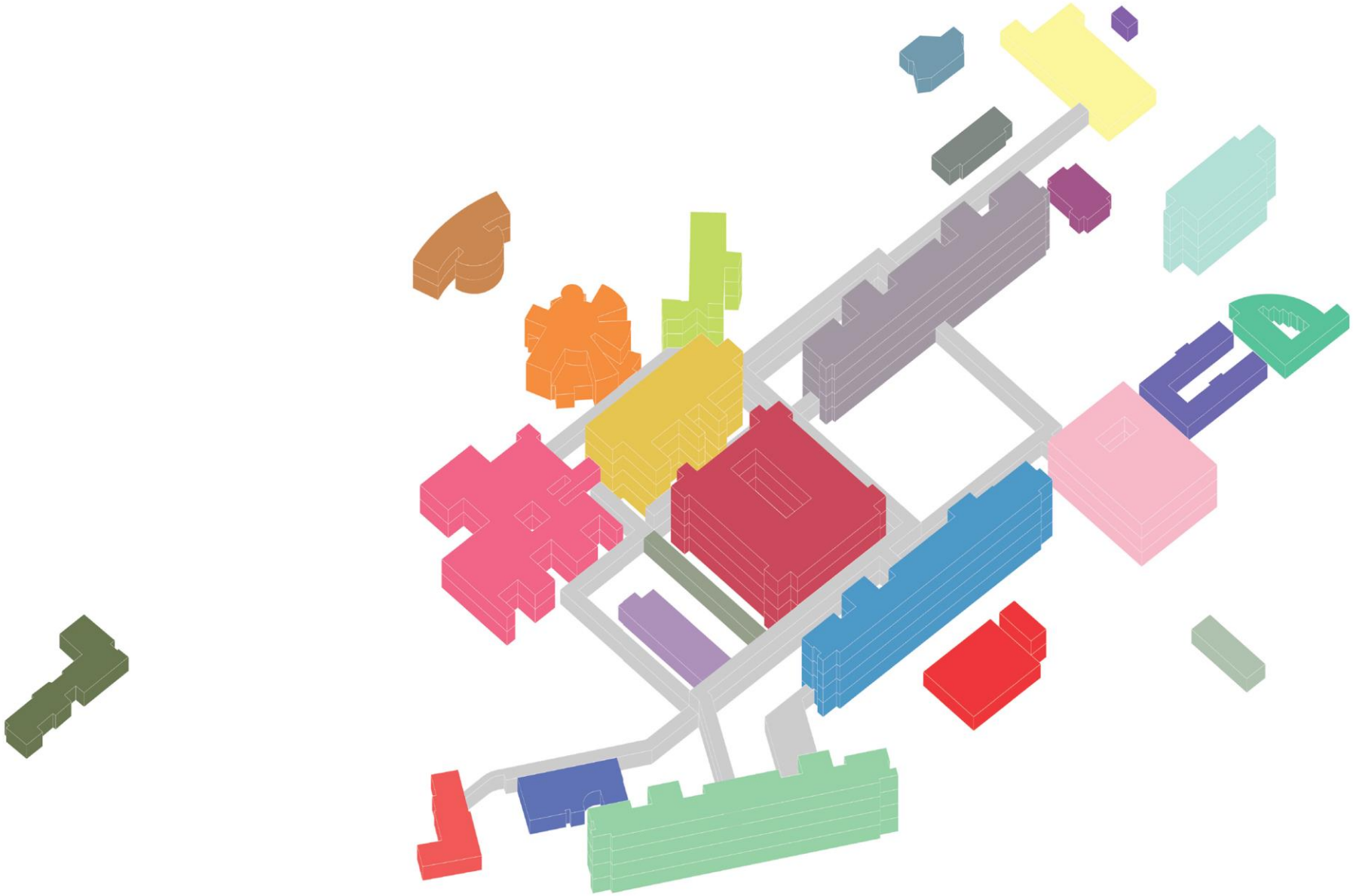
FIRE-FIGHTING CENTRAL

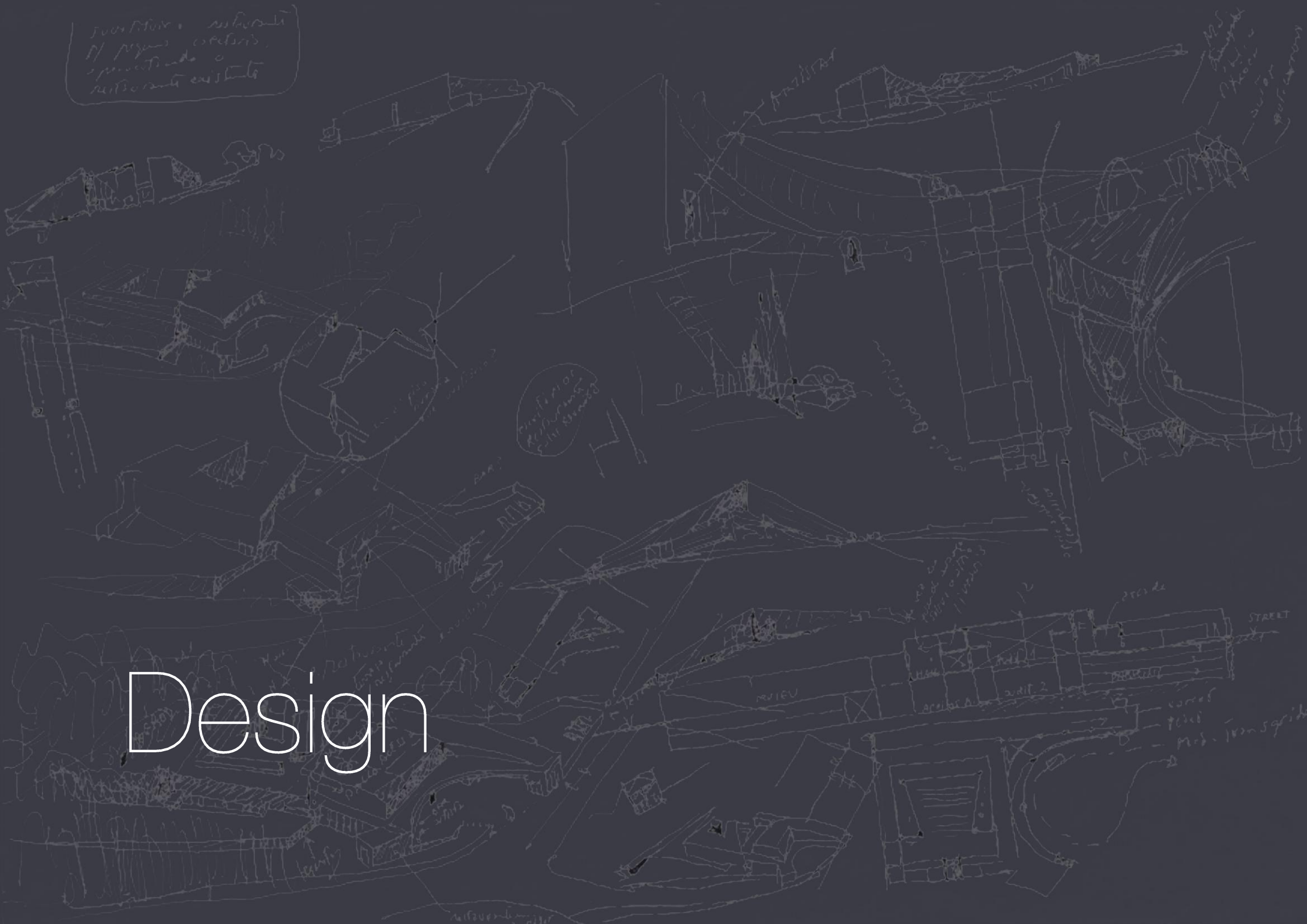
UNIVERSITY CLINICAL BIOLOGY

UNIVERSITY CLASSROOMS

NICO,NEUROSIENCE INSTITUTE CAVALERI OTTOLENGHI

CORRIDORS





Design

In this part is dedicated to the design part according to the conducted study during the previous parts of the thesis. The main objective followed in this part is to utilize the information given by the Biophilia Theory and applying them as the design tools which is called Biophilic design, in order to apply the concept of humanization in the healthcare facility specifically in the San Luigi Gonzaga Hospital.

The following design proposals can be listed as bellow:

1. **Courtyard design**: Focusing on the open spaces between the buildings of the complex
   One the main purpose of the courtyard design is derived from the idea that according to the biophilia theory, connecting the indoor spaces of the buildings to the outdoor green space which have a great potential to be a useful environment for the users of the hospital. Through this one open space in front of the first pavilion is selected due to its proximity to the heart of the complex and important buildings.
2. **Roof gardening**: That is why the wards in each pavilions are settled on the upper floor and the view to outside are neutral (blanked roofs with no visual appeal), applying the green roof idea is proposed to turn the views positive according to the Biophilic design principles.
3. **Hospice design development**: Another design idea in order to improve the concept of humanization in this complex is to present the development of the hospice building. This is one of the important subjects because of its function in addition to the sensibility of the users from patients to staff and families. Therefore the aim is to connect more the indoor space of the hospice by increasing the area of the place especially for the patient at the end of their life feel more comfort to facilitate the moment of dying.

4.3 COURTYARD DESIGN

Open Spaces Design between the Buildings

There are some special spaces in the complex, enclosed by the buildings around, which are almost unusable, potentially can be employed in an efficient way of functioning.

These places can be utilized as some appropriate places for coordinately integrating the internal open space to the greenery outdoor space, in order to promote a natural healing environment and fulfilling various functions, social leisure, and microclimate. They also can provide a climate as well as visual or acoustic protection.

Since they are covered by abandoned greenery, they can provide an opportunity to turn them as the effective places. Additionally, they are enclosed by the buildings of complex and among these buildings, the pavilions with their high level height have a visual sight toward these open spaces. In some points, the corridors have no good view toward the greenery of site even through their wide windows.

These explanations are the reasons to apply some changes in these places in order to apply the Biophilia theory toward providing humanized space in terms of connecting to the reach greenery of the S. Luigi Gonzaga Hospital. Thus, two open space selected to demonstrate the benefits of the courtyard itself and the benefits that can be achieved from them in the complex. So eventually one of the open spaces in front of the pavilion one is chosen to design because of its important location between the buildings around. A round multi-height courtyard design, which is four-sided enclosed by between the buildings of the hospital. The concept of different height in this design is rooted in “social privacy” of people using it. Therefor the people who are passing through the corridors can enjoy the natural view but never disturb those who are inside the courtyard and the level of privacy increased when the height toward the central little pond.

Courtyard Design Idea

1. Keeping, refurbishing, and improving enclosed green areas for the buildings with less connection to the outdoor green space.

2. Providing a calm place for the patient and visitors to relax and reduce the stress, socialize, recovering from pain, having privacy and a tranquil place to be free of work pressure for the staff.

3. Designing a courtyard that contributes toward the specific type of care (e.g. Neurology unit in the first pavilion) which can help to get the best results.

4. Enhancing the visual or non-visual connection of the wards to the outside.

5. Climate mitigation by setting up a microclimate and creating natural ventilation and air circulation inside.

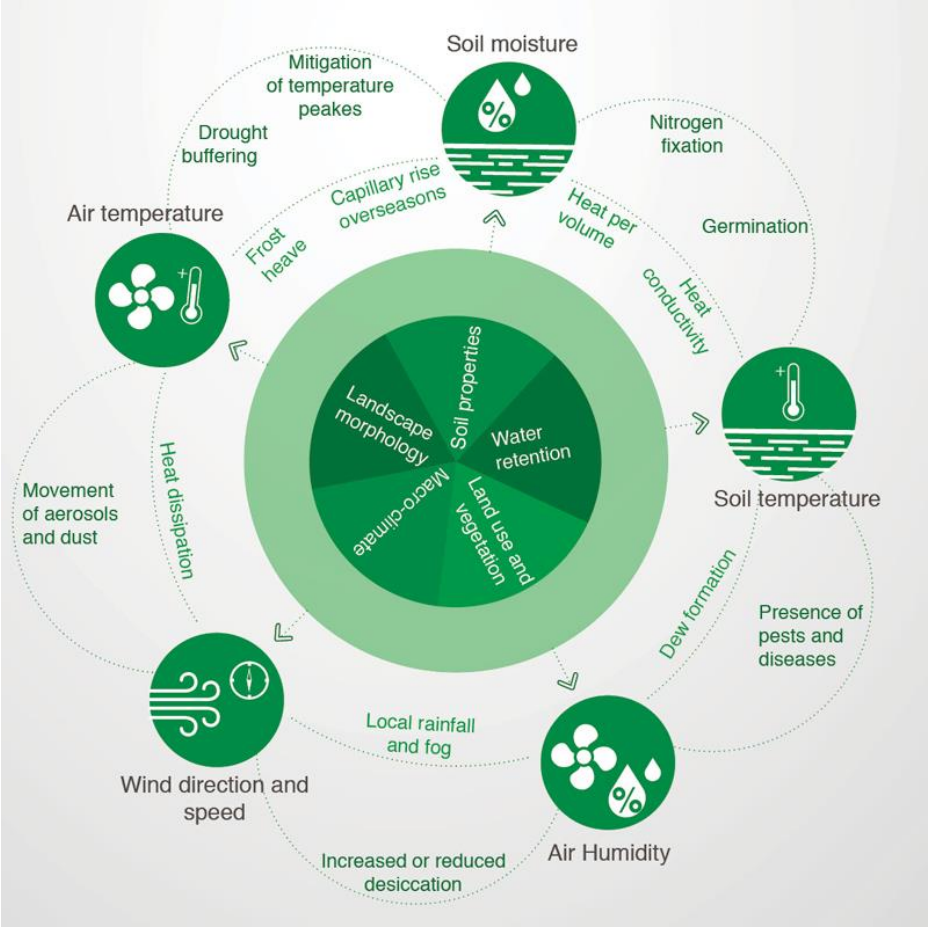
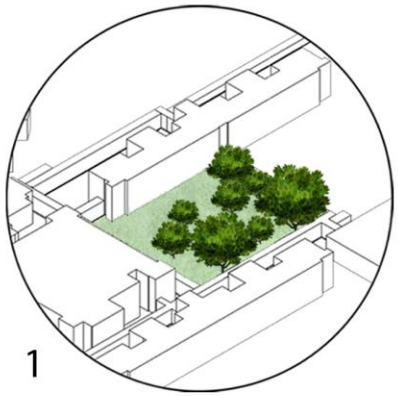


Figure 34. Microclimate effect (Kriptex, 2020)



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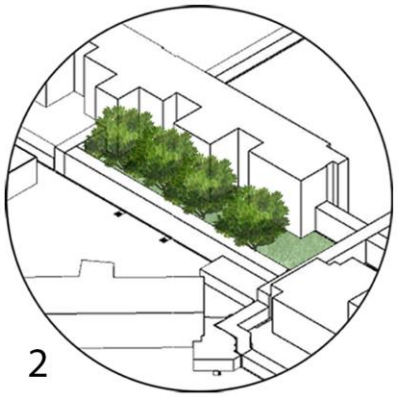

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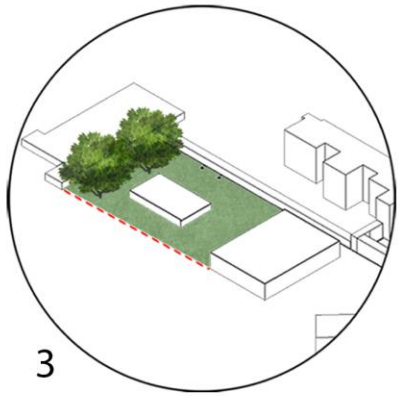

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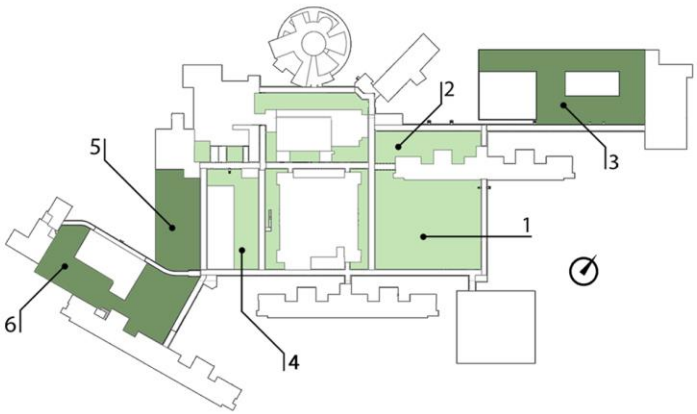

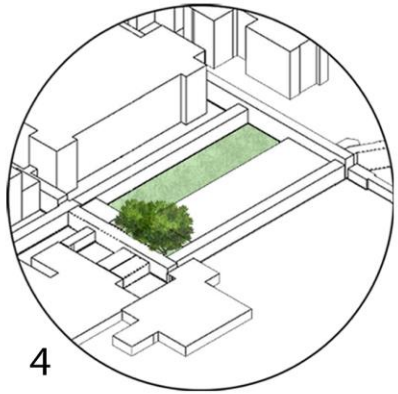

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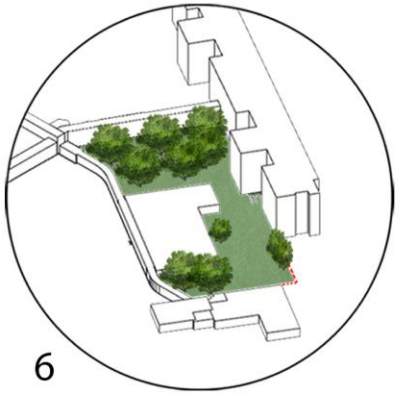

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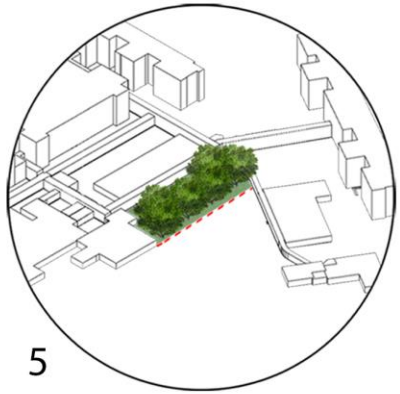
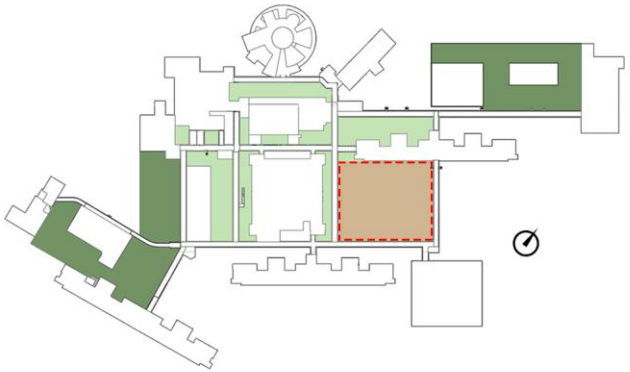
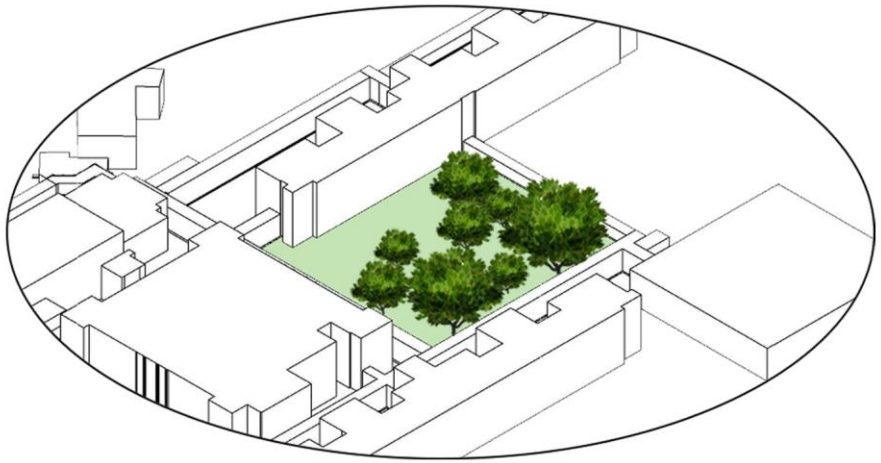
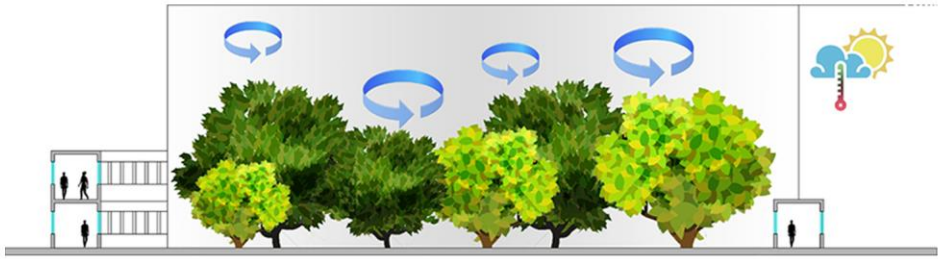


5

An enclosed (4-sided) courtyard in front of the first pavilion in which the neurological medicine is in proceed in there. The first pavilion itself is almost enclosed from fourth directions around by other buildings and a parking lot and it has less proximity to the outdoor green features of the site, hence, the beneficial factors from the courtyard can be mentioned as below:



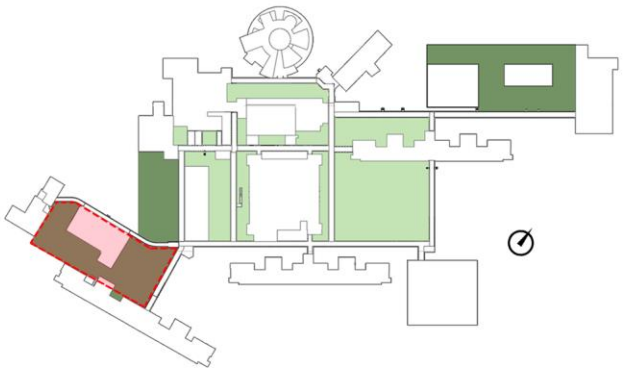


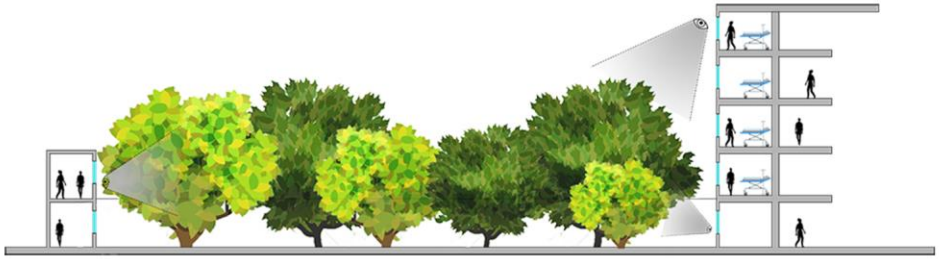


The Courtyard can play a Microclimatic role to modify the environment

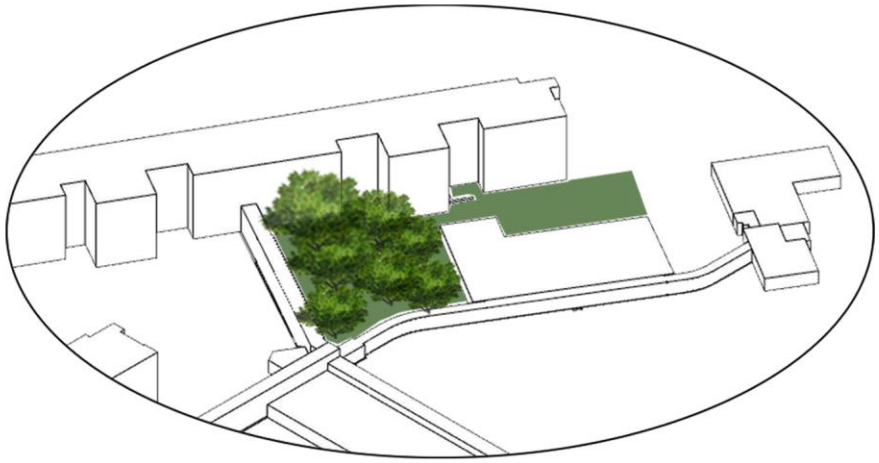
Microclimate condition provide natural ventilation as an important factor

A semi-enclosed (3-sided) courtyard in the back of the third pavilion in which the Internal medicine, rehabilitation, Cystic fibrosis, and Sonography units are proceeding in there. The third pavilion is enclosed from two directions around by other buildings and a parking lot and it is in proximate with Radiotherapy unit and an unused place can be considered as a little backyard to be utilized for staff or visitors to relax from the work pressure, Therefore improvement of this backyard can enhance some factors that are mentioned below:

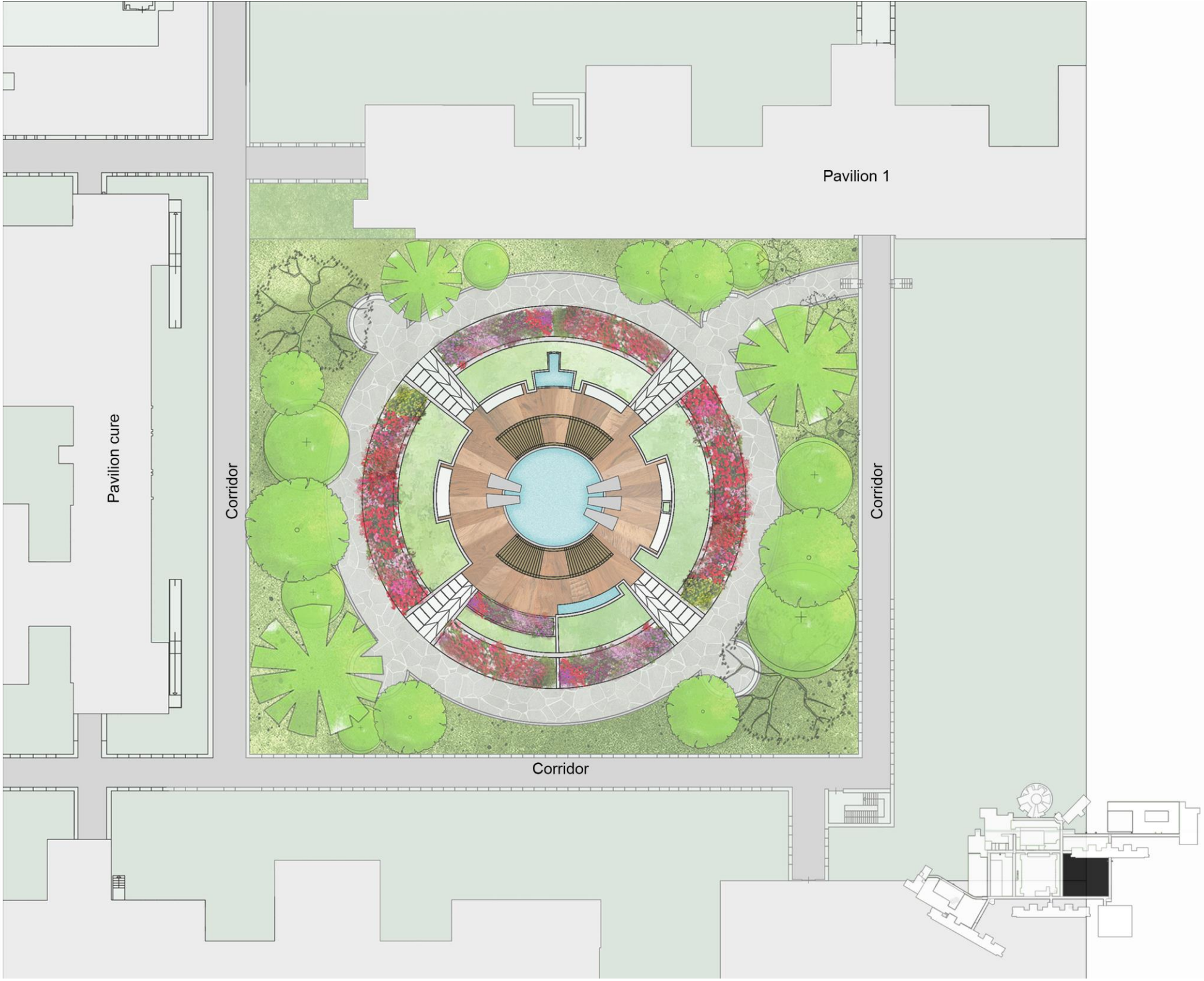


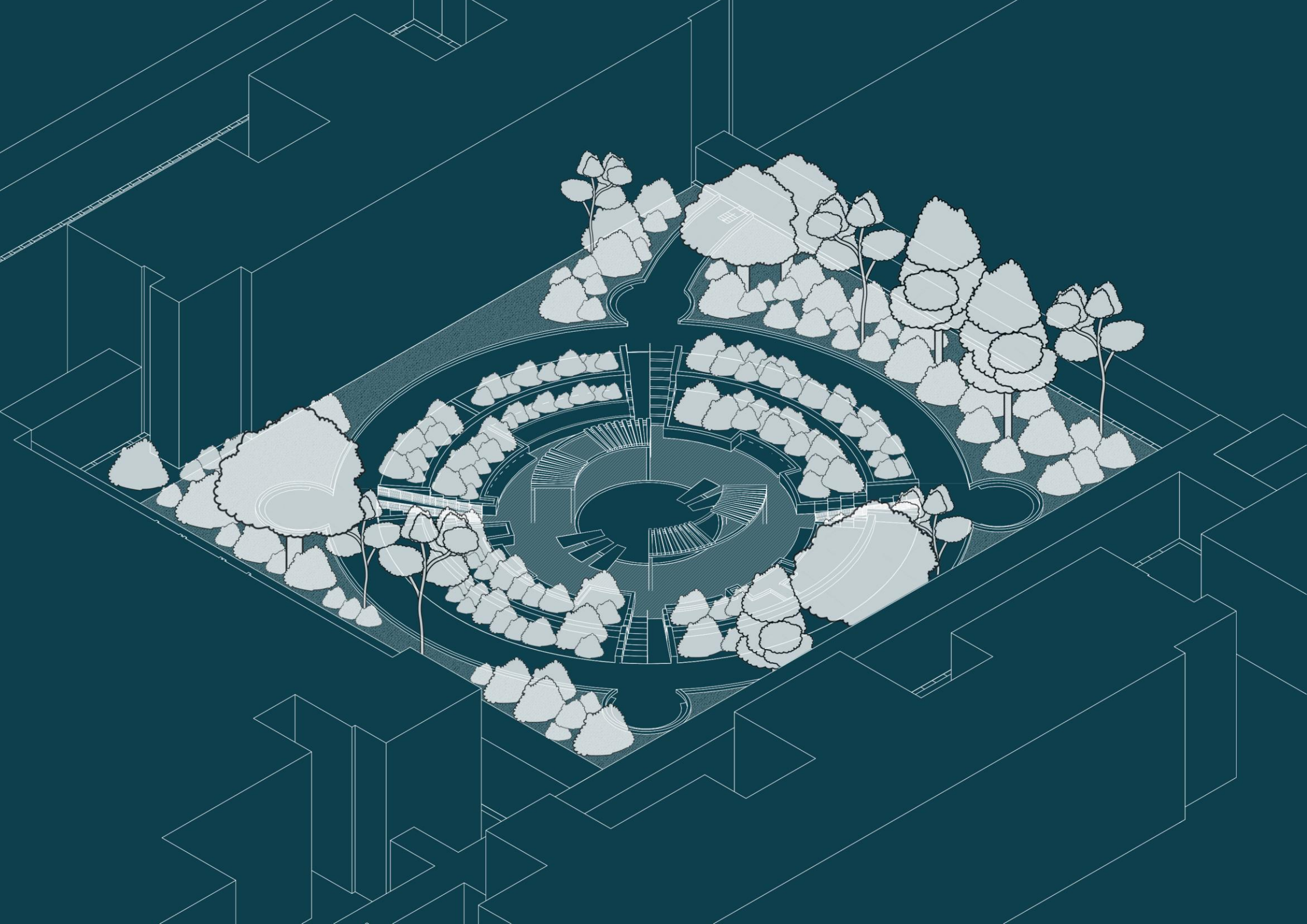


The courtyard provides a visual connection for the wards of the first pavilion



The trees of the courtyard can block the northern cold wind

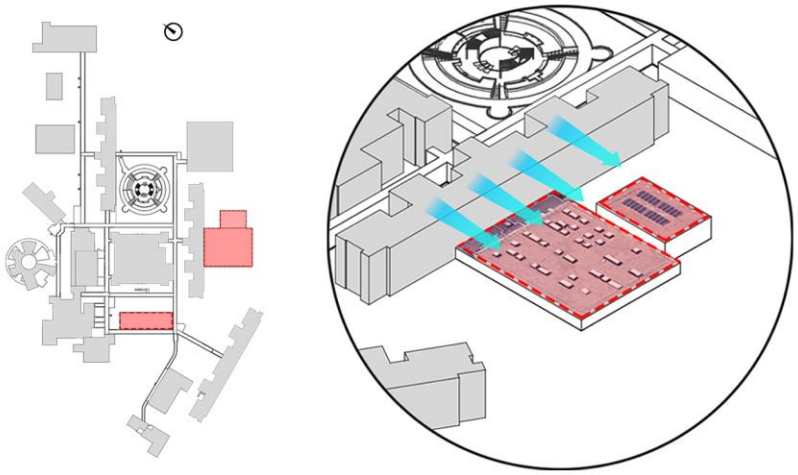

Pavilion 1
Pavilion cure
Corridor
Corridor
Corridor



4.4 ROOF GARDENING

One of the important objectives in order to apply the Biophilic design approach is to utilize or employing intentionally the recognizable potentials and turning them to active functions, coordinated and aligned with the green characteristics of the green outdoor site space.

Modifying roofs of low-level buildings can be beneficial to users who are working in the higher levels of other buildings, whether with accessible or inaccessible connection.



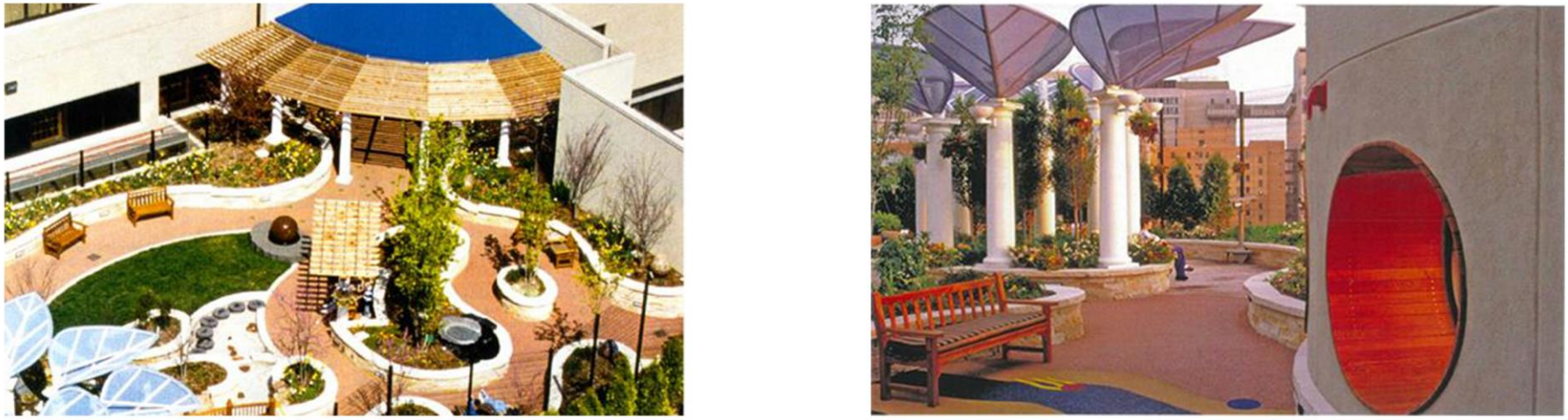
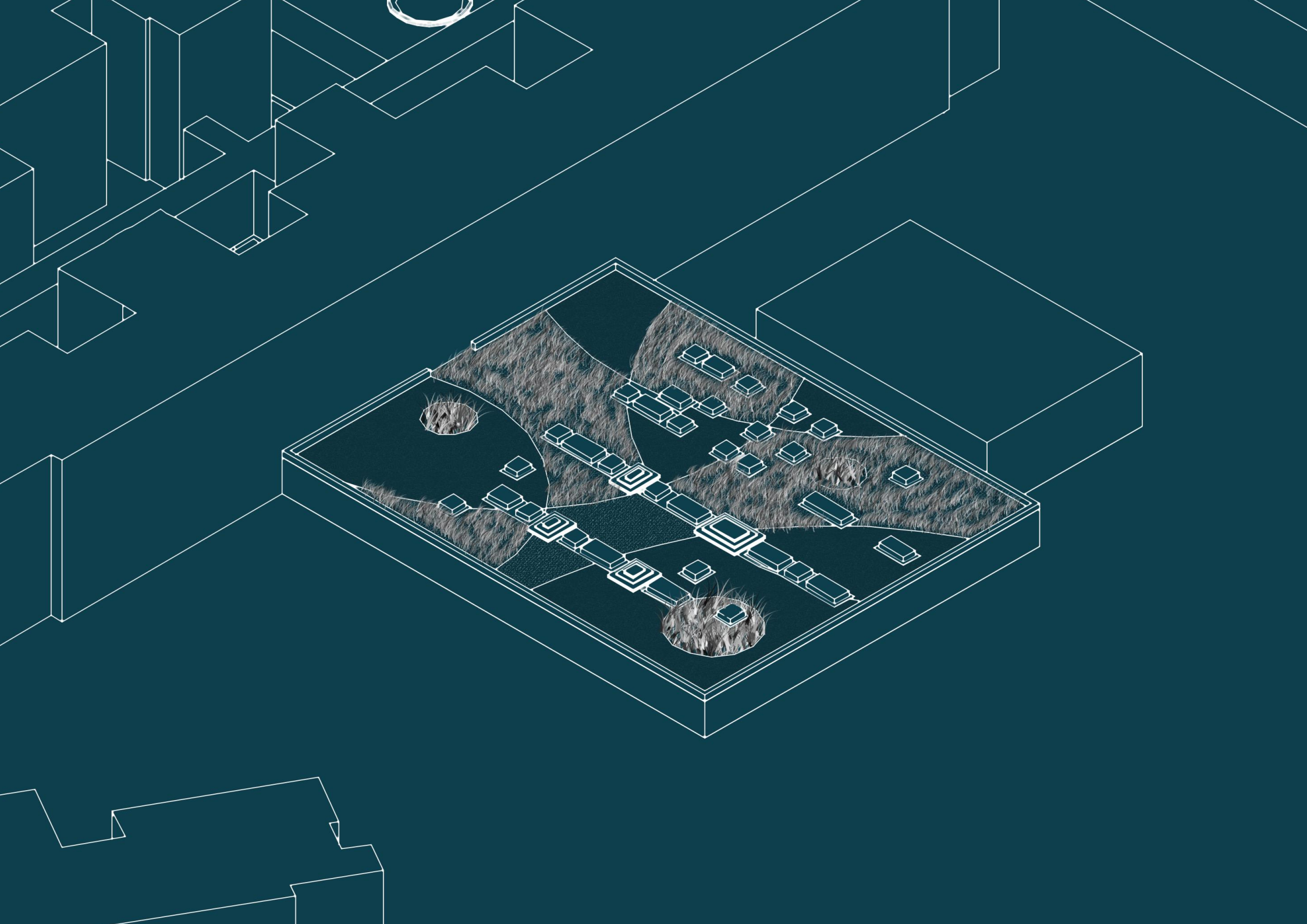


Figure 39. An accessible green roof in the Olson Family Garden at St. Lous Children's Hospital. (Viray, 2018)



By considering the functional and structural aspects of selected buildings in order to apply the green roof, providing inaccessible roof gardens by constructing the intensive roof garden type is suggested. At least, inaccessible roofs can provide view to nature instead of versus a stark white roof. Even the design path of roof garden can follow a scheme to evoke something special to the viewers. As an example, inaccessible green roof of Sharp Memorial Hospital give the viewer the notes of “Beethoven, Ode to Joy” music that reminds them something fun and happy. (Viray, 2018)

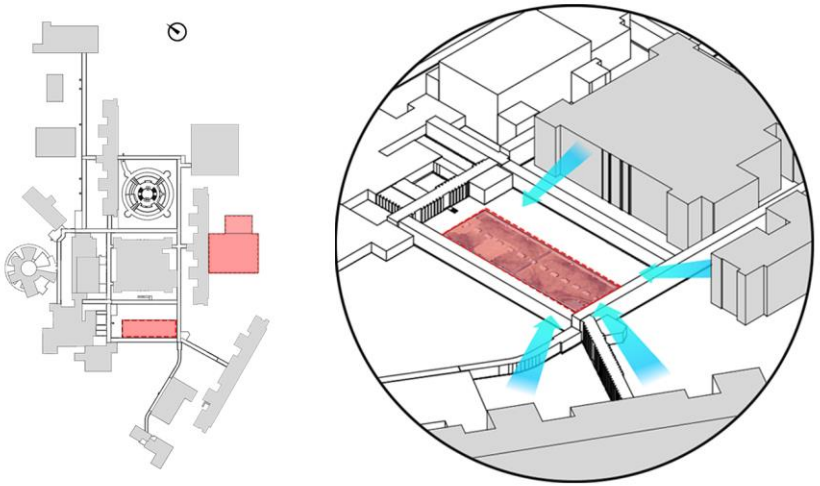
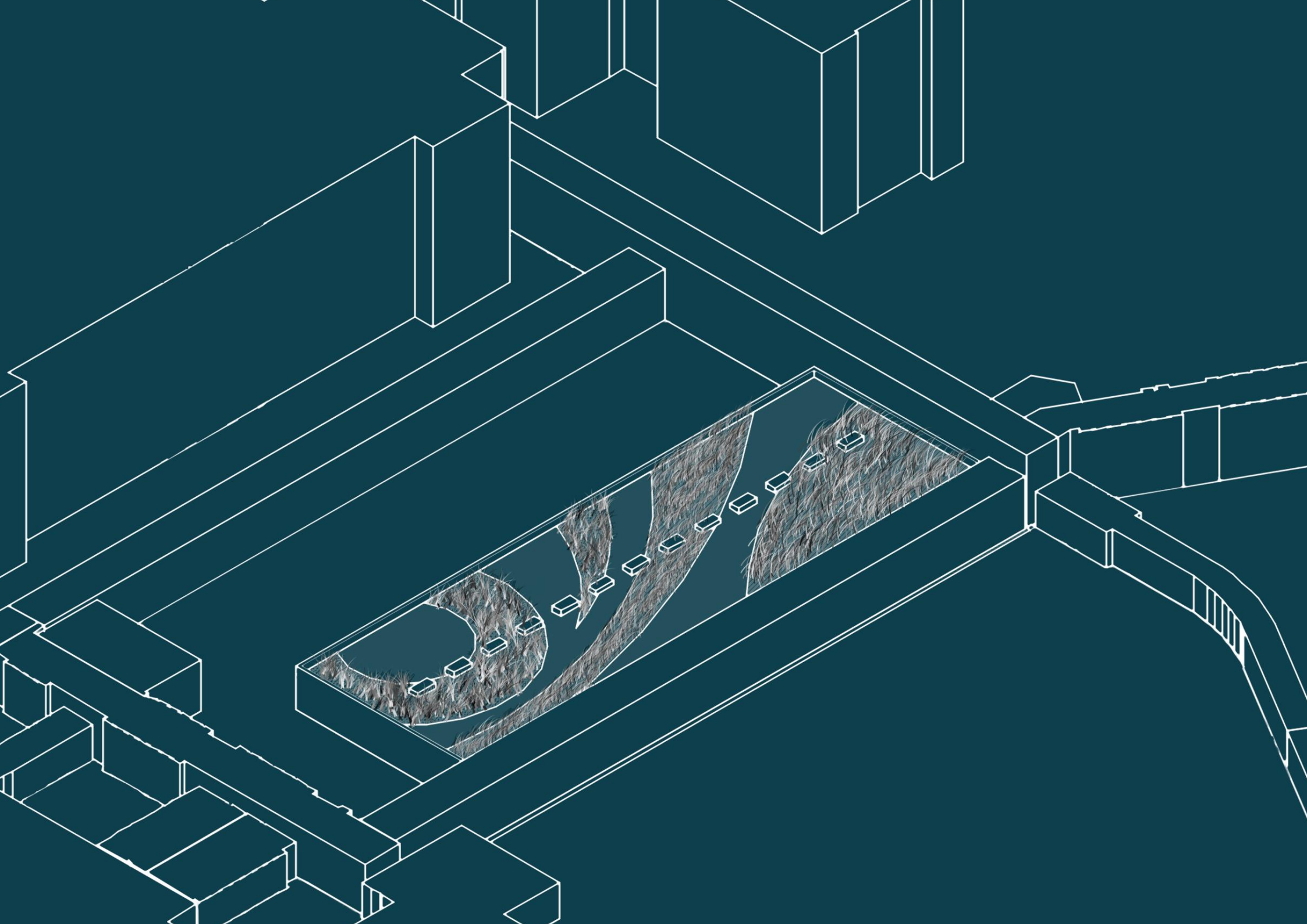


Figure 40. Inaccessible green roof at Sharp Memorial Hospital designed with musical notes to "Ode to Joy." (Viray, 2018)



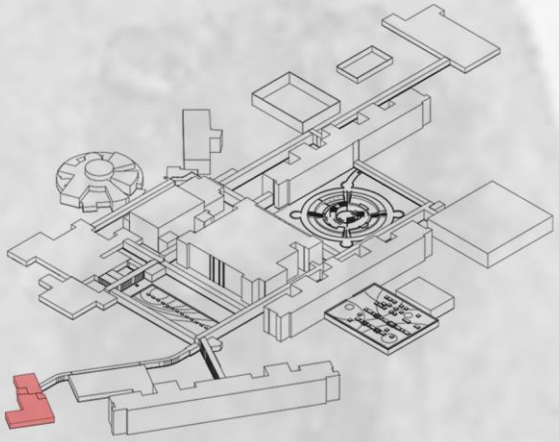
4.5 HOSPICE DESIGN DEVELOPMENT

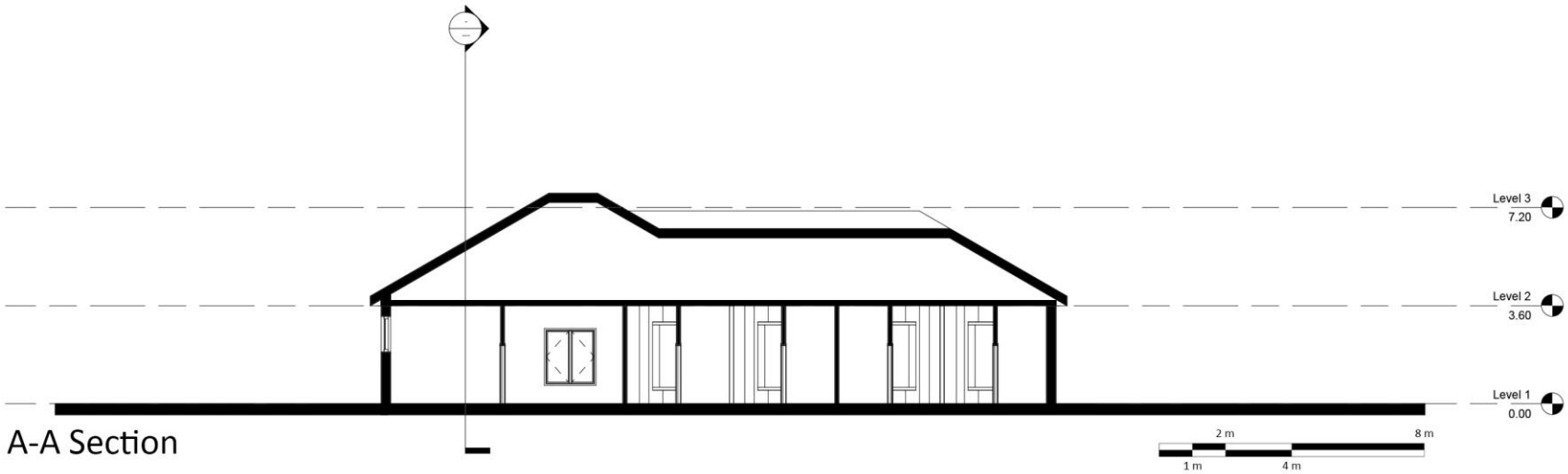
A report published by the World Health Organization estimated that the world's population is getting old and by 2050, the proportion of people 60 years or older in the world will have doubled, from 11% in 2000 to 22% in 2050. Thus a need and demand for elderly services will increase and palliative or hospice care facilities have to be faced with this issue. (World Health Organization, 2014)

In this part, the hospice care unit of healthcare facilities has been design which is or it can be categorized as palliative care facilities, focusing on the patients at the end of their life, who are suffering from the terminally ill, pain and symptoms, caring for their emotions and spiritual need. Mostly, the hospices are the hospital-home-like places in which the diagnostic or treatment performances do not take place, but some actions that decelerate the arriving of death are in practice. Since the palliative care facilities approach is caregiving and improving the quality of life and mitigating the endures difficulty of agony, the main purpose of a hospice care facilities are designated as providing the comfort for the patients and their family members by fulfilling the physical, emotional, social and spiritual needs in order to make the dying moment less painful. (Twaddle, 2016)

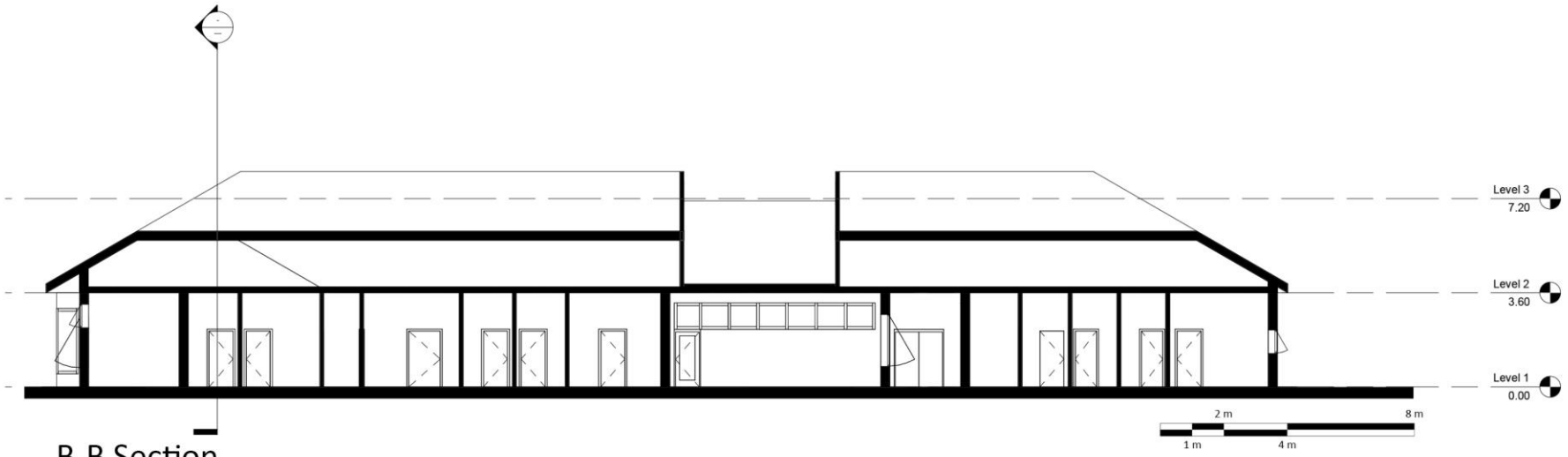
Therefore the objective that this proposed design is following is to provide an additional place to the existing hospice building of S. Luigi Hospital and developing it toward supporting the physical, psychological, social, and spiritual needs of the occupants consist of caretakers, families, and patients to minimize the pain and improve the quality of life and symptoms for patients state according to the benefits presented by the Biophilia Theory and Biophilic architecture. Thus the connection of indoor space to the greenery features of the outdoor and utilizing the rich potential of the greenery of the site.

The Existing plan of the Hospice



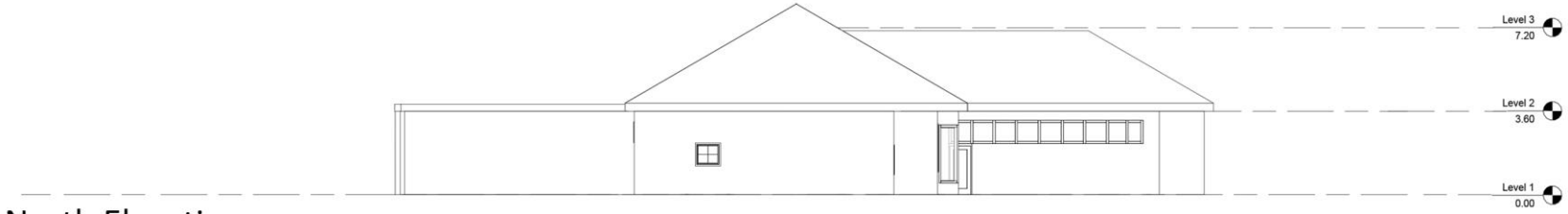


A-A Section

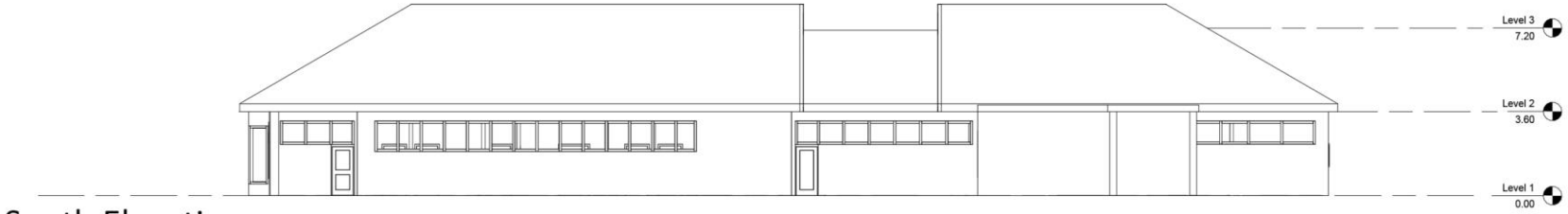


B-B Section

West Elevation



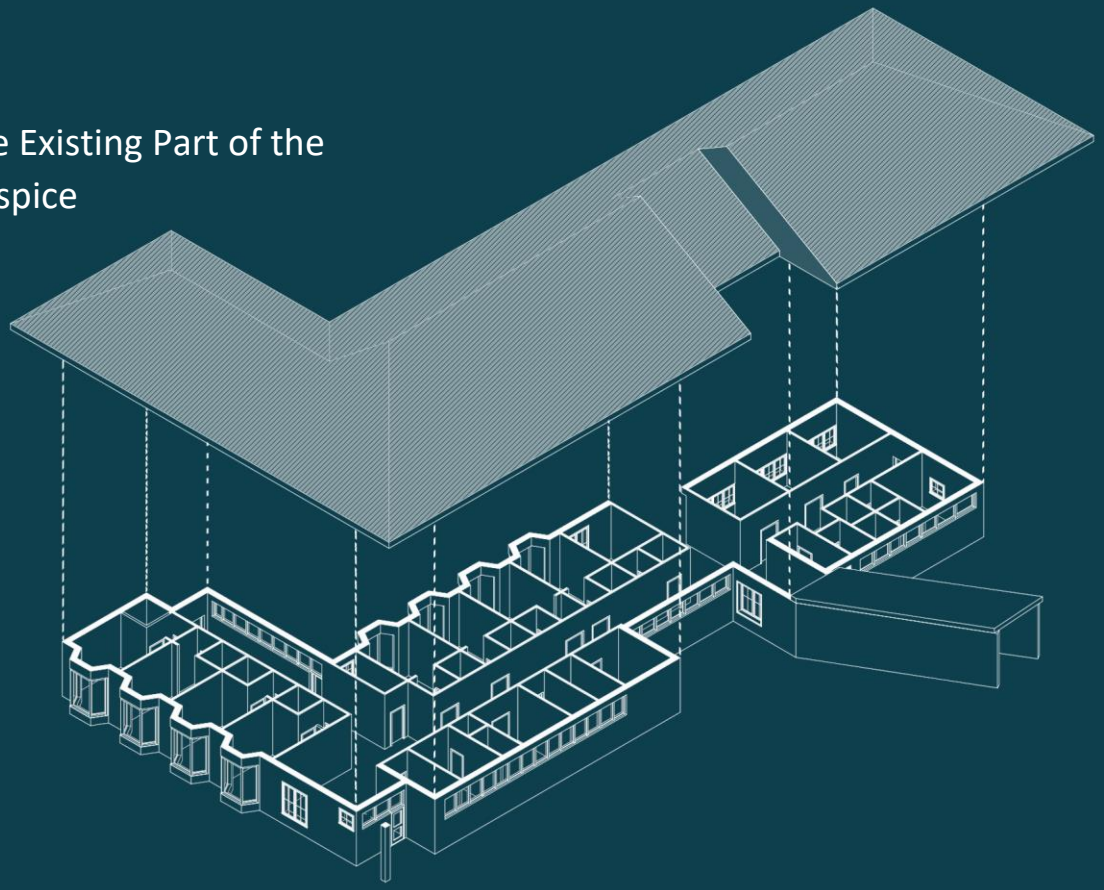
North Elevation

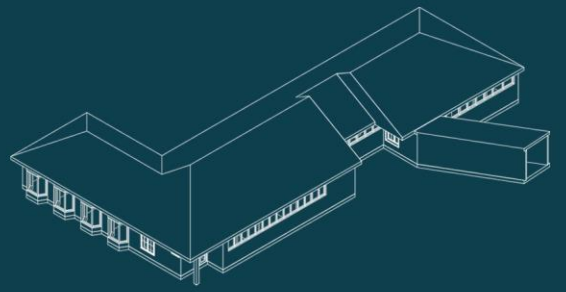


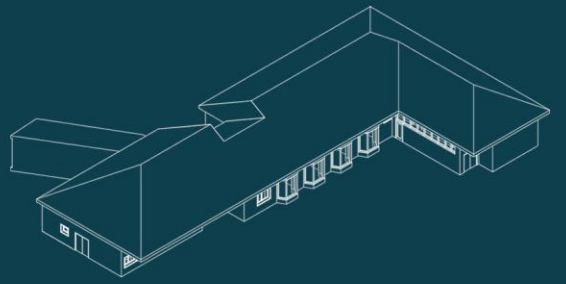
South Elevation

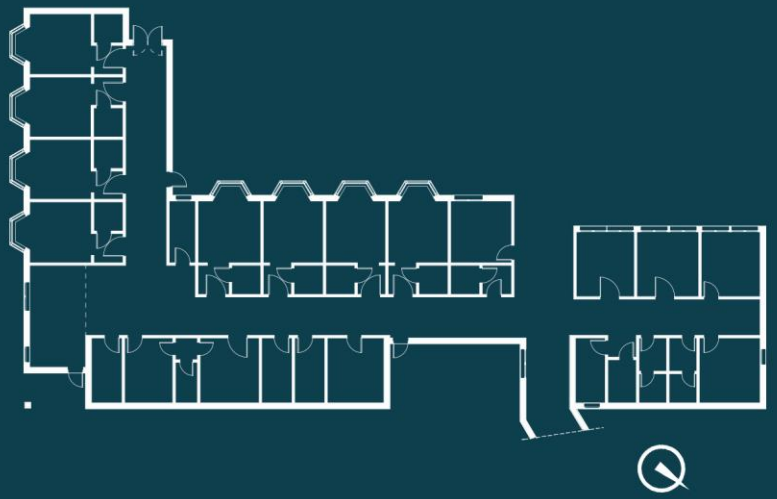
East Elevation

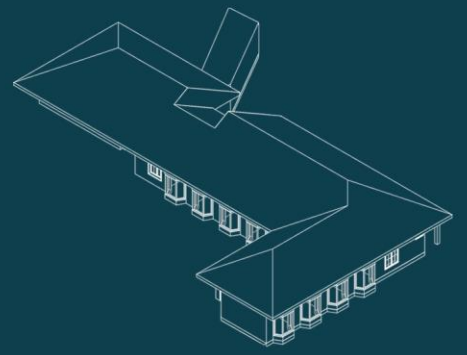
The Existing Part of the Hospice









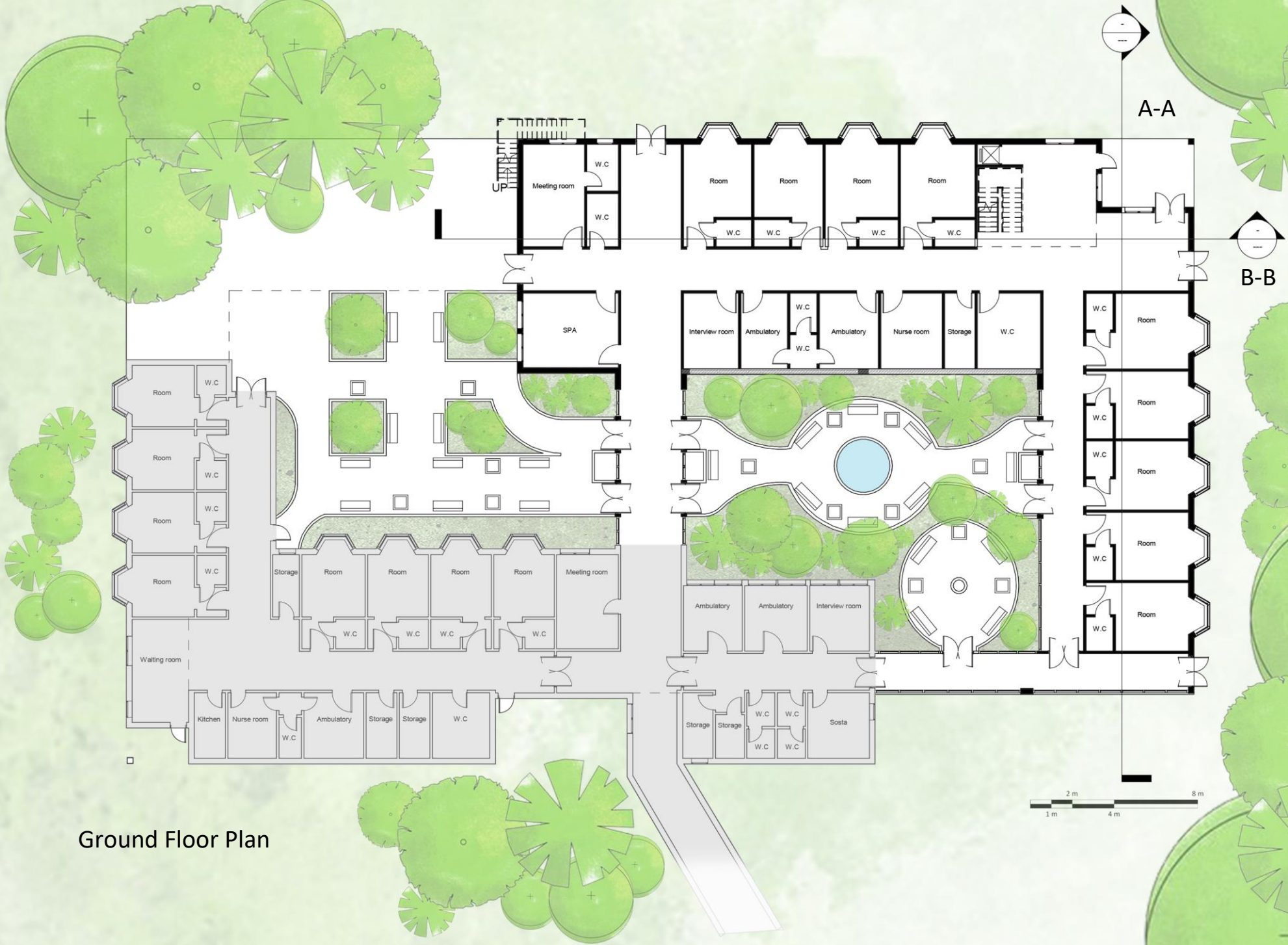


New designed part of the Hospice

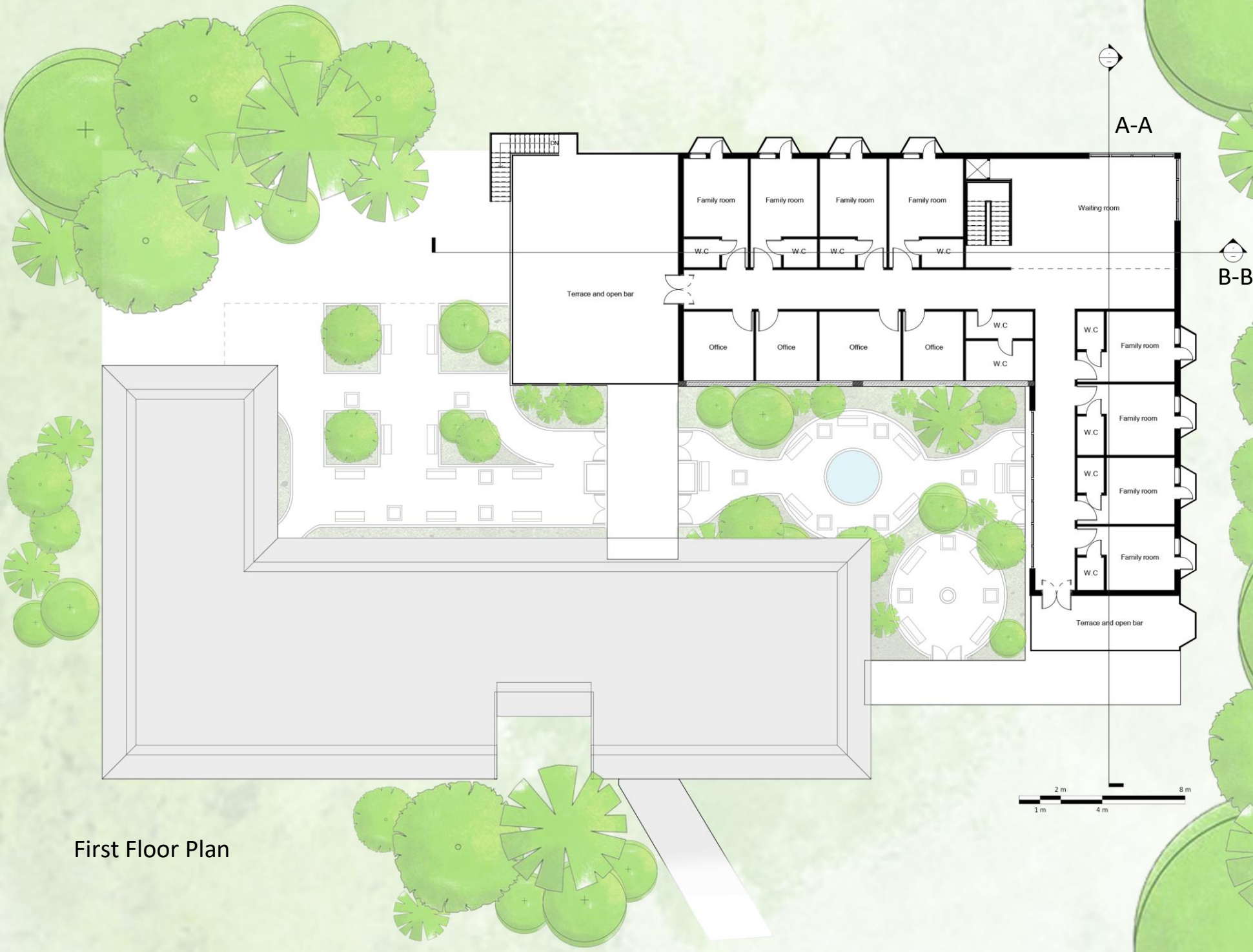
In order to apply the concept of biophilia to the hospice design of the San Luigi Hospital, a symmetrical L-shape path of the existed building followed. The long corridor system of the complex continued to the center of the design to connect the developed part of the hospice in reasonable way. This continues corridors provide two open spaces on each side for each units and creates a semi-private open space that can be used as courtyards and benefiting their advantages. This is while one of this courtyards I semi-opened thus the connectivity with the outdoor space is more accessible.

By considering all the occupants in this building consist of patients, staff, visitors and families, some spaces are dedicated to increase the level of comfort and decrease the problems, discomfort and stress that people might struggle with. Instead of the courtyards between the buildings, family rooms are designed to provide places for the patient's families that may need to stay near to their hospitalized person, or due to the mental pressures after passing away of the person, the members of family need to stay and recover themselves by helping the doctors and other expert persons.

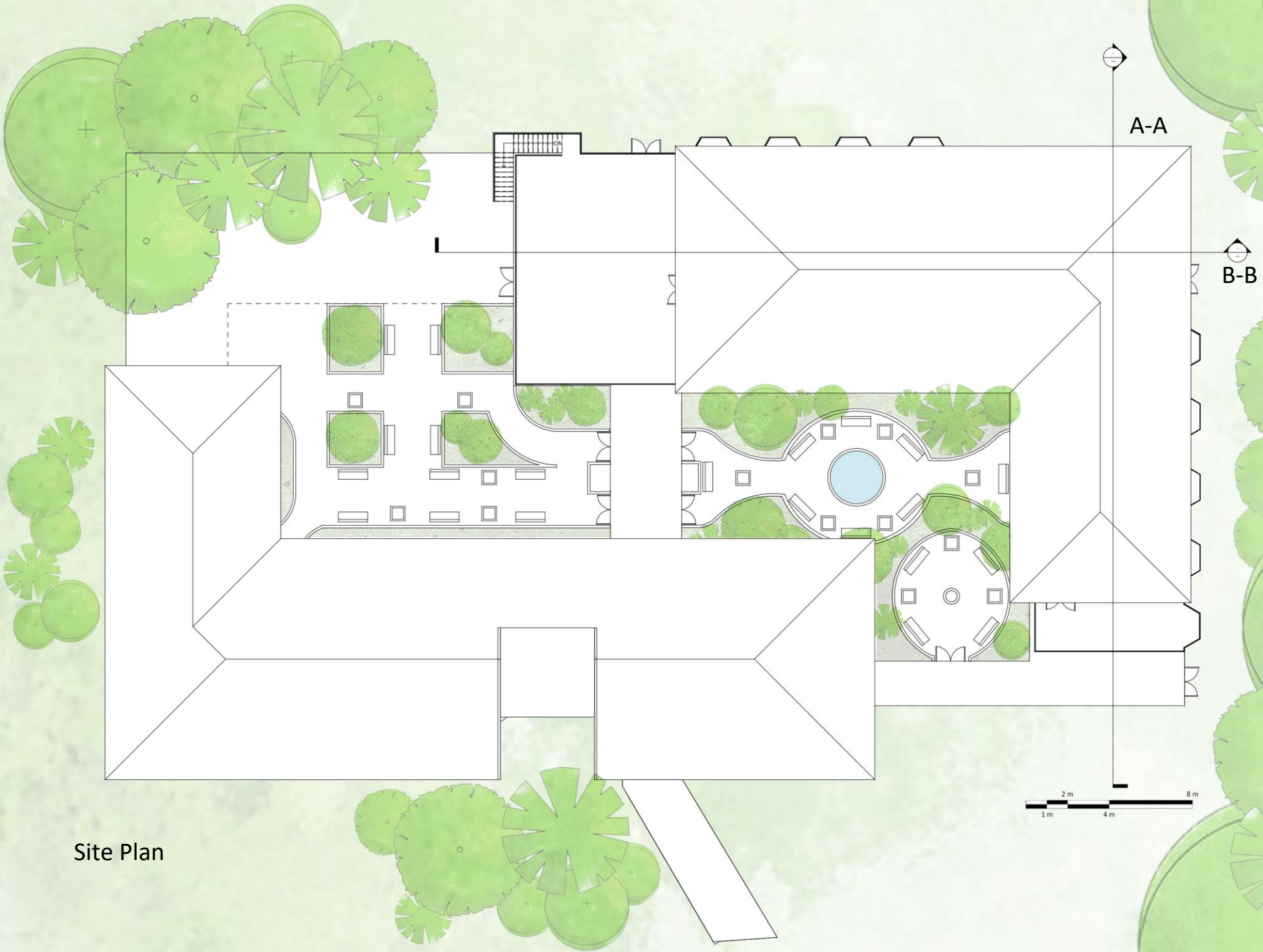
In addition to the family rooms, more spaces toward increasing the rehabilitation is considered such as SPA, in which the patient or other users of this facility can use and relax from the nervous situation of illnesses.



Ground Floor Plan



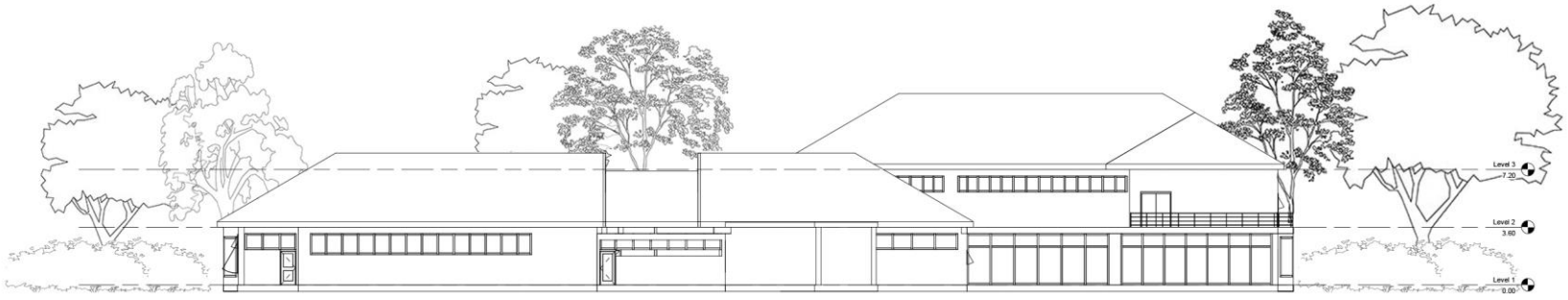
First Floor Plan



Site Plan

A-A Section

B-B Section



North Elevation

2 m 8 m
1 m 4 m

West Elevation

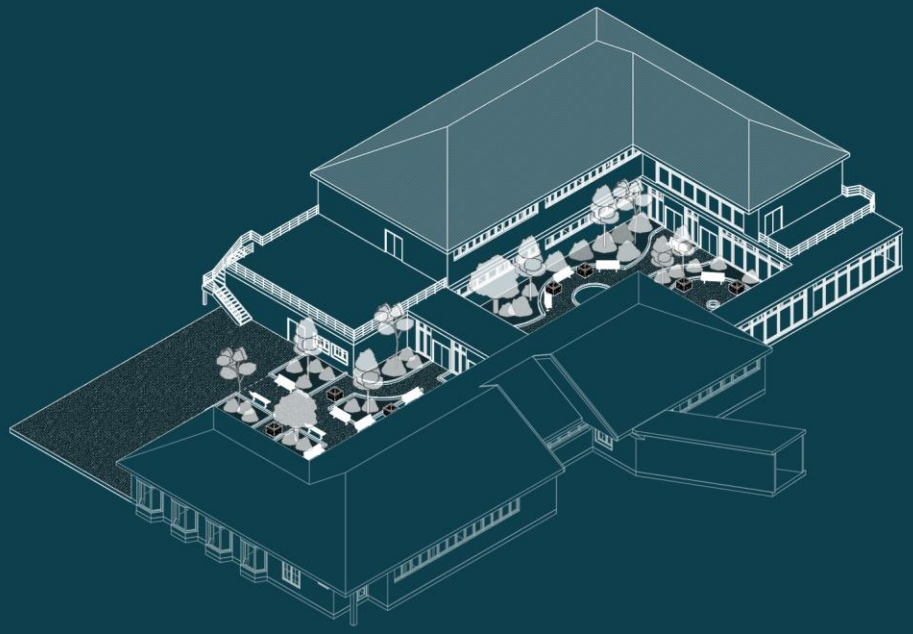
2 m 8 m
1 m 4 m

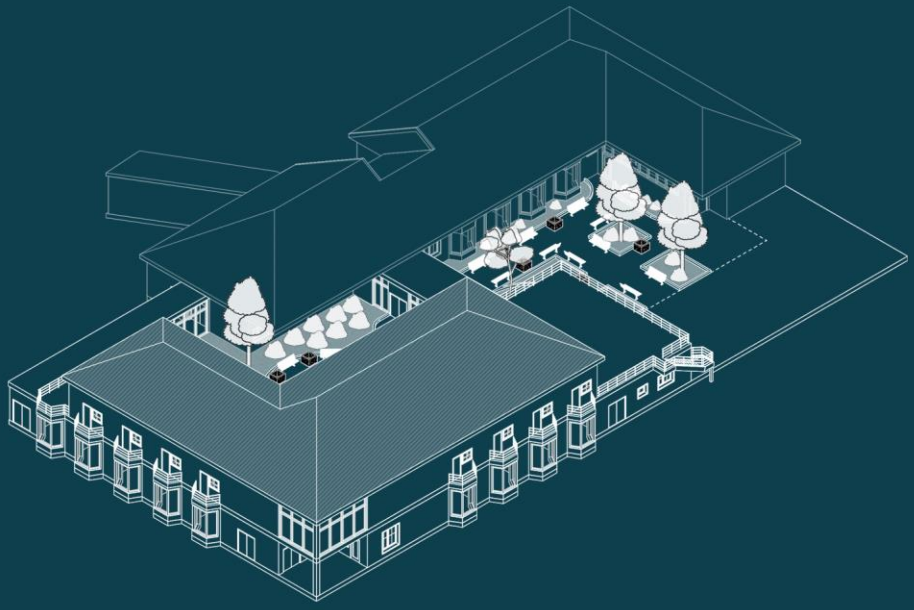
South Elevation

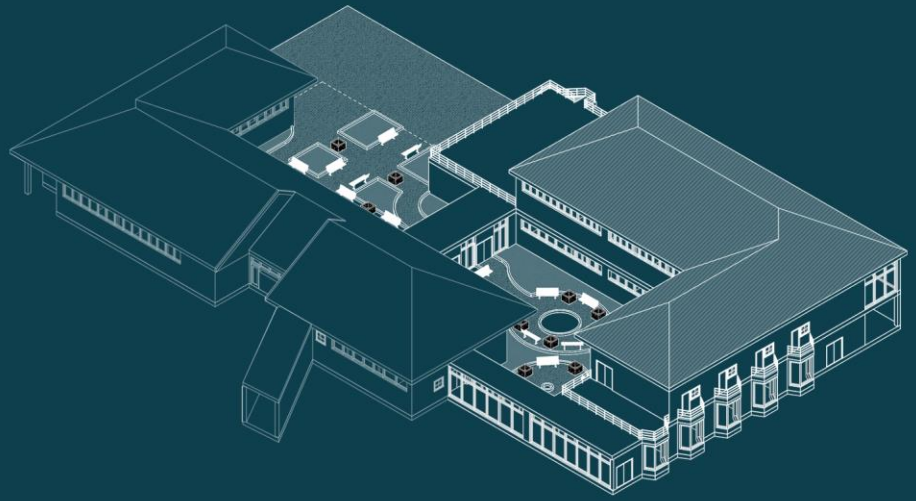
2 m 8 m
1 m 4 m

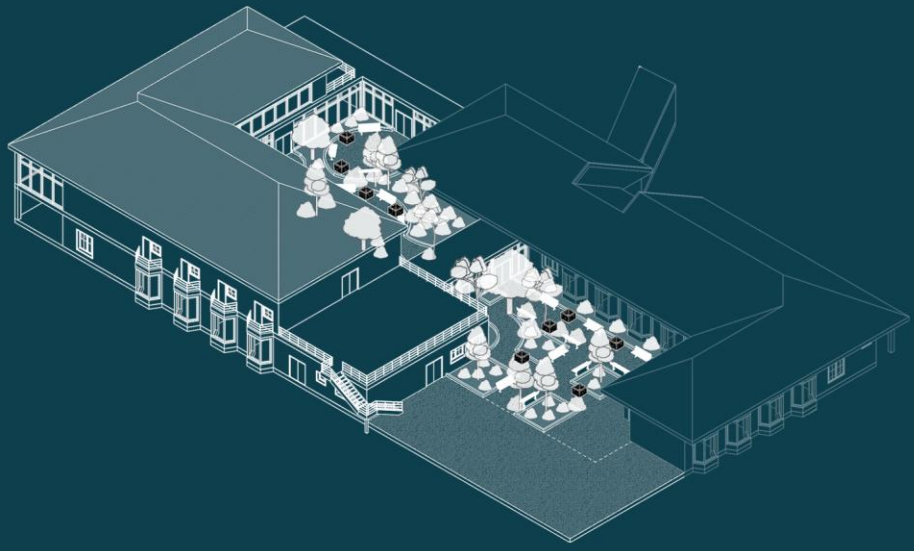
East Elevation

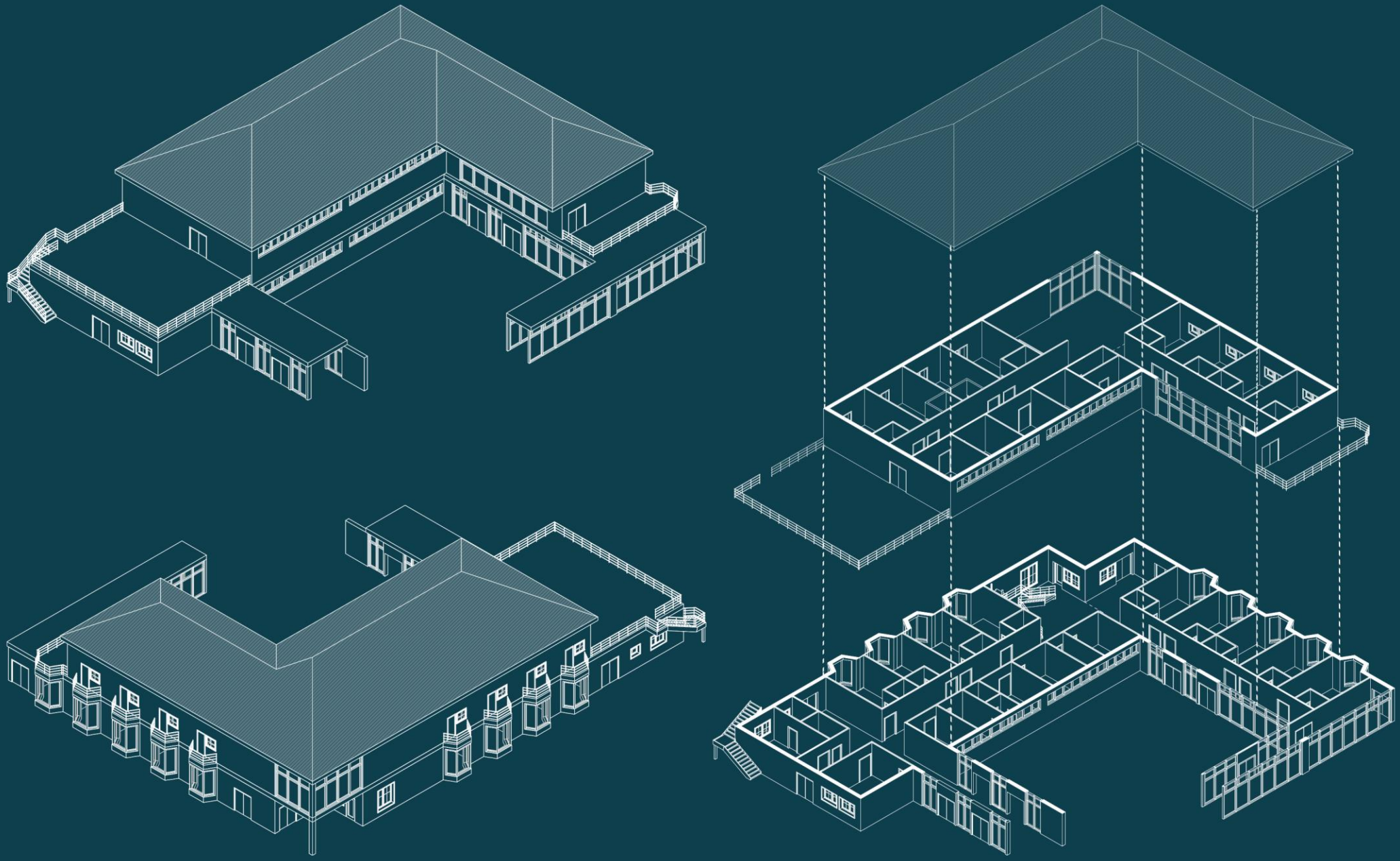
2 m 8 m
1 m 4 m











Conclusion

Hospitals and medical centers as one of the most important environments for human survival have always undergone extensive changes throughout history, and these changes have had different views on the users of these spaces with different approaches. The advances in industry, science, economy, and technology have provided ample facilities for improving the treatment of patients and greatly assisted physicians and medical staff. However, these advances merely met the physiological needs of the patients and often ignored non-physical needs. In addition, spatial complexity, stressors, and the priority of medical and therapeutic aspects over the other factors formed an unfavorable environment not only for patients but also for staff and visitors. These resulted in damage caused by stress and nervous crises in individual life, the physical, psychological and social consequences have been costly. Knowing that stress, depression, and anxiety derived from the treatment and hospitalization period have detrimental effects on health, humanizing the space as an approach has become increasingly important today.

The involvement of architecture as a decisive part of this subject is inevitable. Architecture based on biophilia theory with the approach of human-centered in order to increase the level of interaction with nature plays a key role in the humanization of the hospital environments because nature acts as a useful resource for humans and architecture can work as an effective mediator to achieve positive results.

In general, man is a part of the whole of nature and is biologically dependent on it, and any distance between man and his natural root can have negative effects. Therefore, biophilia with the help of architecture can be a bridge to nature to provide a space in accordance with human needs. Hospitals are one of them, and biophilia is a way to improve these environments. According to the conducted studies on the effects of experiencing nature, Biophilic architecture can shape the evolutionary path in hospitals and medical centers and prepare a humanized environment by enhancing the quality of space. This strategy can be used in

various fields such as office buildings, residential buildings, schools, etc., and by creating more connections between users and the existing nature, or the created nature, it can form a more favorable atmosphere in line with human needs. With these strategies, we can focus on other goals and use of Biophilic architecture to humanize the environment for hospital staff or visitors to reduce the stress level of the hospital environments.

Another mentionable point is that this content is about to emphasize on considering the potentials of the environment to enrich the outcome. For instance, the investigation of the case study of S. Luigi Hospital revealed that by applying a thoughtful attitude and employing the Biophilic design principles, the possible evolution toward a humanization, close to the human nature source, can take place.

To further facilitate well-being, the built spaces need to be environments that reconnect the body and mind and foster a sense of place. These healing effects can be achieved through Biophilic and sensory encounters within the facility. By focusing more on the human-environmental response research from environmental psychology, the methods for healing architecture, and expanding on the principle of connection to nature in evidence-based healthcare design, healing interior, and exterior environments can begin to be redefined. Using concepts of Biophilic design to guide decisions for the built environment, spaces are designed to support healing through Biophilic responses and connection to natural elements and systems. Through continued research, innovation, and interdisciplinary approaches, new solutions for increased integration of natural elements within the built environment can begin to foster greater levels of connection to nature and improved human health and well-being.

Bibliography

Toms, W. H. (n.d.). Charterhouse Hospital engraved by Toms, c.1750. *Charterhouse Hospital engraved by Toms, c.1750.* https://londontraveller.org/2013/02/23/bradshaws-hand-book-to-london-second-day-district-iv-completed/, London.

A. Bellagarda, E. Bellini, Buffoli, M., M. di Noia, M. Nickolova, & S. Capolongo. (2014). Listening to people to cure people The LpCp-tool, as instrument to evaluate hospital humanization. 9.

Abinama , A., & Jafari, M. (2015). The Impact of the Design of Hospitals on Hospital Hoteling, Healing. *Modern Applied Science; Vol. 9*, 9.

Adams, A. (2017). Decoding Modern Hospitals: An Architectural History. *Architectural design*, 8.

Alfonsi, E., Capolongo, S., & Buffoli, M. (2014). Evidence Based Design and healthcare: an unconventional approach to hospital design. *Annals of hygiene: preventive and community medicine 26, vol.2*, 137-143.

Alzubaidi, S., Roaf, S., Banfill , P. F., Talib, R., & Al-Ansari, A. (2013). Survey of Hospitals Lighting: Daylight and Staff Preferences. *International Journal of Energy Engineering*, 287-293.

Azienda Ospedaliero-Universitaria S.Luigi Gonzaga. (2005). *Presentation, Commitments and Programs*. Retrieved from www.sanluigi.piemonte.it/: sanluigi.piemonte.it/azienda/impegni_prog.shtml

Babakhani, R. (2017, June 3). *A look at the human scale in architecture through the lens of phenomenology.* Retrieved from kargosha.com: https://kargosha.com/fa/content/id/874/%D9%86%DA%AF%D8%A7%D9%87%DB%8C-%D8%A8%D9%87-%D9%85%D9%82%DB%8C%D8%A7%D8%B3-%D8%A7%D9%86%D8%B3%D8%A7%D9%86%DB%8C-%D8%AF%D8%B1-%D9%85%D8%B9%D9%85%D8%A7%D8%B1%DB%8C-%D8%A7%D8%B2-%D8%AF%D8%B1%DB%8C%DA%86%D9%87-%D9%BE%D8%

Babakhani, R. (2017, May 28). *Active man and activist architecture from a positivist point of view.* Retrieved from kargosha.com: https://kargosha.com/fa/content/id/858/%d8%a7%d9%86%d8%b3%d8%a7%d9%86-%da%a9%d9%86%d8%b4-%da%af%d8%b1-%d9%88-%d9%85%d8%b9%d9%85%d8%a7%d8%b1%db%8c-%da%a9%d9%86%d8%b4-%da%af%d8%b1%d8%a7-%d8%a7%d8%b2-%d9%86%da%af%d8%a7%d9%87-%d9%be%d9%88%d8%b2%db%8c%d8%aa%db

Baldwin, A. (2016). How Do Plants in Hospital Waiting Rooms Reduce Patient Stress? *The Journal of Alternative and Complementary Medicine, vol.18*, 309-310.

Bates, V. (2018). ‘Humanizing’ healthcare environments: Architecture, art and design in modern hospitals. 15.

Belčáková, I., Galbavá, P., & Majorošová, M. (2018). Healing and Therapeutic landscape Design - Examples and Experience of Medical Facilities. *International Journal of Architectural Research, vol.12*, 128-151.

Benedetti, F., Colombo, C., Barbini, B., Campori, E., & Smeraldi, E. (2001). Morning sunlight reduces length of hospitalization in bipolar depression. *Journal of Affective Disorders, vol.62*, 221-223.

Beute, F., & de Kort, Y. (2014). Natural resistance: Exposure to nature and self-regulation, mood, and physiology after ego-depletion. *Journal of Environmental Psychology, vol. 40*, 167-178.

Beute, F., & Kort, d. (2011). Vitalize me! Overcoming ego-depletion by viewing bright and sunny nature. *CongresEnvironment 2.0 : the 9th Biennial Conference on Environmental Psychology.* Eindhoven.

Biophilia hypothesis. (2020, May 27). Retrieved from en.wikipedia.org: https://en.wikipedia.org/wiki/Biophilia_hypothesis

Boyce, P., Hunter, C., & Howlett, O. (2003). The Benefits of Daylight Through Windows. *Rensselaer Polytecnic institute: Troy, New York*.

Browning, W., Ryan, C., & Clancy, J. (2014). *14 patterns of biophilic design; Improving Health & Well-Being in the Built Environment.* New York: Terrapin Bright Green llc.

Burpee, H. (2008). History of Healthcare Architecture. *Integrated Design Lab Puget Sound*, 1-3.

Cambridge Dictionary. (n.d.). Retrieved from dictionary.cambridge.org/: https://dictionary.cambridge.org/dictionary/english/humanize

Ciampi, A. (n.d.). *The Meyer Children’s Hospital in Florence*. Retrieved from archello.com/: https://archello.com/project/the-meyer-childrens-hospital-in-florence#stories

Demiray, A. (2018, December 20). *The evolution of Hospital Architecture from the Beginning to the Present Day : Koç University Hospital*. Retrieved from ademirayblog.wordpress.com/: https://ademirayblog.wordpress.com/2018/12/20/the-evolution-of-hospital-architecture-from-the-beginning-to-the-present-day-koc-university-hospital/

Diette, G., Lechtzin, N., Haponik, E., Devrotes, A., & Rubin, H. (2003). Distraction therapy with nature sights and sounds reduces pain during flexible bronchoscopy: A complementary approach to routine analgesia. *Chest*, 941-948.

Farbstein, J., Farling, M., & Wener, R. (2012). *Developing the evidence for Evidence-based Design.* http://www.correctionalnews.com/articles/2012/08/9/research- report-developing-the-evidence-evidence-based-design.

Feelisch, M. (2014). Here comes the sun to lower your blood pressure. *Journal of Investigative Dermatology*.

First Annual Stephen R. Kellert Biophilic Design Award Goes to Khoo Teck Puat Hospital. (2017, November 13). Retrieved from www.3blmedia.com: https://www.3blmedia.com/News/First-Annual-Stephen-R-Kellert-Biophilic-Design-Award-Goes-Khoo-Teck-Puat-Hospital

Fornara, F., Bonaiuto, M., & Bonnes, M. (2006). Perceived hospital environment quality indicators: A study of othopaedic units. *Journal of Environmental Psychology 26 (2006) 321–334*, 14.

French Photographer. (n.d.). *View of Hopital Lariboisiere, Paris, before 1880 (b/w photo).* Museum of Decorative Arts, Paris.

Galton, D. (n.d.). The Royal Herbert Hospital in Woolwich. *The Royal Herbert Hospital in Woolwich.* Flickr, Woolwich.

Genuis, S. (2006). Keeping your sunny side up: How sunlight affects health and well-being. *The official journal of the College of Family Physicians of Canada, Vol.52*, 422-423.

(n.d.).Gibson and Mother Marianne Cope, 1886. *Walter Murray Gibson (left) with Mother Marianne Cope and other sisters at Kapiolani Home in Kakaako for daughters of Hansen's disease patients.* Utah State Historical Society Classified Photo Collection, Utah.

Greek History and Prehistory. (2016, December 4). Retrieved from greekhistoryandprehistory.blogspot.com/: http://greekhistoryandprehistory.blogspot.com/2016/12/blog-post.html

Grinde , B., & Patil, G. (2009). Biophilia: Does Visual Contact with Nature Impact on Health and Well-Being? *International Journal of Environmental Research and Public Health*, 2333-2343.

Gullone, E. (2000). The Biophilia Hypothesis and Life in the 21st Century: Increasing Mental Health or Increasing Pathology? *Journal of Happiness Studies 1, vol. 3*, 293-322.

Harting, T., Evans, G., Jamner, L., Davis, D., & Gärling, T. (2003). Tracking restoration in natural and urban field settings. *Journal of Environmental Psychology, vol. 23*, 109-123.

Hasanpour, K., baqeri, M., & Almasi, A. (2012). The role of medical center architecture in improving the safety and health of the work environment for employees. *First National Conference on Health, Safety and Environment (HSE).* Mahshahr.

Hering, H. (n.d.). Florence Nightingale, 1860. *Photograph by Henry Hering.* National Portrait Gallery, London, London.

(n.d.).*Hunger and sickness Madras, 1939.* Salesians of Don Bosco, India collection, India.

International Living Future. (2018). *HEALING THROUGH NATURE KHOO TECK PUAT HOSPITAL*. Retrieved from living-future.org: https://living-future.org/biophilic/case-studies/award-winner-khoo-teck-puat-hospital/

Kaida, K., Takahashi, M., & Otsuka, Y. (2007). A Short Nap and Natural Bright Light Exposure Improve Positive Mood Status. *Industrial Health, vol. 45*, 301-308.

Kauffman, J. (2009). Benefits of Vitamin D Supplementation. *Journal of American Physicians and Surgeons, vol.14*, 38-45.

Kaviani pooya, H. (2010). The first hospitals and medical centers in pre-Islamic Iran. *Journal of Medical Ethics and History*, 11.

Kelz, C., Grote, V., & Moser , M. (2011). Interior wood use in classrooms reduces pupils' stress levels. *9th Biennial Conference on Environmental Psychology.* Eindhoven, Netherlands: Eindhoven Technical University.

Kent, S., McClure, L., Crosson, W., Arnett, D., Wadley, V., & Sathiakumar, N. (2009). Effect of sunlight exposure on cognitive function among depressed and non-depressed participants. *Environ Health, vol.7*.

Kim, T.-H., Jeong, G.-W., Baek, H.-S., Kim, G.-W., & Sundaram, T. (2010). Human brain activation in response to visual stimulation with rural and urban scenery pictures: A functional magnetic resonance imaging study. *Science of the Total Environment*.

Kishnani, N. (2017, September 8). *Singapore's Khoo Teck Puat Hospital: Biophilic Design in Action*. Retrieved from blog.interface.com/: https://blog.interface.com/khoo-teck-puat-hospital-singapore-biophilic-design/

Kishnani, N. (2018, September 8). *Singapore's Khoo Teck Puat Hospital: Biophilic Design in Action*. Retrieved from blog.interface.com: https://blog.interface.com/khoo-teck-puat-hospital-singapore-biophilic-design/

Kopfen, T., D'Rourke, K., & Hame, R. (2001). A Summary of the Development of the Ethical and Religious Directives for Catholic Health Care Services. *JOURNAL OF THE CATHOLIC HEALTH ASSOCIATION OF THE UNITED STATES*, 18-21.

Kowalski, W. (2011). Alternative Air Cleaning Technologies. In W. Kowalski, *Hospital Airborne Infection Control* (pp. 313-320). Florida: CRC Press.

Kriptex, S. (2020). *Microclimate*. Retrieved from latsolar.l: https://latsolar.lv/32-2/mikroklimats/

Kweon, B.-S., Ulrich, R., & Walker, V. (2008). Anger and Stress: The Role of Landscape Posters in an Office Setting. *Environment and Behavior, vol.40*, 355-381.

Laumann, K., Gärling, T., & Stormark, K. (2003). Selective attention and heart rate responses to natural and urban

environments. *Journal of Environmental Psychology vol. 23*, 125-134.

Li, D. (2014). School landscapes and academic performance: A link through stress reduction and attentional functioning. *Annula Conference of the environmental design research association* (p. 233). New Orleans, Louisiana: Environmental design research association: McLean, VA.

Locklear, K. M. (2012, May). Guidelines and Considerations for Biophilic Interior Design in Healthcare Environments. Austin, Texas, United States: Thesis Presented to the Faculty of the Graduate School of The University of Texas at Austin.

Lohr, V., & Pearson-Mims, C. (2000). Physical Discomfort May Be Reduced in the Presence of Interior Plants. *International Human Issues in Horticulture, vol.10*, 53-58.

Lundy, K. S., & Masters, K. (2017). A History of Healthcare and Nursing. In K. Masters, *Role development in professional nursing practice* (p. 48). Burlington, MA : Jones & Bartlett Learning.

Marfo, T. N. (2007). Master of architecture degree progeamme dissertation, THE ROLE OF ARCHITECTURE IN PROMOTING HEALING IN THE LONG-TERM CARE SETTING. *Designing to heal*, 99.

Margine Designs Pavilion for Meyer Pediatric Hospital Foundation in Florence. (2018, july 31). Retrieved from www.dexigner.com/: https://www.dexigner.com/news/31179

Marsden, J. (1999). Older Persons' and Family Members' Perceptions of Homeyness in Assisted Living. *Environment and Behavior, vol. 31*, 84-106.

Martos, F., Amezcua, R., Espejo, G., Aguayo, L., Fernandez, M., & Alonso, A. (2018). Humanization in healthcare arises from the need for a holistic approach to illness. *Medicina Intensiva 42, vol. 2*, 99-109.

Mat Idris, M., & Sibley, M. (2019). What are Users' Perceptions of the Hospital Courtyard Garden and How Satisfied are they with it? *Asian Journal of Environment-Behaviour Studies, vol.4*, 60-67.

Mat Idris, M., & Sibley, M. (2019). What are Users' Perceptions of the Hospital Courtyard Garden and How Satisfied are they with it? . *Asian Journal of Environment-Behaviour Studies*, 60-76.

Maybury, S. (2015, March, 11). *Pergamum Asclepion*. Retrieved from www.stephenmaybury.co.uk/: http://www.stephenmaybury.co.uk/travelogue/pergamum-asclepeion/

McAllister, C. (n.d.). Reach. *Reach.* Fine Art America, New York.

Meyer Pediatric Hospital. (2009). Retrieved from www.area-arch.it: https://www.area-arch.it/en/itinerario/meyer-pediatric-hospital/

Nazer Ilkhani, R., & Rahaei, O. (2015). The role of architecture in the physical environment of medical centers on the health and well-being of society in the direction of sustainable development. *International Conference on Human, Architecture, Civil Engineering and City ICOHACC*, (pp. 1-7). Tabriz.

Nedin, P. (2015, July 14). The future of healthcare environments. (A. a. NHS, Interviewer)

Nestor, C. (2017). *ÖSTRA HOSPITAL, PSYCHIATRIC FACILITY.* Terrapin Bright Green.

Nielsen, S., Fich, L., Roessler, K., & Mullins, M. (2017). How do patients actually experience and use art in hospitals? The significance of interaction. A user-oriented experimental case study. *International Journal of Qualitative Studies on Health and Well-Being*.

Nieuwenhuis, M., Knight, C., Postmes, T., & Haslam, A. (2014). The Relative Benefits of Green Versus Lean Office Space: Three Field Experiments. *Journal of Experimental Psychology Applied, vol.20*, 199-214.

Nightingale, F. (1863). *NOTES ON HOSPITALS.* London: Longman, Green, Longman , Roberts, and Green.

Ohta, H., Maruyama, M., Tanabe, Y., Hara, T., Nishino, Y., Tsujino, Y., . . . Shido, O. (2008). Effects of Redecoration of a Hospital Isolation Room With Natural Materials on Stress Levels of Denizens in Cold Season. *International Journal of Biometeorol, vol.52*, 331-3340.

Orbassano, l'ospedale S.Luigi si adegua all'emergenza sanitaria. (2020, March 15). Retrieved from www.lunanuova.it/: http://www.lunanuova.it/a-ovest-di-torino/2020/03/15/news/orbassano-l-ospedale-s-luigi-si-adegua-all-emergenza-sanitaria-505802/

Osborn, D. (n.d.). *THE ASCLEPIONS*. Retrieved from www.greekmedicine.net/: http://www.greekmedicine.net/mythology/asclepions.html

Ospedale San Luigi Gonzaga. (n.d.). Retrieved from it.wikipedia.org: https://it.wikipedia.org/wiki/Ospedale_San_Luigi_Gonzaga

Östra Psychiatry Hospital. (2006). Retrieved from architizer.com/: https://architizer.com/projects/oestra-psychiatry-hospital/

Pellitteri, G., & Belvedere, F. (2010). Characteristics of the hospital buildings: changes, processes and quality. 8.

Pellitteri, G., & Belvedere, F. (2011). Humanization and Architecture in Contemporary Hospital Building. 9.

Piyush, S. M. (2017). *Re-humanizing healthcare, Proposal for a loading & caring institute for cancer outpatient in Mumbai.* Mumbai: Manushi Sheth.

Raanaas, R., Patil, G., & Harting, T. (2010). Effect of an Indoor Foliage Plant Intervention of Patient Wrll-being During a

Residential Rehabilitation Program. *HortScience, vol.45*, 387-392.

Rahn, J. R. (1876). Kloster Sanct Gallen nach dem Grundrisse vom Jabre 830. In J. R. Rahn, *Geschichte der Bildenden Künste in der Schweiz Von den Ältesten Zeiten bis zum Schlusse des Mittelalters* (p. 91). Zürich.

Regional Multiple Sclerosis Centre, AOU San Luigi Gonzaga Orbassano, Turin, Italy. (2019, February 26). Retrieved from ki.se: https://ki.se/en/cns/regional-multiple-sclerosis-centre-aou-san-luigi-gonzaga-orbassano-turin-italy

Sakuragawa, S., Miyazaki, Y., Kaneko, T., & Makita, T. (2004). Influence of wood wall panels on physiological and psychological responses. *Journal of Wood Science, vol.51*, 136-140.

Sansal, K., Edes, B., & Binatli, A. (2012). Effects of Indoor Lighting on Depression Probability and Academic Performance in a Population of Turkish Adolescents. *The International conference on the Effect of Light on Wellbeing.* Eindhoven, the Netherlands: http:/www.experiencinlight.nl.

Sheth, M. (2018). *Design Dissertation: Re-Hmanizing Healthcare.*

Shibata, S., & Suzuki, N. (2002). Effects of the Foliage Plant on Task Performance and Mood. *Journal of Environmental Psychology, vol. 22*, 265-72.

Smith, R., & Watkin, N. (2016). Whole building design guid. *Therapeutic Environments* .

Sodagar, S., & Mafakher, F. (2016). An analysis of the design requirements of a green hospital with a sustainable architectural approach. *Quarterly Journal of Urban Management, vol. 45*, 517-532.

Stewart Jr, C., Abudayyeh, R., & Stewart, S. (2018). Houseplants as home health monitors. *Science, vol. 361*, 229-230.

Torricelli, M., Setola, N., & Borgianni, S. (2013). How Architecture promote Right to Health in Hospital. 14.

Totaforti, S. (2018). Applying the benefits of biophilic theory to hospital design. *City, Territory and Architecture, vol.5*, 1-9.

Tsunetsugu, Y., Miyazaki, Y., & Sato , H. (2007). Physiological effects in humans induced by the visual stimulation of room interiors with different wood quantities. *Journal of Wood Science, vol 53*, 11-16.

Tsunetsugu, Y., Miyazaki, Y., & Sato, H. (2002). The Visual Effects of Wooden Interiors in Actual-size Living Rooms on the Autonomic Nervous Activities. *Journal of Psychological Anthropology and Applied Human Science, vol.21*, 297-300.

Twaddle, M. L. (2016, November 2). *Creating comforting designs in palliative and hospice facilities*. Retrieved from www.hfmmagazine.com: https://www.hfmmagazine.com/articles/2489-designs-for-palliative-and-hospice-care

Ulrich, R. (1984). View through a window may influence recovery from surgery. *Science, vol. 224*, 420-421.

Ulrich, R. (1991). Wellness By Design: Psychologically Supportive Patient Surroundings. *Group practice journal, vol. 40*, 10-19.

Ulrich, R. (2002). Health Benefits of Gardens in Hospitals. *Plants for People.* Texas : International Exhibition Floriade 2002.

Ulrich, R., & Gilpin, L. (2003). Healing arts: Nutrition for the soul. In S. Frampton, L. Gilpin, & P. Charmel, *putting patient first: Designing and practicing patient-Centered care* (pp. 117-146). San Francisco: John Wiley and Sons.

Ulrich, R., Simons, R., & Miles, M. (2003). Effects of environmental simulations and television on blood donor stress. *Journal of Architectural and Planning Research, vol. 20*, 38-47.

Viray, A. (2018). Current and Potential Uses of Green Roofs on Hospitals. *An undergraduate honors thesis submitted in partial fulfillment at Portland State University*.

Wagenaar, C. (2006). *The architecture of hospitals.* Rotterdam : NAi Publ.

WALCH, J., RABIN, B., DAY, R., WILLIAMS, J., CHOI, K., & KANG, J. (2005). The Effect of Sunlight on Postoperative Analgesic Medication Use: A Prospective Study of Patients Undergoing Spinal Surgery. *Psychosomatic Medicine, vol.67*, 156-163.

Wang, C.-H., Anthony, K., & Kuo, N.-W. (2014). Impacts of Window Views and Daylight Exposure on Recovery: A Prospective Study of Post-Cesarean Section. *45th Annual Conference of the Environmental Design Research Association (EDRA).* Washington, DC: EDRA.

Weenig, M., & Staats, H. (2010). The impact of a refurbishment of two communal spaces in a care home on residents' subjective well-being. *Journal of Environmental Psychology, vol.30*, 542-552.

World Health Organization. (2014, September 30). *Ageing and life-course*. Retrieved from www.who.int/: https://www.who.int/ageing/about/facts/en/

World Health Organization. (n.d.). *What is the WHO definition of health?* Retrieved from www.who.int: https://www.who.int/about/who-we-are/frequently-asked-questions#:~:text=What%20is%20the%20WHO%20definition,absence%20of%20disease%20or%20infirmity.

Zhang, J., Piff, P., Iyer, R., Koleva, S., & Keltner, D. (2014). *An Occasion for Unselfing: Beautiful nature leads to Prosociality.* Journal of Environment Psychology, in press.