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HUMANITY IN A CHILDREN'S CANCER HOSPITAL

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HUMANITY IN A CHILDREN'S CANCER HOSPITAL

A Thesis Presented

By

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DEDICATION

This thesis is dedicated to my husband, Mohammad Elikaee, without whose caring support it would not have been possible, and to the memory of my parents, Maryam Khoshroo and Hossein Jandaghi Jafari, who passed on a respect for education.

ACKNOWLEDGMENTS

Firstly, I would like to express my sincere gratitude to my advisor Prof. Kathleen Lugosch for the continuous support of my Master study, for her patience, motivation, and immense knowledge.

Besides my advisor, I would like to thank the rest of my thesis committee: Prof. Ajla Aksamija and Mr. Derek Noble for their insightful comments and encouragement, but also for the hard question which incented me to widen my research from various perspectives. Last but not the least, I would like to thank my husband for supporting me spiritually.

ABSTRACT

HUMANITY IN A CHILDREN'S CANCER HOSPITAL

MAY 2017

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Children, who are the future of the country, are the most important asset. If cancer in children is diagnosed at an early stage, effective precautionary measures can be taken in order to save their lives. Children sense their physical space in a very immediate and detailed manner and their response to spaces can be far more direct and energetic than adults. For children, visiting hospitals can be particularly difficult emotionally, as they are stressed by ill-health, painful medical procedures.

The objectives of this research are first to understand what constitutes a supportive pediatric setting from children's and adolescents' perspectives and try to explore the role of architecture in making hospital stays more pleasant. Second, to define a vision for the sustainable hospital design movement; and third, to illustrate the value of participatory research for healthcare design. The outline is a new design of the children hospital and how architectural design steps can be taken to improve cancer patients' care.

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ENVIRONMENTAL FACTORS AFFECTING CHILDREN'S STRESS

1.1. Impact of the designed environment on children's stress

The effects of the designed physical environment on the healing process and well-being have proved to be increasingly relevant for patients and their families as well as for healthcare staff. Art is widely considered to influence the healing process for children, as part of the patient-focused design in healthcare. So it would be so important to contribute the psychological wellbeing of children to design a healthcare building. Then, identification of stress reduction elements for children is vitally important. But is this actually what children prefer and what helps them heal?

According a researcher Sara L. Eisen at the University of Texas on adult patients suggests that by infusing art into the healthcare buildings, the patient-focused design may foster improved moods or reduce the stress that would impact the negative thoughts that could impede the healing process. The results can be positive psychophysiological effects and improved medical outcomes.

1.2. Environmental factors affect stress

For understanding the relationship between the environment and human behavior, we should analyze the environmental conditions which could impede or interfere with human functioning. Stress is a critical concept which comes from the interaction between individuals and the environment. The presence of integrated architecture design in the built environment in regarding stress reduction is the focus of this study, with a specific focus on the finding and bringing humanity to the children hospital.

The effect of stress on health and healing process has attracted the attention of researchers and designers, and there is some evidence[1] that shows children experience

[1] Annu Rev Clin Psychol. 2005; 1: 607–628.

stress as well and, that their health is adversely affected by it. Children may miss their family or friends. Children may not understand why they are in the hospital, or they may have false beliefs about what is happening to them and they may be afraid.

1.3. Hospitalization sources of stress for children

Generally, being in a hospital could be a stressful experience for children. A lot of research studies have found that children have fears and concerns regarding illness and hospitalization[2]. Their concerns are about pain, mutilation, immobility, separation from significant others, loss of control. Timmerman report (1983) assessed the fears of 16 children aged 10 to 12 years who were having surgery for the first time. Their fears were the loss of control, the unknown, pain or discomfort, injections, lagging in school achievement, destruction of body image, separation from significant others, disruption of peer relationships and death. These same fears were reported by 63 children aged 12 to 17 years in Stevens' (1986) study, which suggests that children of all ages may experience a range of fears. Research by Bossert (1994) with 82 hospitalized children aged eight to 11 identified 337 events as stressful, which were reduced to six key areas. These were: intrusive events, physical symptoms, therapeutic interventions, restricted activity, separation, and environment. The list of stressful events identified by previous research indicates that children hold many fears about a range of events in the hospital.

[2] Journal of Child Health Care

Table 1: Children's fears and concerns

Separation from family and friends	Disruption to: • family routine • normal activities • peer relationships • school achievement
Being in an unfamiliar environment	Fears of: • the unknown • strange environment • professionals Dislikes: • noisy ward • bright lights at night • hot environment • inadequate play facilities • food
Receiving investigations and treatments	Fears of: • operations • needles • mmistakes in treatment • harm to body • mutilation • pain • altered body image • dying
Loss of self-determination:	• loss of independence • restricted activities • lacking control over personal needs • lacking control over sleeping and waking time • lacking control over food / meal times • lacking control over timing of procedures

Figure 1. Children's fears and concern (Image credit: Journal of Child Health Care)

Children have fears about hospitalization because they have a misconception about the hospital. The pediatric hospitals need to be more child-centered. Good communication between medical staff and children leads to an increased understanding of illness and treatment; this, in turn, reduces stress for children and provides the foundation for

effective treatment. Children are more likely to be more comfortable if they are allowed to participate in their health care.

1.4. The impact of cancer on children

Cancer diagnosis and treatment has adverse effects on many children are experiencing it. These effects are physical, intellectual and emotional and can have a great impact on not only a child's health but also their education, social opportunities, and friendships.

Tiredness, fatigue and physical impairments imposed on children as having negative effects on their ability to live their lives to the full. And all of these lead to limit their social opportunities and 'fun time', which causing social isolation. Emotional issues such as fear of getting hurt and concerns about mortality were often reported. Other emotional issues such as lack of confidence and low self-esteem were also prevalent, hair loss, in particular, having a significant impact on children's self-esteem.

1.5. Environmental factors affecting children relieve stress

Healthcare designers and researchers have recognized four key factors which, if applied in the design of a healthcare environment, can measurably improve patient outcomes:

- Reduce or eliminate environmental stressors
- Provide positive distractions
- Enable social support
- Give a sense of control

The objective of above factors has been focused on the patient and patient's family. However, there are also recognized potential benefits for staff and caregivers in terms of satisfaction, effectiveness, and staff retention, from environmental factors such as:

- Noise reduction

•Same-handed patient rooms

•Access to daylight

•Appropriate lighting

•Providing 'off-stage' areas for respite

•Proximity to other staff

•Appropriate use of technology

•Decentralized observation, supplies, and charting

In general, Therapeutic Environments have been proven to be cost-effective by improving patient outcomes, reducing the length of stay, and by enhancing staff satisfaction, recruitment, and retention of staff. [3]

To design a healthcare environment, there are some solutions for stress reduction listed as below[4]:

•Artwork can improve the qualities of a space

•Providing enough and adequate space should be provided in public areas and waiting rooms.

•Visual and noise privacy and reduce or eliminate sources of noise.

•Easy wayfinding through building elements, daylight, color, texture, and pattern should all give cues, as well as artwork and signage.

•Reduce or eliminate sources of noise; other patients, public address systems, equipment 'clatter', loud conversations at nurse stations.

•Acoustical treatment of corridors adjacent to patient rooms by carpet tiles or rubber flooring.

[3] Therapeutic Environments Forum, AIA Academy of Architecture for Health
[4] Healthcare Design Magazine

•Acoustical separation of staff work areas from patient rooms

•Appropriate lighting systems; Choice of lighting; patients and staff can benefit from personal dimming controls.

•Provide lighting that supports natural circadian rhythm

•Maintain good indoor air quality; 100% outside air where climatic conditions allow

•Color, while subjective, can be a design factor in reducing environmental stress when understood and used in the context of the color preferences of a project-specific population.

•Views of nature, from patient rooms, and wherever possible in lobby, waiting, and other 'high stress' areas

•Access to nature, healing gardens

•Chapel, meditation room, and meditation gardens

•Mild physical exercise; corridors, public spaces, and gardens that invite walking when appropriate

•Pets and other activities or elements that allow for a sense of stimulation that helps nurture a patient's sense of positive well-being

•Additional Information on Providing Positive Distraction

•Family zone inpatient room; with furniture for sleeping, phone, and internet connection, reading light with separate control, and out of the way of staff

•Provide places where patients can engage socially with family and other caregivers

•Provide accommodation for accompanying family member to be with patient throughout the examination and treatment process

•Organize Family Focus Groups and Patient and Family Advisory Councils to be an active part of the design process, tuning into the specific needs of the population and community to be served, as recommended by the Institute for Family-Centered Care

•Ensure culturally appropriate environments

•Give the patient control over the immediate environment; i.e., radio, TV, reading light, night light

•Volume and programming control of televisions in waiting areas

•Room service/menu selection

•Storage area for patient belongings

•Additional Information on Giving a Sense of Control

Every healthcare project should begin with a review of the existing available literature on design interventions that have been proven to improve patient outcomes, staff effectiveness and patient safety, and a decision made with the users as to how each one might apply to the project, and what outcomes/benefits would be expected. Design goals that are set and clearly defined at the beginning of a project can serve as research questions to be answered by surveys, data collection, and evaluation.

CHAPTER 2

PEDIATRIC HOSPITAL DESIGN GUIDELINES

2.1. Family-centered approach

A Family-centered approach is a way of working with families across healing process to improve their capacity to care for and protect their children. Information sharing between medical staff, family, and child allow understanding and education of the illness or injury and promote active participation in making decisions about their health and care. It focuses on children's needs within the context of their families and communities and builds on families' strengths to achieve optimal outcomes.

2.2. Workflow through the hospital

For reducing the risk of child exposure to a potentially negative experience, it would be better to separate the children's entrance to emergency services and ambulatory areas.

2.3. Acoustic control

Some Sound control systems should be designed to minimize transmission of noise between adjacent treatment areas and designated sound attenuated treatment rooms provided for procedures. For absorbing sounds and making it softer we can use Ceiling acoustic tiles, absorbent panels, walls, curtains, upholstered furniture, and carpets.

2.4. Visibility

Based on different case studies and the other healthcare designing guidelines, the designer teams should provide clear visual contact between Medical staff with all patient areas, including waiting areas and play areas, and outpatient, bed and treatment spaces. For example, the nursing staff should be able to oversee the patients at all times, which lead to feeling safe and reassured by the patient and their family.

2.5. Furniture, fittings, equipment and ambience

"Age appropriate décor, furniture and artwork will aid in patient distraction while providing a comfortable and reassuring environment for the patient and their family. Durable and cleanable materials used for furniture, and fittings will assist to manage the impact of wear and tear which may be higher in this setting. The therapeutic effects of viewing nature and gardens are well documented to support optimization of a healing environment. Windows providing an external and pleasant outlook should be included in areas likely to be occupied for any length of time by patients, family/career or staff. A parent's room, baby change facilities and toilets for patients and family/careers should be in close proximity to the children's service areas and preferentially separate from adult services waiting area. The need for toilet/change facilities for older disabled children may need to be considered as standard baby change and adult toilets may not provide a suitable nor safe amenity for these children.

2.6. Space requirements

Children's clinical requirements need to consider additional space to accommodate facilities for the family/career, such as chairs at bedsides, bed/recliners, kitchenette, shower and toilet amenities (with stroller access) and baby changing facilities. The provision of additional storage areas for age appropriate toys and ambulation equipment in the acute clinical areas should also be considered. The design of consulting and treatment areas must permit parents to remain with their child.

2.7. Signage and wayfinding

Wayfinding is the process individuals use to navigate in unfamiliar surroundings. Wayfinding extends beyond signage to include elements of site design, site layout, physical, sensory, cultural and cognitive needs. The strategy implemented in a facility should be consistent and appropriate for the children's services context as well as a diverse range of facility visitors and users with differing levels of capacity and ability to engage with the built environment. The use of graphic and character display is encouraged, keeping in mind all age groups of children, as different age groups each have

their own visual prompts which they are drawn to. Techniques must also be considerate of children and adolescents who have learning impairments. "[5]

2.8. The patient room

One of the large and complicated topic for designing a healthcare is the patient room. Patient room design has a direct effect on the patients and families, and hospital staff and administration as well. A healthcare designer should consider and optimize some important issues such as procedures in the patient room, infection control and etc. The following intricate diagram can help the designer to understand the critical role of the patient rooms in a hospital.

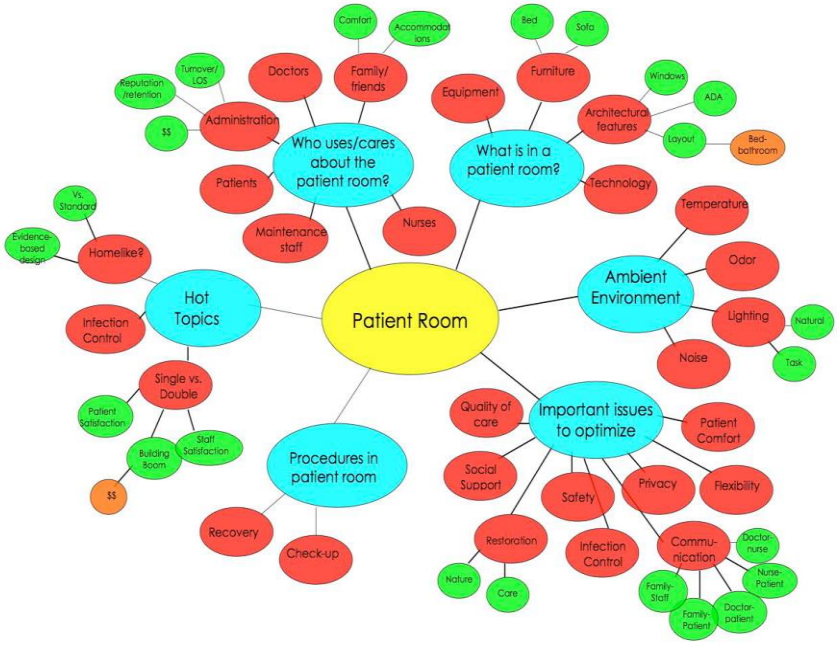


Figure 2. Patient Room's Diagram (Image credit: Journal of Child Health Care)

The vast array of components of insight of patient rooms highlight just a few out of a great deal of topic/issue overlap that the patient room creates in healthcare debate.

In this chapter the author tried to consider some topics as a means of exploring the inner-workings of the patient room. These topics were chosen as a result of the great building

[5] https://www.health.qld.gov.au/__data/assets/pdf_file/0019/150904/qh-gdl-374-6.pdf

boom occurring in the healthcare world, which makes the intention behind the design of the modern patient room more important than ever.

Important points for design of Patient Rooms include:

- Infection Control
- Single vs. Multi-Patient Rooms
- Evidence-Based Design and the Patient Room

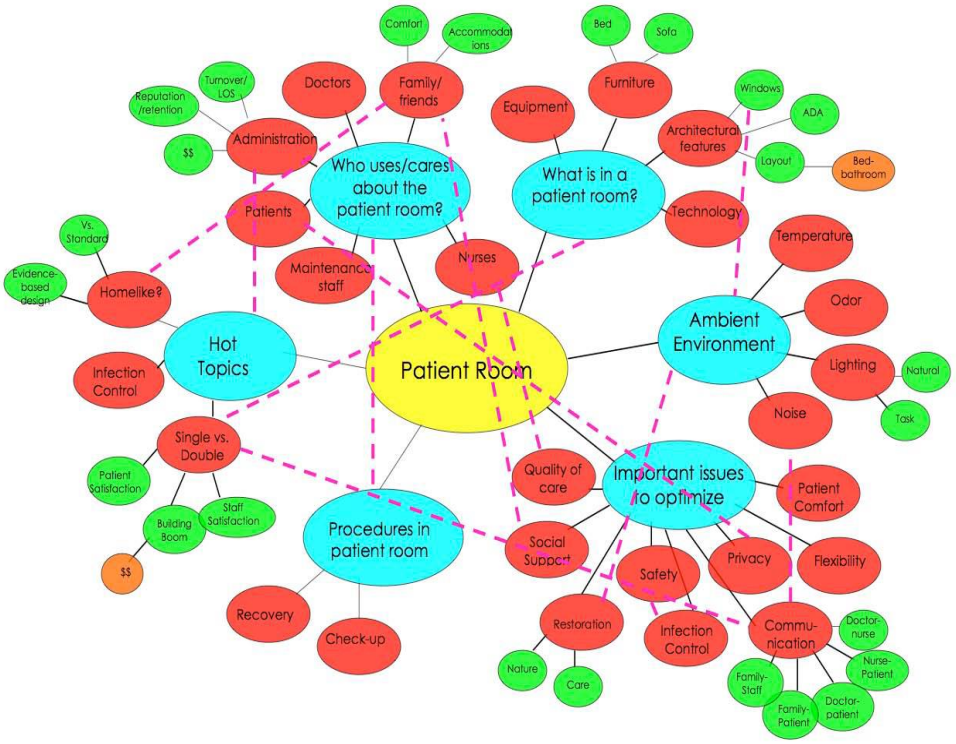


Figure 3. Patient Room's Diagram (Image credit: Journal of Child Health Care)

2.9. Patient room and infection control

There is a lot of research [6]which indicates the single rooms reduce infection rates. The objective of single-bed rooms are not being built exclusively for patient satisfaction.

[6] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3255204/

The healthcare designer should consider the water fixtures such as sinks, faucets, showers, and toilets of the patient rooms as potential sites for pathogenic microorganisms.

There are some infection control solution[7] for private rooms:

- Private toilets enable separation or isolation of patients
- Reduces airborne infection transmission by increasing isolation capacity
- Infected patients carry airborne pathogens that can easily be spread if the patient is not in isolation, or a private room
- Private rooms facilitate "filtration, ventilation, and airflow control"
- Provides protection to immunocompromised patients in nearby rooms from airborne pathogens
- Single rooms facilitate thorough cleaning of a room because cleaning multi-bed rooms would disrupt other patients or force patients to relocate during cleaning
- Research shows that hospital staff is more likely to sanitize hands in a single room due to the layout

[7] http://www.slideshare.net/iamsinghsandeep/final-hospital-planning-and-layout-ppt

2.10. Single patient room, benefits & drawbacks

Single Patient Room and Increased Patient Safety

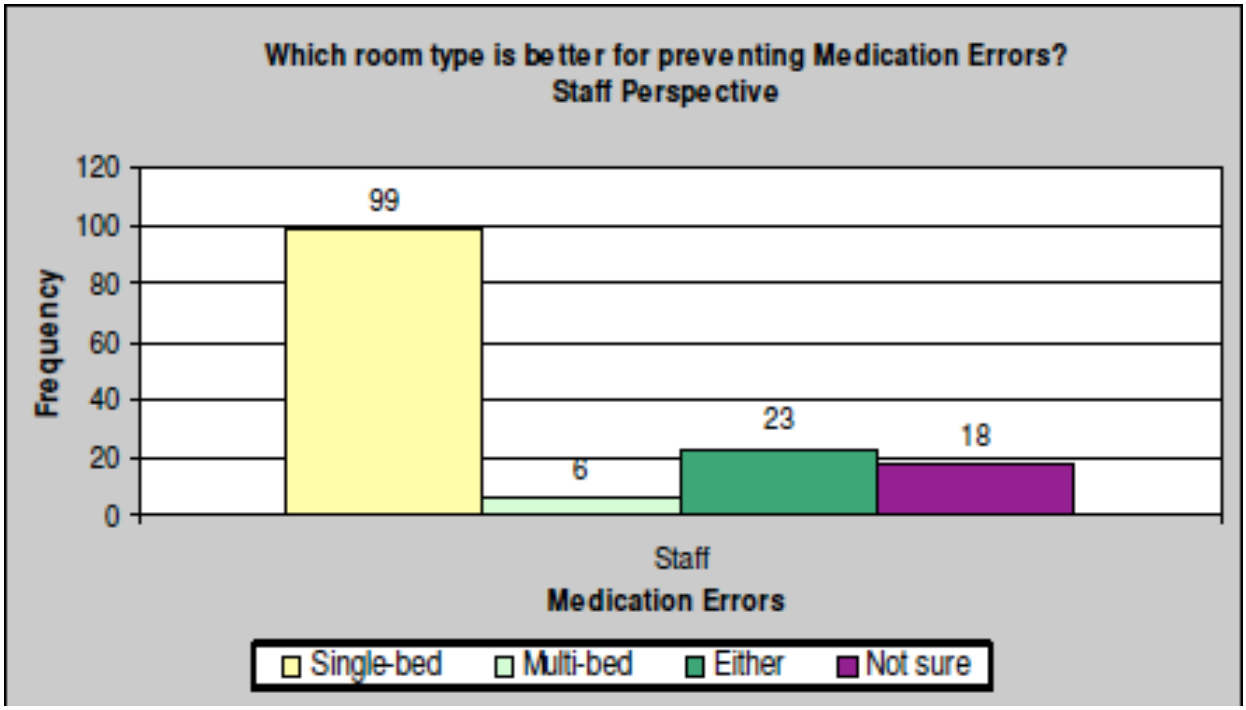


Figure 4. (Image credit: Arup & NHS, 2010)

In a research study performed by Arup and National Patient Safety Agency comparing the benefits and deficits between multi-bed and single-bed rooms in healthcare, they surveyed staff on patient safety in regards to medication errors. The survey reported that almost all (99%) of hospital staff found that single-bed patient rooms decreased chances of medication errors in the healthcare environment (Arup & NHS, 2010).

The identical nature of each single room allows for greater staff efficiency and safety because all of the supplies and facilities kept within the room can be found quickly and easily. While single patient rooms offer privacy to a patient and his/her family, this may lead to experience social isolation from spending a great deal of time alone during the day.

Single-patient rooms are more expensive than multi-patient rooms to incorporate into a hospital, because a hospital with 100% private-patient rooms affects the layout of designing. A tendency for hospitals, when building 100% single -patient rooms, is to align each room one after the other, creating long corridors for the nurses to travel. This alignment is often necessary to ensure that each private room maintains its privacy and that each one's layout is identical to the next (the "handedness" of the room).

2.11. The ideal patient room

Provision of suitable ideal patient room still is unclear. As the study has shown, there are pros and cons to each, the most glaring cons being the high cost of these solutions and increased workload on staff, so the most ideal solution for hospitals at this point is to weigh the negative and positive aspects given the available resources.

"Things like rearranging furniture, adjusting lighting and setting temperature are small things that seem unimportant at first but when you feel so much stress, a little bit of control over your environment makes you feel a little more comfortable and confident." Mrs. Odman, a mother of a young boy who has been cared for at Montreal Children's Hospital for several years (MUHC, 2005).

The following suggestions are all positive additions to the patient room, but incorporating all may be unrealistic and impractical for most hospitals, each can be considered independent of the others.

- Single-patient rooms should be the norm, but patients should have a choice in room type, especially for pediatrics.
- Construct hospital with windows as a priority for patient rooms, but strike balance between
- Use sound absorbing ceiling tiles and give patients the option of music, which can decrease stress and offset any noise from hospital traffic or nearby rooms

• Maintain ‘same-handed’ layout in patient rooms for staff efficiency and decrease risk of patient falls and medical errors

• Decentralize nursing stations to counteract the long walks down hospital corridors

• Strategically locate the hand washing dispensers, so patients play a role in monitoring staff Procedure

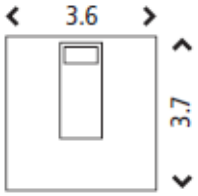
• Temperature and lighting: There should be some handheld control systems for the lighting and temperature.

• Take advantage of technology: hospitals are beginning to incorporate flat panel televisions with wireless capabilities and access to social networking and using some LED lights on the ceiling or ground. This innovation enhances social support, patient satisfaction, patient education, and decreased stress - in cases of social isolation this is an ideal solution Optimize patient control and social support through choice. (Vickery, 2010).

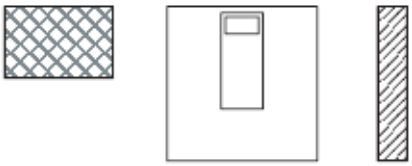
2.12. Achieving more single rooms and sufficient space around the bed

The following diagrams show how a single room can be configured to include the clear bed space along with restroom, clinical workstation, storage, and an overnight stay facility for family, indicates that the current space allowance for the single room of 77 ft^2 provides sufficient space to encompass the 3.6ft x 3.7 ft. clear bed space.

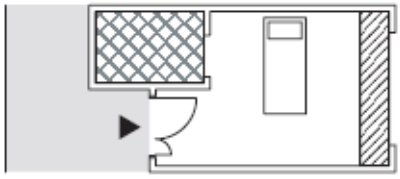
1. Clear and open space around the patient bed.



1. Clear space around the bed + enough spaces for the restroom with basin and clinical workstation, storage and overnight stay facility.



2. The single room – 240ft^2 in a typical layout includes allowance for planning and circulation within the room.



3. Alternative positions are possible.

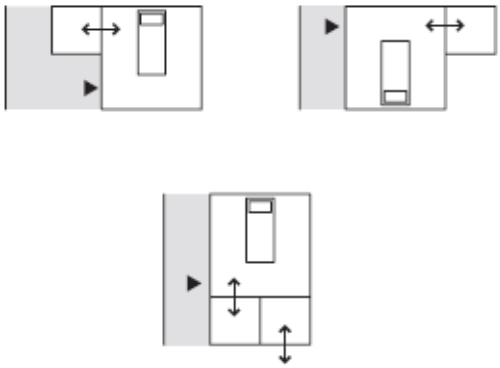


Figure 5. (Image credit: Arup & NHS, 2010)

CHAPTER 3

HOSPITALS AND SUSTAINABILITY

3.1. Sustainable design

Sustainability by definition, ties with the goal of this thesis. So it sounds necessary to the author to explore possibilities of thinking and designing more sustainable in the framework of this project.

We can consider Hospitals as environmental role models, for their staff, patients, visitors, and the general public by:

- designing and maintaining energy-efficient buildings
- implementing programs to conserve energy and water
- using non-disposable, multi-use and durable materials
- recycling some products

Thus the author came up with this question:

Why an Environmental sustainable design is Important for Healthcare Facilities?

Healthcare facilities:

- Generate hazardous and non-hazardous waste, air emissions, and wastewater that can, if not properly managed, contribute to air, water, and soil pollution.
- Rank second only to manufacturing facilities in electricity usage per square foot, in the United States.[8]
- Must comply with a growing number of increasingly complex regulations.

[8] Environmental Challenges and Visions of Sustainable Healthcare

•Can strive to proactively minimize pollution, while increasing the quality of care, reducing risk and saving money.

"By implementing an environmental management system healthcare facilities can prevent pollution, and analyze and potentially address the life-cycle impacts of their products and services. This will allow them to more effectively comply with applicable regulations, foster good community relations, provide better healthcare services, and stay competitive within the industry."[9]

3.2. Environmental impacts and prevention

It is crystal clear that man-made pollution has been potentially associated with increases in certain types of human illnesses[10]. As preventive way, the hospitals must design and lead the way in environmental awareness and protection.

Figure 5, illustrates how pollution can increase the need for medical services, which can, in turn, result in increased pollution.

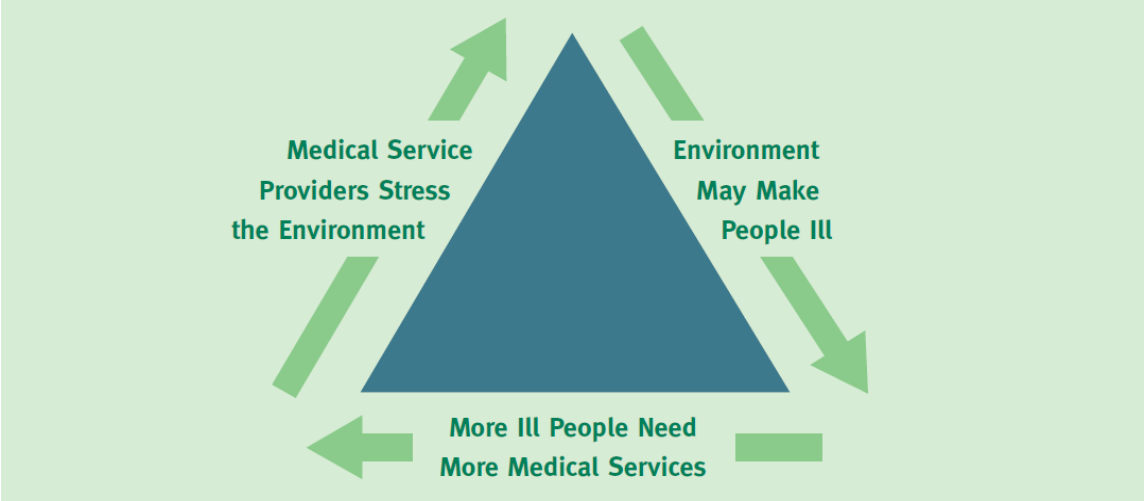


Figure 6. Environmental impacts, (Image credit: by Folkhard (1999), Pomp (1998))

[9] https://www.bms.com/content/dam/bms/us/en-us/pdf/greenh.pdf
[10] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4144270/

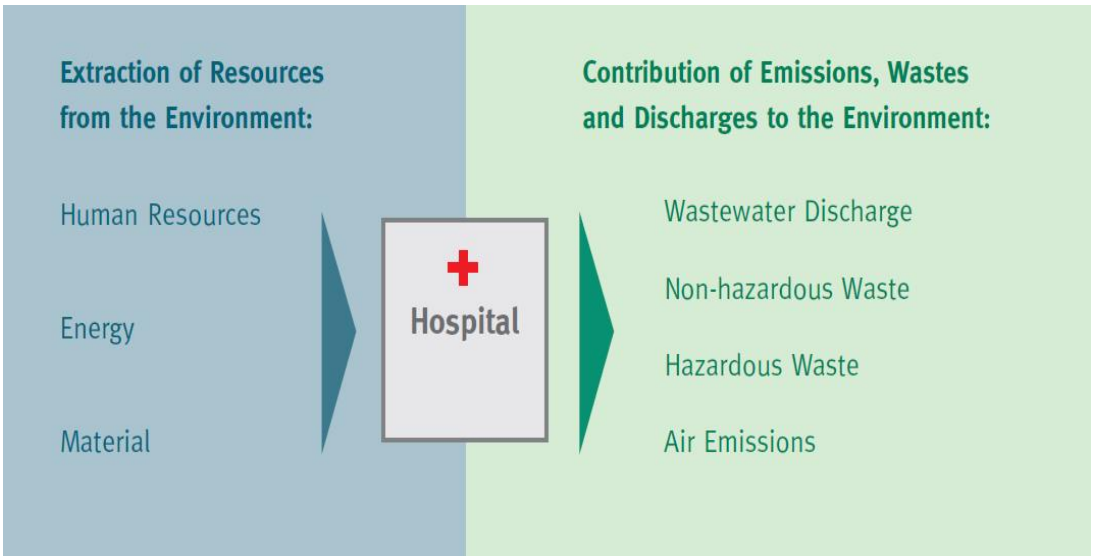


Figure 7. Input-output principle. (Image credit: Folkhard (1999), Pomp (1998))

3.2.1. Evaluating and Benchmarking Environmental Impact

Hospitals consume more energy and water[11], and generate more waste, than many other industries3[12]. To control costs and environmental pollution, the guidelines should be developed for conserving energy and water, and for using more environmentally friendly products.

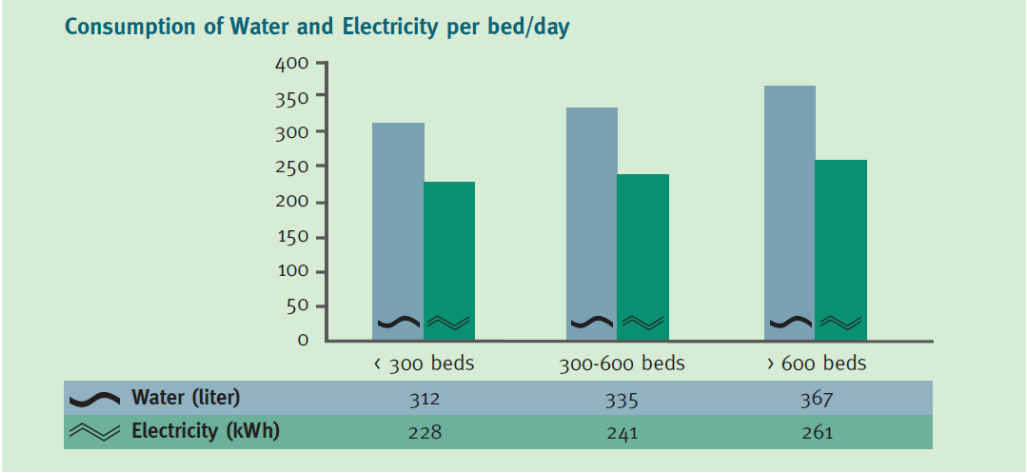


Figure 8. Water and electricity consumption (Image credit: Folkhard (1999), Pomp (1998))

This unexpected finding has an explanation. Financial pressures constantly drive hospitals to find ways to operate more efficiently. As a result, the hospitalization period per patient

[11] Studies conducted by Folkhard (1999), Pomp (1998), Pomp / Hackelberg (1999)
[12] Study conducted by the German Umweltbundesamt (1998)

is reduced, as well as the number of beds per habitant of the surrounding community. This result is more procedures being performed per day, thus increasing the environmental impact per bed but more importantly, this is decreasing the level environmental pollution on a per-patient basis. .[13]

3.3. Energy consumption

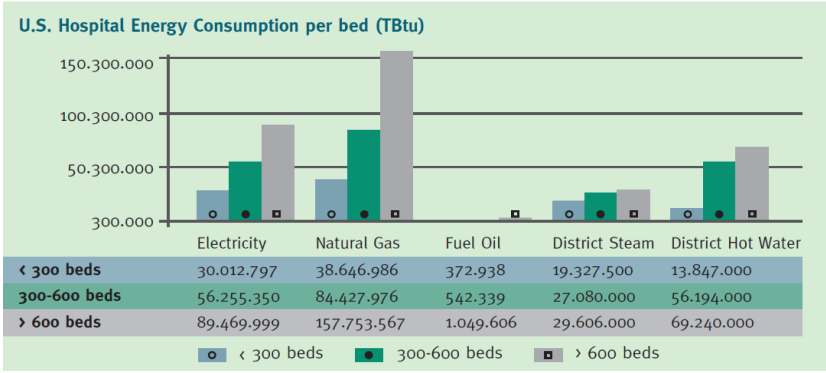


Figure 9. Energy consumption in U.S. hospitals (Image credit: Folkhard (1999), Pomp (1998))

Figure 8 approximates a hospital's average annual, per-square meter thermal and electrical energy consumption.

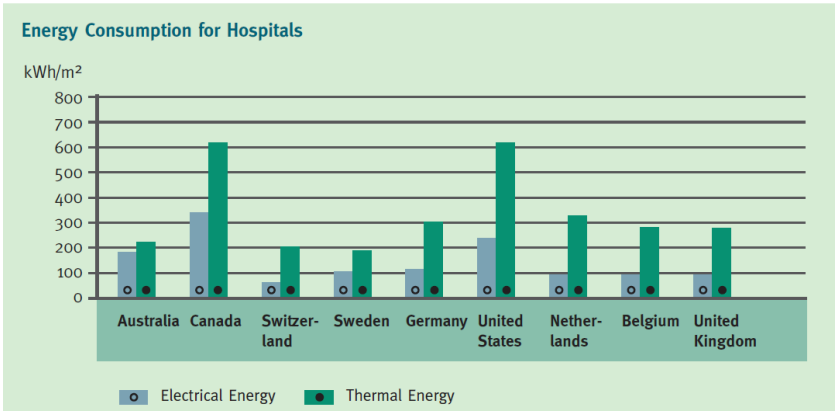


Figure 10. Energy consumption for hospitals (Image credit: Folkhard (1999), Pomp (1998))

The thick white line in the following diagram separates electricity from thermal (fuels) energy which indicates how energy consumption is broken down. "The precise split

[13] CADDET - Energy Efficiency in Hospitals, Maxi Brochure 05 – www.caddet-ee.org

depends upon hospital type and the complexity of equipment and services. New hospitals often spend more on air conditioning (larger-capacity chiller plants and ventilation systems add cost) than older hospitals. Fuel is mainly used for space heating and to produce domestic hot water. Electricity is primarily used for lighting and ventilation. These areas may account for 75% of a hospital's energy costs."[14]

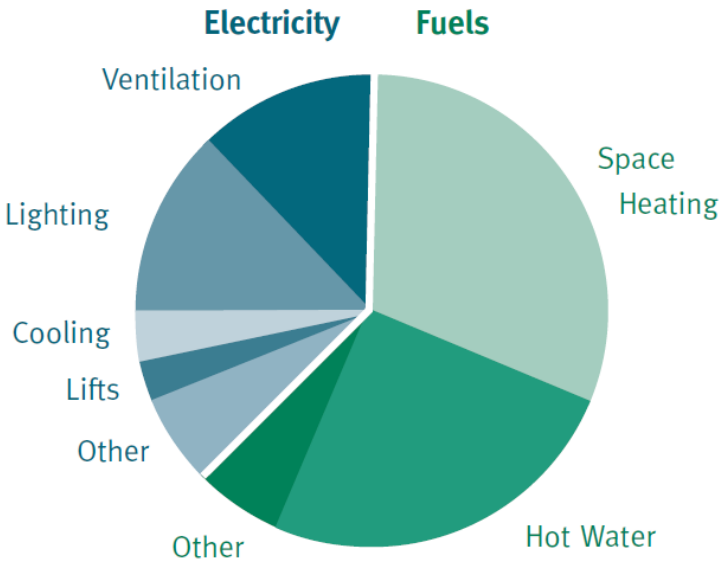


Figure 11. Hospital energy consumption (Image credit: Maxi Brochure 05)

3.3.1. Combined Heat and Power Systems

"Combined heat and power systems can reduce energy use by simultaneously generating electricity (and/or mechanical energy) and thermal energy. They recover waste heat and reduce energy use. Systems should be inspected and regularly maintained."[15]

Heating Ventilation and Air Conditioning Systems

Some solution for reducing heating and ventilation may include:

[14] https://www.bms.com/content/dam/bms/us/en-us/pdf/greenh.pdf

•Re-circulating air and reducing air-supply volume

•Adjusting optimum temperature installing variable air-handling units

•Recovering heat from exhaust air, improving building insulation

3.3.2. Lighting

For reducing electricity costs would be better to replace incandescent (bulbs) with LED, installing motion-sensors on light switches and incorporating monitoring of lighting-control settings and natural light (daylight) into new buildings.

3.3.3. Water Consumption

U.S. hospitals typically use 80 to 150 gallons (300 – 550 liters) of water per bed per day[15]. German hospitals use about 80 to 162 gallons (300 – 611 liters) of water/bed/day[16] or 80 to 272 gallons (300 – 1000 liters) per client/day[17]. Water use is driven by the number of inpatients and outpatients, equipment used, facility size, number and types of services, facility age and maintenance requirements. Other contributors include steam sterilizers, autoclaves, medical processes, heating ventilation and air conditioning (HVAC), sanitary, x-ray equipment, laundries and food services. Figure 11 shows average water use by category for seven randomly selected hospitals ranging from 130 to 500 bed capacities, with water consumption of 15 million to 145 million gallons[18].

[15] Massachusetts Water Resource Authority - www.mwra.state.ma.us/water/html/bullet1.htm
[16] www.ciwmb.ca.gov/bizwaste/factsheets/hospital.htm
[17] Extracted from Daschner F. D. / K. Kummerer / M. Scherrer / P. Hubner / L. Metz: Handbuch mweltmanagement
[18] Studies conducted by Folkhard (1999), Pomp (1998) / Hackelberg (1999)

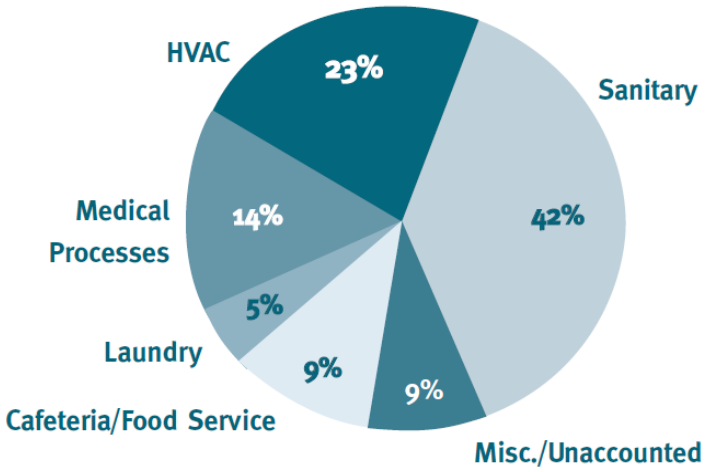


Figure 12. Water consumption (Image credit: Daschner, Kummerer, Scherrer, Hubner, Metz)

3.4. Energy saving solutions

The one of the aims of author's thesis project has been to develop some solutions that could improve children's cancer hospital sustainability. Best solutions could deeply differ depending on the local environment, on climate, on mix and size of the served community, on available resources and on the starting point.[19] The study points to adapt some affordable and cost effective energy saving solutions in different categories as below:

Sustainable Site:

• Site selection in a compact urban area to provide easy access

• Select the right building orientation

Innovation and Integrative Process:

•Protective thermal glazing solar protection systems

•Select Brightly-colored facades and Roof blinds to avoid thermal loads

•Use the natural lighting as much as possible

[19] Improving Sustainability During Hospital Design and Operation Book

•Solar collectors for hot water

•Modern lighting elements with better light yield

•Use-dependent controls

•Electronic ballast units

•Use of photo-voltaic panels to generate electricity

•Use of trees and plants to reduce solar gains and block winds

•Increased duct size and reduced sharp turns within ductwork to reduce pressure drops

•Motor controls installed to reduce the speed of electric motor systems

•Installation of a building automation system

•Films on the windows to prevent heat loss

Indoor Environmental Quality:

•Specific room parameters (temperature, humidity, air exchange)

•Control settings (temperature, humidity)

•Air flow reductions are in place when rooms are unoccupied

•Air flow reductions in fume hoods and bio-cabinets when not in use

•Use absorption refrigeration machines

•Heat-recovery preheat loop

•Variable speed pumping

•Cooling coil condensate recovery

•Supply air located on windward side to increase positive pressure

•Thermal insulation on pipes, heat generators, and storage units

•Select the proper sized hot water storage tanks

•Power-efficient instruments, equipment and appliances

For example, Berlin Hospital, in Wisconsin, U.S., saved $21,000 per year by using variable speed drives in hot water pumps, eliminating exhaust in unnecessary areas, and recovering boiler heat[20].

[20] . Berlin Health, Check-up Reveals Savings Opportunities, www.wifosonenergy.com

CHAPTER 4

PRECEDENT STUDIES

4.1. Dell children's medical center of central Texas

Location Austin: Texas

Gross Square Footage: 515,940

Distinctions/Awards LEED Platinum-NC

Dell Children's Medical Center includes 176 licensed beds, pediatric intensive care unit, intermediate care unit, neonatal intensive care unit, oncology, respiratory, surgery, general nursing units, Level 1 trauma designated emergency department, imaging department, 24/7 laboratory, pharmacy, kitchen/dining area, rehabilitation therapy department with therapy pool.

Figure 13. Dell Children's Site (Image credit: Dell Children's Website)

Figure 14. Dell Children's Program (Image credit: Dell Children's Website)

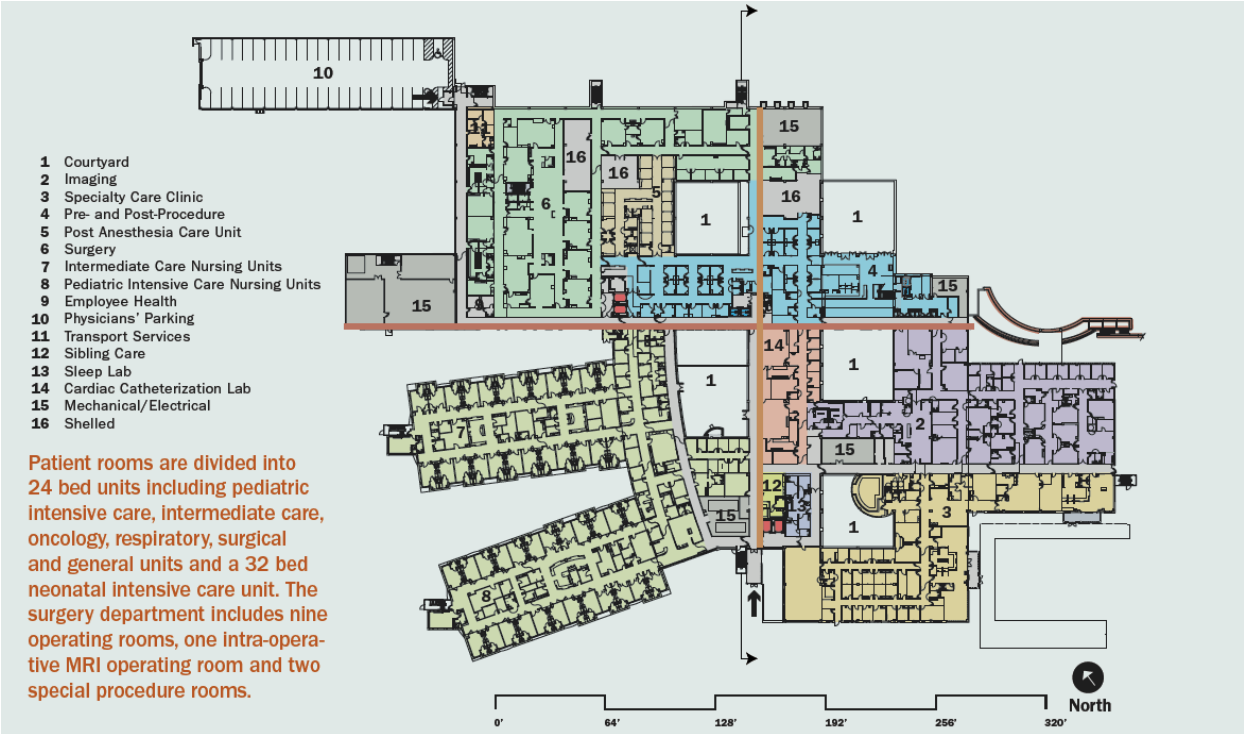


Figure 15. Dell Children's Program (Image credit: Dell Children's Website)

4.1.1. Healing Power of Art and Nature

Dell designers have tried to bring both natural and aesthetic healing to its site. There are artworks and sculptures grace at the walls and lobby. A stroll through Dell Children's grounds has been described by design specialists as "breathtaking," including such features [21]as:

- Courtyards and gardens that represent each of the seven ecosystems, each corresponding to a distinct area of the 46-county Central Texas region that Dell Children's serves.
- Multi-level Healing Garden designed with a labyrinth, human sundial, reflecting pond and bridge.
- Using plants and the other elements with unique textures and colors in the garden area, stimulate the senses of healing garden.
- Butterfly Gardens created to attract butterflies.
- A plethora of art from both global and featured local Austin artists, with pieces chosen as much for the collection's clinical healing power as they are for their beauty.
- Landscaping featuring a natural palette of indigenous plants, in line with the overarching theme of "green" building.
- The area which Dell Children's is located, there is a hike and bike greenbelt that is created by the City of Austin

[21] Philips.Risner,P.E, Member Ashrae

Figure 16.Dell Children's Play Room (Image credit: Dell Children's Website)

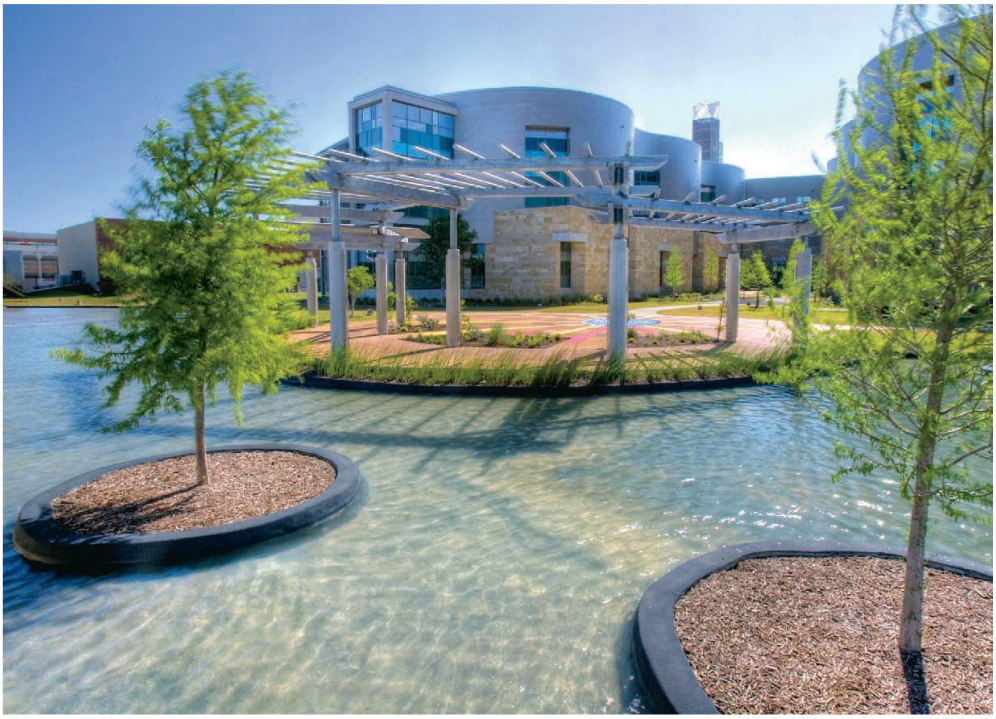


Figure 17.Children's Healing Garden (Image credit: Dell Children's Website)

4.1.2. Key Sustainable Features

These energy-efficiency strategies include:

- Materials: Low-VOC adhesives, sealants, paints and coatings
- Exhaust heat recovery;
- Dedicated outdoor air units;
- High-efficiency lighting;
- Native and adapted plants help reduce potable water use
- Daylight harvesting controls; the six internal courtyards provide daylight, fresh air, views and access to nature. These connections to the outdoors contribute to a healing environment that improves patient outcomes, and plays a role in improving productivity and recruiting and retaining doctors and nursing staff.
- High performance glazing.
- Water Conservation by Low-flow faucets and showerheads, dual-flush toilets, water-efficient autoclaves, xeric landscaping, reclaimed irrigation water from nearby water treatment plant save an estimated 5.5 million gallons of potable water a year.

Building automation system (BAS) monitoring and control strategies.

- CO2 demand control ventilation in the administration and public areas.
- Unoccupied setback of operating rooms.
- Scheduling/night setback for specific areas of the hospital.
- Underfloor air distribution for the 40,000 ft2 administration area.
- Low velocity ductwork and piping sized to minimize friction losses; and
- Low pressure drop electrically enhanced ionization filtration on patient care air-handling units.

Dell Children's Medical Center shows that sustainable design approach has both financial benefits and intangible benefits[22] for building users. Continued monitoring and evaluation of the building system will help ensure that building systems perform at their optimal levels, providing a healthy and sustainable environment.

4.2. Children's hospital of Pittsburg of UPMC

Location: Pittsburgh, Pennsylvania

Year Built: 2008

UPMC is a major health system in western Pennsylvania and a nationally recognized academic medical center (UPMC 2007). The new CHP represents a part of a major development consisting of a clinical services building (the hospital), academic research center, plaza building, faculty pavilion, administrative office building, and three parking garages. Importantly, the CHP hospital project is primarily new construction with a portion of an existing building retained, on a congested, brownfield site. The entire project is not just new construction; six buildings were retained with about the same amount of renovated space as new. The cost of the entire development is approximately $625 million. CHP is a nine-story building consisting of inpatient and outpatient areas, 296 licensed beds, including the critical care unit, pediatric intensive care unit, cardiac intensive care unit, and neonatal intensive care unit. The hospital also has a surgical suite with thirteen operating rooms (ORs), of which six contain minimally invasive equipment. The process used to identify the principles and then translate them into design such as:

- Family-centered care: Private rooms with sleeping space for parents, a chapel, library, business center, sibling center, laundry facilities, and playrooms.

- Healing garden and adjacent atrium: For personal downtime, able to feature movies and group activities;

[22] Philips.Risner,P.E, Member Ashrae

• Quiet and calm environment: To reduce stress and promote healing. Specific details and materials were created in order to minimize noise. Staff and consult rooms were strategically spaced to minimize sound and promote privacy. Personal communications are used, instead of overhead paging;

• Patient safety and quality: Reflected in private patient rooms that lower infection rates and increase privacy. Surgical services are all located on one floor and specialty services are located close to the associated laboratories; and,

• Green Attributes: The new CHP is pursuing "certified" certification under the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) rating system.

Some of the building's features include:

• Reduced heat island effect and light pollution;

• Water efficient landscaping and recycling of water;

• Key building materials have high recycled content, are purchased locally or regionally, and emit low to no volatile organic compounds;

• The air filtration system ensures high-quality indoor air, and despite the hospital's large floor plate, the design maximizes daylight and views;

• The healing garden is a prominent feature, for which CHP is attempting to achieve an innovation credit; and,

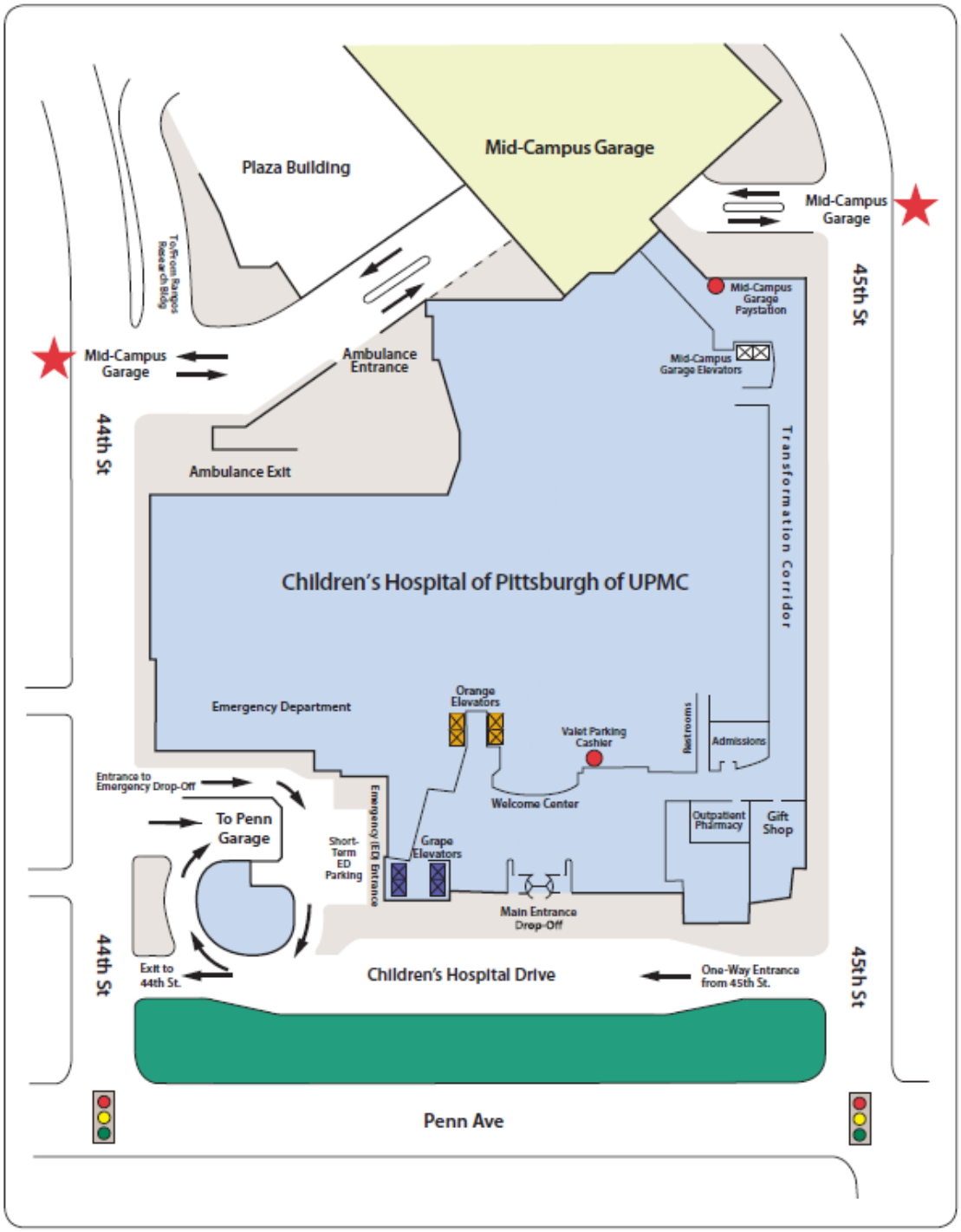
• CHP is developing educational programs and materials to teach staff how to inhabit and work in the building to maximize the benefits of their green environment.

Figure 18. City Elevation (Image credit: CHILDREN'S HOSPITAL OF PITTSBURGH OF UPMC)

Curtain wall and storefront included 70,000 square feet of glass. The project also included sunshades, louvers, floor to ceiling all-glass walls, decorative art glass feature walls, mirrors, metal panels, Uncial blinded windows, aluminum entrances, ICU doors.

Figure 19. Exterior façade (Image credit: CHILDREN'S HOSPITAL OF PITTSBURGH OF UPMC)

Figure 20.Children play ground(Image credit:CHILDREN'S HOSPITAL OF PITTSBURGH)



- The **Penn Garage** is reserved for outpatient families and for those arriving at the Emergency Department.
- The **Mid-Campus Garage** is the primary parking for inpatient families and visitors.

Figure 21.Hospital Site (Image credit: CHILDREN'S HOSPITAL OF PITTSBURGH OF UPMC)

This Children's Hospital got a LEED Silver certification, which shows the designer team met the mandatory requirements. These mandatory requirements included such things as erosion control on the construction site, elimination of CFC refrigerants, recycling programs, basic indoor air quality, basic commissioning, minimum energy performance, , and tobacco smoke control. Children's achieved its points largely via substitutions of green materials and designs in place of more conventional systems. Most notably, they were as follows[23]:

- Selecting the site appropriately
- Urban area redevelopment
- Access to alternative and public transportation (buses, trains, etc.).
- Preferred parking for car pools.
- Reducing heat islands by putting parking under cover and using green roofing systems
- Water-efficient landscaping.
- Use of building materials with recycled content. 100% post-consumer structural steel.
- Minimizing transportation burden by maximizing use of local construction material
- Use of certified and durable wood products
- Internal air quality management plan throughout construction and flushing building prior to occupancy with filter changes as appropriate.
- Use of low VOC materials such as sealants, adhesives, paints, woods, and carpets
- Provide for thermal comfort including humidity controls
- Maximize use of daylight and views
- A green education program for staff, patients, and visitors.
- Reducing the use of vinyl- and mercury-containing products
- Designing healing gardens

[23] www.chp.edu

4.3. CS Mott Children's hospital and Von Voigtlander Women's Hospital - MI

Total building area (sq. ft.): 1,100,000

Construction cost/sq. ft.: $399

The new CS Mott Children's Hospital and Von Voitlander Women's Hospital is designed to create a friendly and healing environment. CS Mott has 855,000 SF of inpatient space and 245,000 SF of outpatient clinics and offices.The hospital is located at the University of Michigan Medical Center, the wide spans of the glass of the building allows to take advantage of natural daylighting. There is eye-catching views to nature specifically to the Nichols Arboretum. Using Two tons of precast color will emphasize the

Figure 22. Facade Glazing (Image credit: CS Mott Children's Hospital Website)

building, and also add interest to the façade.The building's architecture is composed of a simple palette of materials (limestone colored precast concrete, glass, and metal panels). story lobby and waiting area are very inviting entry by overlooking dramatic outdoor courtyards.facility. The lobby connects to the existing Taubman Clinic and the medical center. A glassed sky bridge will provide a pedestrian connection from the Simpson parking garage to the upper lobby level. Wide spans of glass allow views to nature due to its location across from the University of Michigan's Nichols Arboretum.

Figure 23. A two-story lobby (Image credit: CS Mott Children's Hospital Website)

Figure 24. The main lobby(Image credit: CS Mott Children's Hospital Website)

The main lobby includes an array of colors to call to mind the setting sun. The central figure emulates a tree house.

Figure 25.The arboretum (Image credit: CS Mott Children's Hospital Website)

The arboretum theme plays throughout the hospital, including the flower pattern in the flooring at this elevator lobby.

4.3.1. Green Features[24]

Green Roof

The "green roof" essentially makes to reduce the amount of paved surfaces on campus, the new hospital is built on what was previously a parking lot. The green roof also can be as part of a natural storm-water management by filtering rainfall. The living roof helps insulate the building and reduce energy loss and contributes to overall air quality.

Recycled Materials

Basically a large amount of used material (93%) harvested from the site. More than 200 tons of concrete and asphalt were recycled from the project site.

No-wax floors

Most of the flooring in the new C.S. Mott Children's Hospital are requiring no waxing, stripping or buffing. The floors material are made by PVC- and chlorine-free, that make to contribute to the overall indoor air quality.

Other "Green" Features

•Using certified wood materials in accordance with FSC (Forest Stewardship Council) principles for wood building components.

•Choosing low-emittance interior materials such as carpet, paint, adhesives and composite woods for increasing the high indoor air quality.

•Using HEPA filters for enhancing air quality and other high-risk patients.

[24] CS Mott Children's Hospital Website

CHAPTER 5

PROGRAM

5.1. Program for a sustainable cancer children's hospital

Children's Hospital design depends totally on their complex functional requirements. The form and layout of hospital facilities have to meet the criteria for: Un-obstruction of emergency routes, Segregation of workflow, Nurse Stations, Patients and staff safety and others. All these factors lead to divide the hospital to different zones. In this chapter, the author tried to divide the children cancer hospital program to 5 important parts.

5.1.1. Lobby

Hospital lobbies are very critical destinations where patients and visitors can get information and they spend significant amounts of time. Lobby in the hospital is the first point of patient's contact with a facility, so a lobby should give a very welcoming message. Lobbies basically support a variety of functions. By studying different precedent studies the author believes that the lobby provides a gracious arrival experience, clear guidance, and an inviting environment. Patients and visitors in an effective lobby can easily orient and navigate through space. The lobby by offering information and directions provides a meeting space for patients and their family and serves as a waiting space before transferring patients to another part of a hospital building. The following diagrams show the connection between different spaces in the lobby and main entrance.

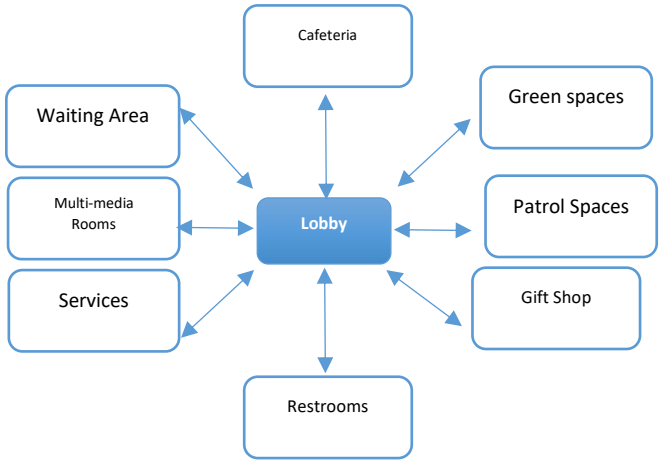


Figure 26.Lobby's Diagram Image credit by the author

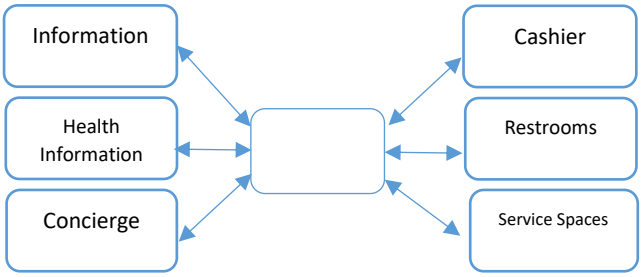


Figure 27.Main Entrance's Diagram (Image credit by the author)

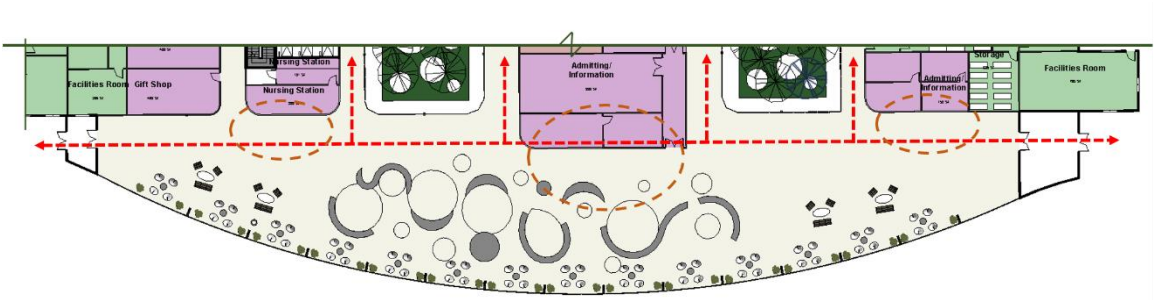


Figure 28.This Enlarged lobby Plan (Image credit by the author)

There are 3 main help desks information and nursing statins in the lobby to serve the patients.

5.1.2. Emergency

An emergency zone is a medical treatment facility specializing in emergency medicine, the acute care of patients who present without prior appointment.[25]

Establishing a quick track process for patients with emergency conditions that would be treated quickly can reduce extensive waits and improve the overall flow of patients through the emergency ward. Emergency ward is included:

Emergency Services, Admitting and Administration, Interventional Services, Adaptive and Acute Care beds Room, Outpatient Infusion, Ambulatory Surgery, Cashier, CPR, Nurse

[25] wiki/Emergency_department

Station, Wound Care, Imaging and casting Room and Blood center. All these spaces should be close to the ambulance entry to support the patient with urgent condition.

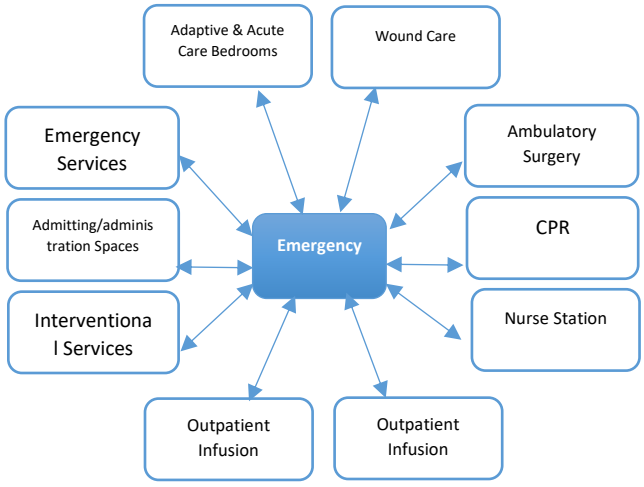


Figure 29. Emergency ward's Diagram (Image credit by the author)

Imaging & Radiology rooms in the emergency zone is included: MRI Imaging, Diagnostic Imaging, Ultrasound, CAT scan, and Radiation Oncology.

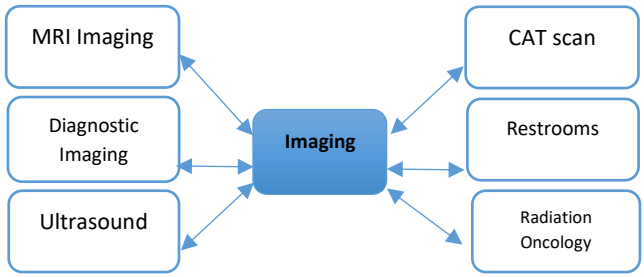


Figure 30.Imaging Room's Diagram (Image credit by author)

The yellow zone in the following floor plan is the emergency ward, which has 2 main nursing stations with a separate access to the outside. The author put the CPR and Trauma center close the entrance. This zone is separated by two doors from the other parts on the ground floor in regarding create the visual barriers.

Figure 31.Emergency Ward's Floor Plan (Image credit by the author)

5.1.3. Clinics

Clinical Zone is consisting of diagnostic and treatment facilities. Clinical Zone is included: Admitting and Administration, Waiting area, Restrooms for public, Different Types of Clinics (Dermatology, Otolaryngology, Cardiology, Gastroenterology, Cardio Rehab, Endoscopy, Bronchoscopy, Orthopedics, Wound Care, Hematopathology, Neonatology, Vascular Testing, Integrative Medicine, Exam/ Treatment Room).

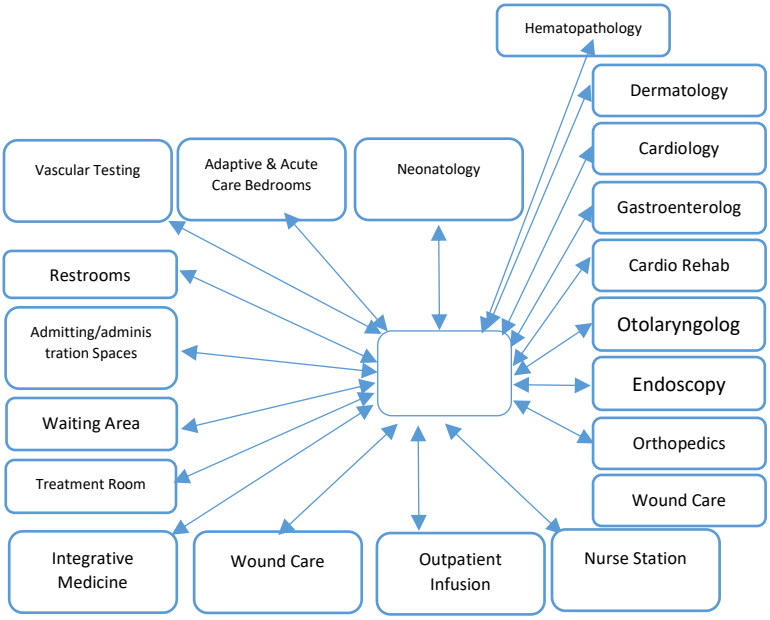


Figure 32.Emergency ward's Diagram (Image credit by the author)

The Bright blue color in the following image is dedicated to the different types of clinics. There are a big open space, consultation rooms and community rooms, waiting areas in the clinical zone to support the patient's family. The author designed the clinical zone in 3 levels.

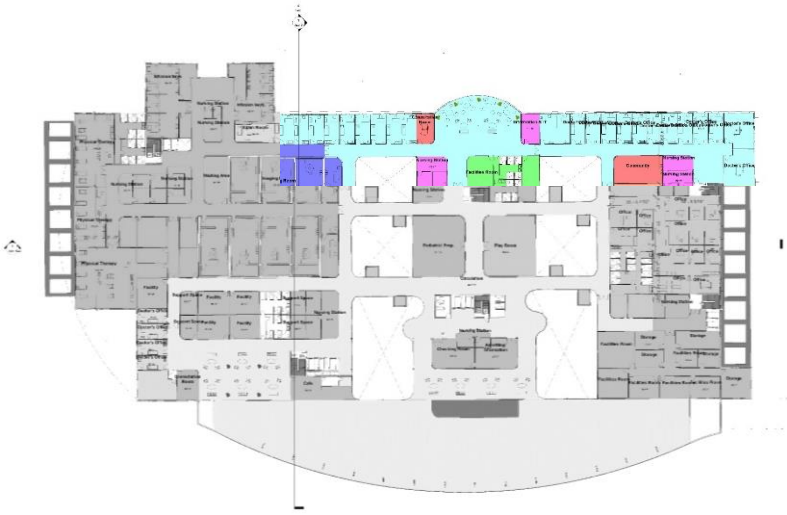


Figure 33.Clinical Ward's Floor Plan (Image credit by the author)

5.1.4. Cancer Therapy Center

The functionality of cancer center design is essential to any healthcare environment and hospitals that provide cancer care must encompass characteristics that address the distinctive aspects of the cancer patient and the care spaces. The Cancer Therapy Center is included: Chemotherapy, Radiation Oncology, Medical Oncology, Outpatient Infusion, Nuclear Medicine/ Cardiology Testing, Coffee shop, Restrooms, Reception, Information.

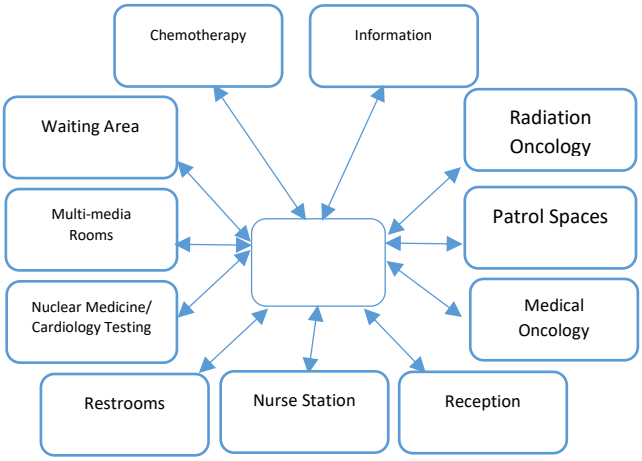


Figure 34.Cancer Therapy Zone's Diagram (Image credit by the author)

The darker blue zone is dedicated to the cancer therapy zone by author. Actually there are some infusion bays room in the other levels too.

Figure 35.Cancer Therapy Zone Floor Plan (Image credit by the author)

5.1.5. Surgery Zone

A surgery ward or operating room, is a room within a hospital within which surgical and other operations are carried out. The establishment and working of the operation room needs specialized planning and requirements. Four zones can be defined in a surgery zone, based on varying degrees of cleanliness, in which the bacteriological count progressively decrease from the outer to the inner zones .[26]

Surgery zone is defined by Preparation Area (Surgical Supply, Work Room),Scrub Room, Operating Room, Semi-restricted Corridor, Post Anesthesia Care Unit, Recovery Room, Surgical Intensive Care Unit , waiting spaces for parents.

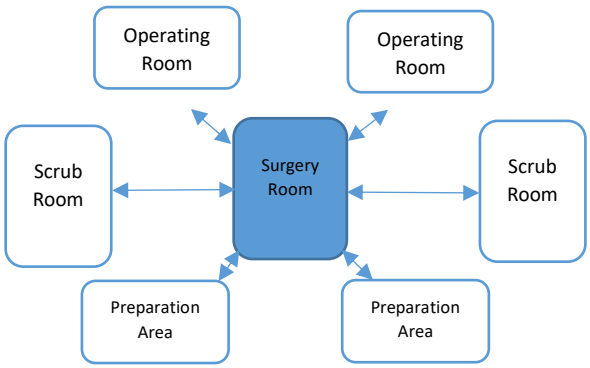


Figure 36. Surgery zone's Diagram (Image credit by author)

The green color in the following image is dedicated to the surgery zone. The author designed recovery rooms and ICU and CCU rooms beside the operation rooms.

[26] Ravi Singh (Head Healthcare)

Figure 37.Surgery Zone's Floor plan (Image credit by author)

In the following stacking diagram, the floor's functions and the connections between spaces would be understandable.

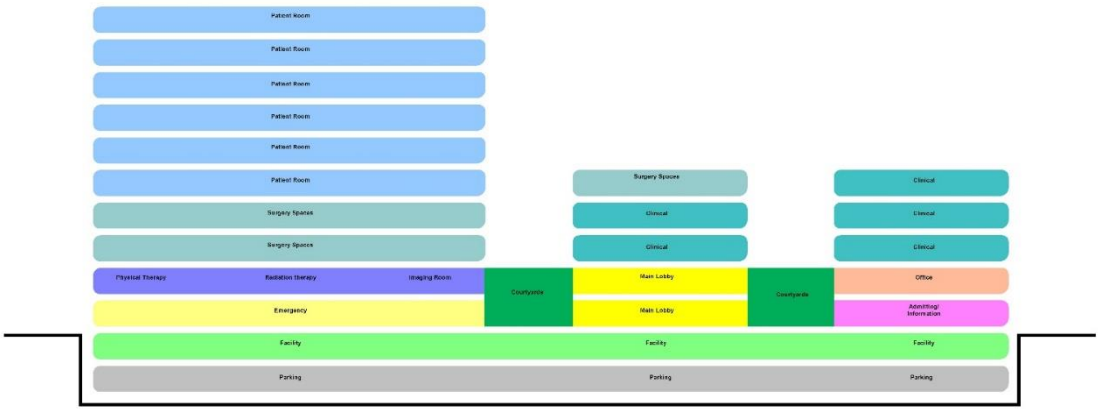


Figure 38.Stacking Diagram (Image credit by author)

5.2. Children's cancer hospital program

Cancer Pediatric's Hospital Program	Areas
Total Squre Footage for 100 beds Children's Hospital	460,000 sq. ft
Emergency	
Admitting and Administration	450 sqft
Interventional Services	365 sqft
Adaptive and Acute Care beds Room	480 sqft
Outpatient Infusion, Ambulatory Surgery	323 sqft
Ambulatory Surgery	323 sqft
Cashier	39 sqft
CPR	118 sqft
Nurse Station	82 sqft
Wound Care	100 sqft
Lobby	
Waiting Area	356 sqft
Multi media Rooms	39 sqft
Services	492 sqft
Retrooms	X.30 sqft
Cafeteria	323 sqft
Pastoral spaces	181 sqft
Gift Shop	181 sqft
Clinics	
Admitting and Administration	260 sqft
Waiting area	180 sqft
Restrooms for public	X.30 sqft
Dermatology	180 sqft
Otolarynology	180 sqft
Cardiology	180 sqft
Gastroenterology	180 sqft
Cardio Rehab	180 sqft
Endoscopy	180 sqft
Bronchoscopy	180 sqft
Orthopedics	180 sqft
Wound Care	100 sqft
Hematopathology	180 sqft
Neonatology	180 sqft
Vascular Testing	180 sqft
Integrative Medicine	180 sqft
Exam/ Treatment Room	131 sqft
Blood Bank	
Sterilize spaces	39 sqft
laboratory	78 sqft
Storage with refrigrators	39 sqft
Nutritional Services	
Family Resources Center	
Staff Zones	
Cancer Therapy Center	

Chemotherapy	262 sqft
Radiation Oncology	262 sqft
Medical Oncology	262 sqft
Outpatient Infusion	262 sqft
Nuclear Medicine/ Cardiology Testing	262 sqft
Coffee shop	262 sqft
Restrooms	X.30 sqft
Reception	82 sqft
Information	82 sqft
Medical Supply	
Nurse Station	
Exam/ Treatment Room	
Surgery Room	
Preparation Area (Surgerical Supply, Work Room)	39 sqft
Scrub Room	39 sqft
Operating Room	78 sqft
Semi-restricted Corridor	78 sqft
Post Anesthesia Care Unit	78 sqft
Recovery Room	78 sqft
Surgical Intensive Care Unit	181 sqft
waiting area for parents	323 sqft
Patient room	100.39
Inpatient Care Unit	
Laboratory & Pathology & Cytopathology	
Imaging & Radiology	
MRI Imaging, Diagnostic Imaging	646 sqft
Ultrasound	78 sqft
CAT Scan	78 sqft
Radiation Oncology	78 sqft
Pharmacy	
Café	
Outpatient Pharmacy	
Physical Therapy	
Enclosed office	
Confrence Room	
Locker Room	
Lundry Room	
Corridor	
Storage Rooms & Archive Rooms	
Medical Records	
Restrooms	
Electrical/ Mechanical	
Lounge	
Dining Area	
Food Preparation	
Material Management Rooms (Shipping & Receiving)	
Parking	

Public Parking	
Emergency Parking	
Handicapped Parking	
Temporary Parking	
Ambulance Parking	
Healing Garden	
Helipad	
Physician Office Suites	
Courtyards	
Neurology	
Orthopedics	
ICU/CCU	
Community Pavilion	
Children Area	
Play Rooms	646 sqft
Library(Book Store, Support)	323 sqft
Multimedia Learning Center	323 sqft
Auditorium	646 sqft

CHAPTER 6

SITE ANALYSIS

6.1. Massachusetts climate

Massachusetts's climate is the continental climate type. The seasonal temperature variance can be as great as 91 °F (51 °C), but is typically about 59 °F (33 °C) to 71 °F (39 °C). The temperature difference between the warmest and coldest months increases as one moves further inland and away from the moderating influence of the ocean. Places with a hottest monthly temperature above 50 °F (10 °C) and a coldest monthly temperature below 27 °F (−3 °C), and which do not meet the criteria for an arid climate, are classified as continental.[27]

Figure 39.Average Outdoor Wet Bulb Temperatures (Image credit by author)

Figure 39.Average Outdoor Dry-Bulb Temperatures (Image credit by author)

[27] Weather Data Website

6.2. Cambridge, MA weather

Cambridge, Massachusetts, gets 45 inches of rain per year. Cambridge, MA climate is warm during summer when temperatures tend to be in the 70's and very cold during winter when temperatures tend to be in the 30's. The warmest month of the year is July with an average maximum temperature of 82.20 degrees Fahrenheit, while the coldest month of the year is January with an average minimum temperature of 22.10 degrees Fahrenheit. Temperature variations between night and day tend to be fairly limited during summer with a difference that can reach 16 degrees Fahrenheit, and fairly limited during winter with an average difference of 14 degrees Fahrenheit.[28]

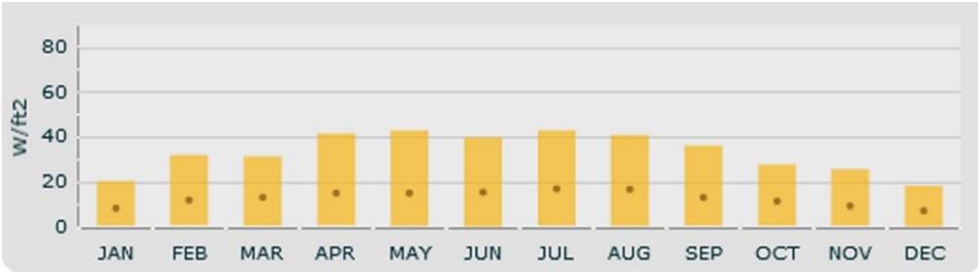


Figure 40. Global Horizontal Diffuse (GHD) (Image credit by author)

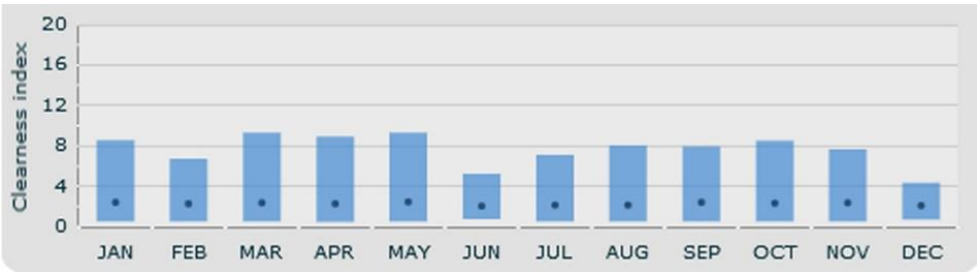


Figure 41.Monthly Sky Clearness (Image credit by author)

[28] Weather Data Website

6.2.1. Average Temperature

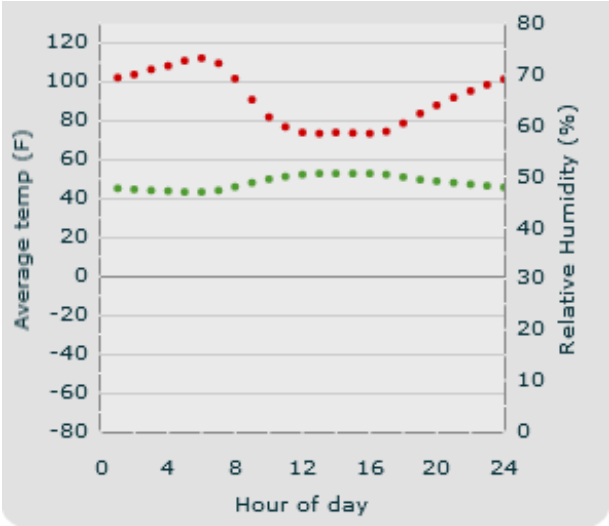


Figure 42.Spring (MAR, APR, MAY) (Image credit by author)

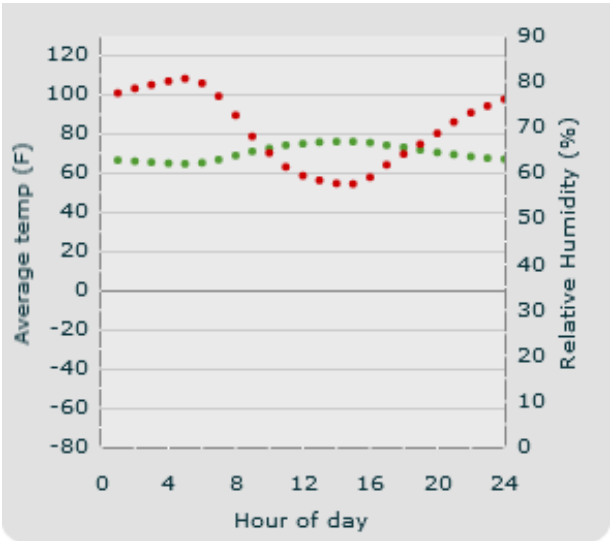


Figure 43.Summer (JUN, JUL, AUG) (Image credit by author)

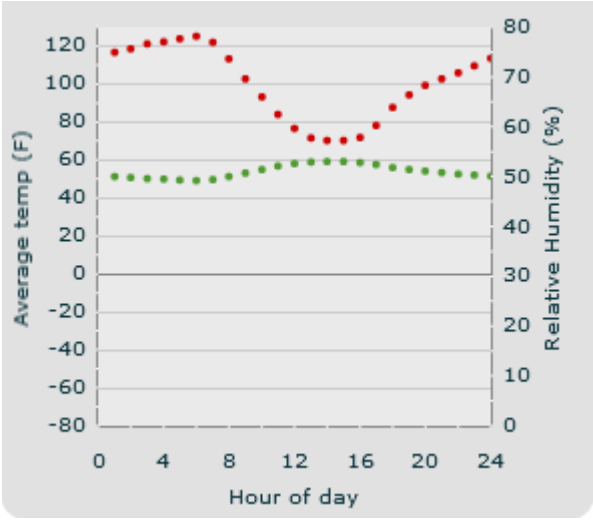


Figure 44.Autumn (SEP, OCT, NOV) (Image credit by author)

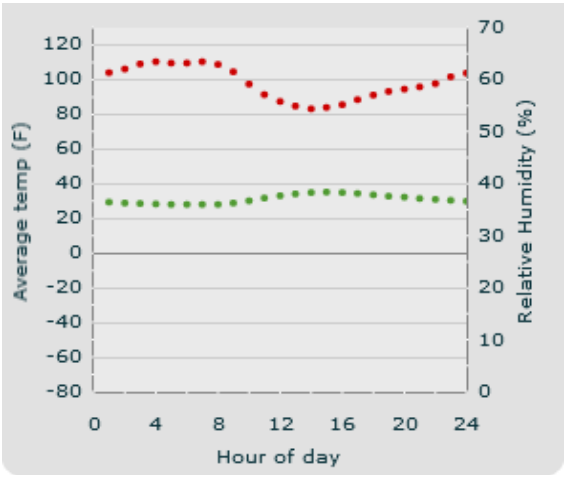


Figure 45.Winter (DEC, JAN, FEB) (Image credit by author)

6.2.2. Solar Studies during different seasons

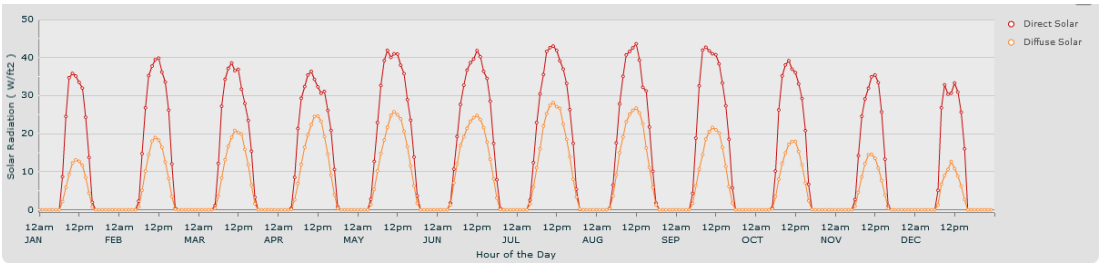


Figure 46.Solar Radiation (Image credit by author)

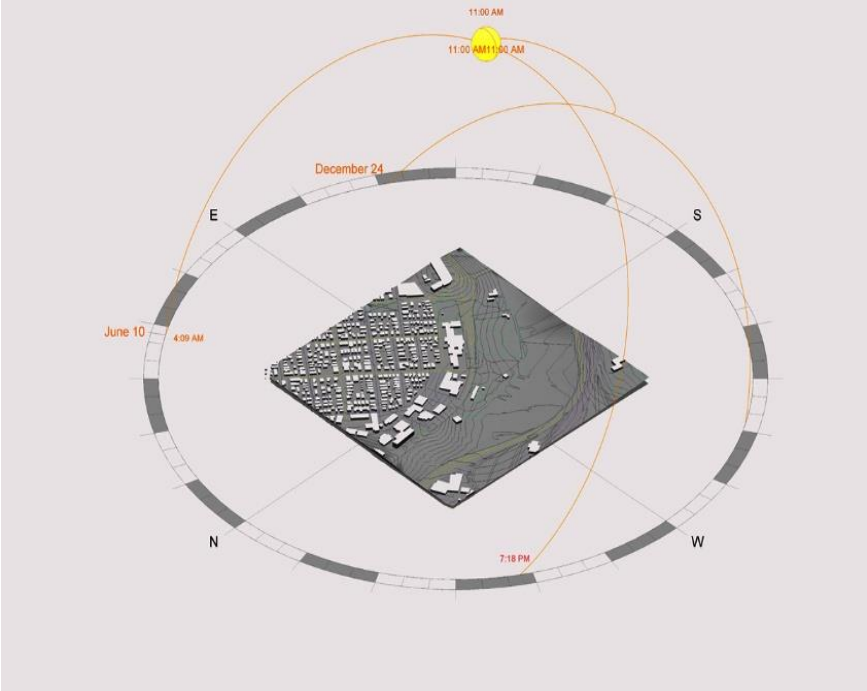


Figure 47. January to June (Image credit by author)

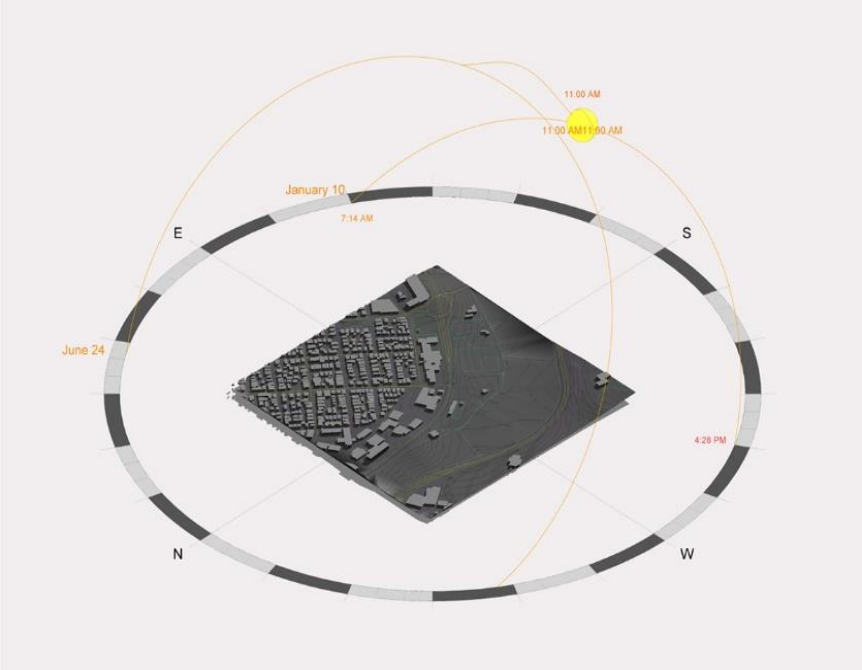


Figure 48.July to December (Image credit by author)

6.3. Site analysis

The site plan is located in Cambridge, Massachusetts. There are 10 hospitals or clinics around site plan (Figure 44).

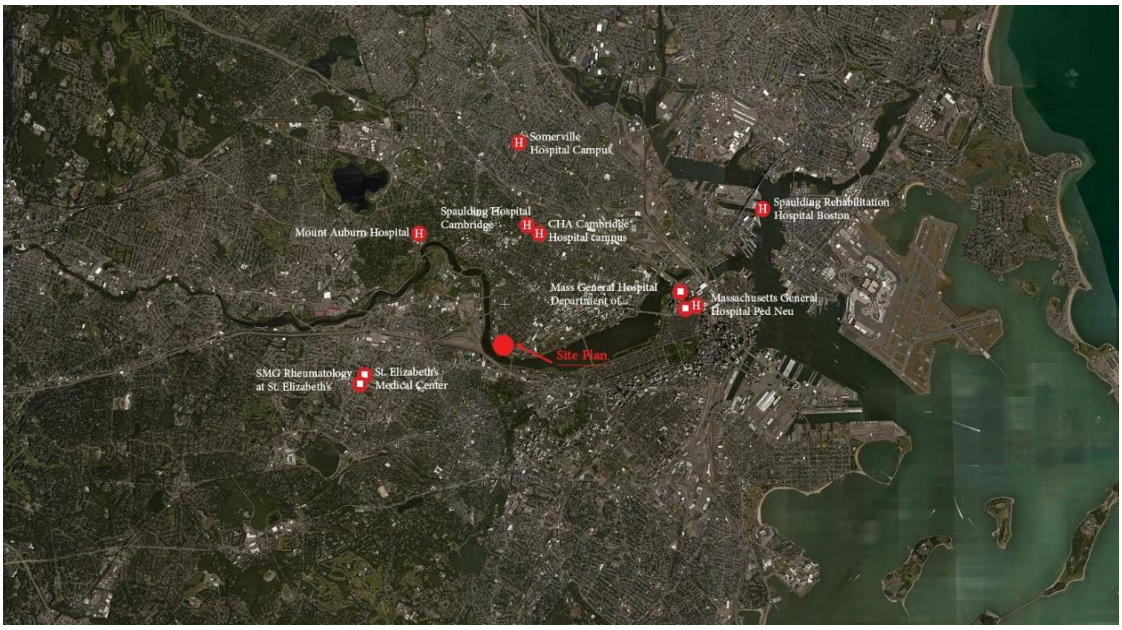


Figure 49.Hospital's position around site (Image credit by Google)

There are 10 schools, Colleges or Institutes around site plan (Figure 45).

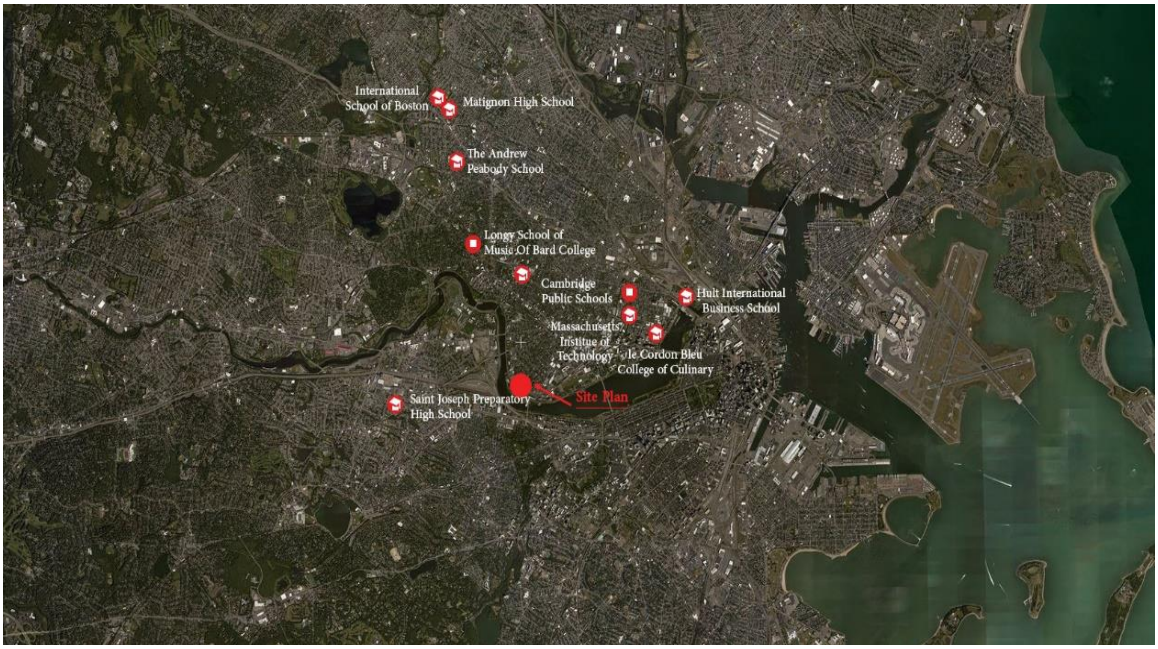


Figure 50.School's position around site (Image credit by Google)

Figure 51. Site Analysis (Image credit by author)

The above images are the initial site analysis that shows the site boundaries, wind arrows from the river and noise pollution from the high traffic street beside the site.

6.3.1. Wind Analysis

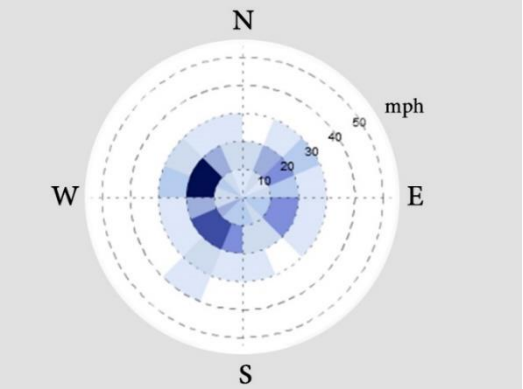


Figure 52. Spring (MAR, APR, MAY) (Image credit by author)

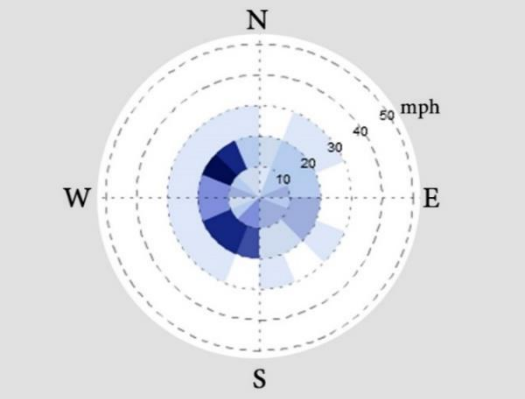


Figure 53. Summer (JUN, JUL, AUG) (Image credit by author)

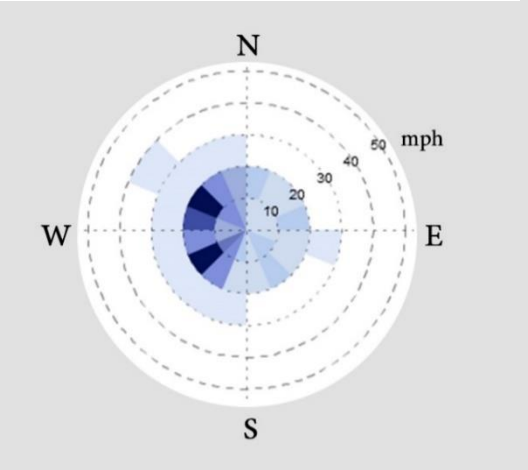


Figure 54 . Autumn (SEP, OCT, NOV) (Image credit by author)

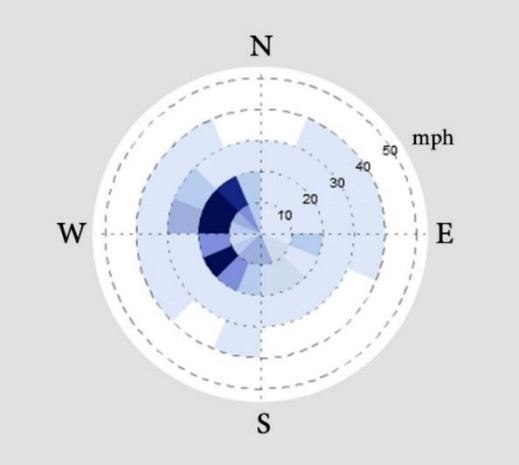


Figure 55. winter (DEC, JAN, FEB) (Image credit by author)

6.3.2. Views

Figure 56. View from the Street (Image credit by author)

Figure 57. View from the Street (Image credit by author)

Figure 58. View from the Street (Image credit by author)

Figure59. View from the Street (Image credit by author)

Figure 60. View from the Street (Image credit by author)

The site is easily accessible through four major traffic routes. The situation provides fantastic views to the Charles River and lets light for inside. The other pros and cons of the site are mentioned by arrows in the following image. Since this thesis seeks to create a healing environment for the 2-3 months long hospitalization period of cancer, the hotel near the site provides a good opportunity for the Patient's family.

Figure 61. Site Analysis (Image credit by author)

Figure 62. City Elevation (Image credit by author)

CHAPTER 7

DESIGN

7.1. Design process

There are 3 main compact volume in the following image. These 3 main cores (Emergency zone, Clinic zone and Patient's unit zone), they are all connected by a floor to create a bond between zones. The following image shows the initial explorations of the possible building layouts to maximize the south-west light, to provide private and public entrance for different functions and to do a smart division between these main cores Emergency zone, Clinic zone and Patient's unit zone.

The author's main concept for this thesis includes:

- Create a child-centered and family-centered
- Interactive experience to engage children
- Place of peace and care centered
- Very welcoming, warm and familiar environment
- Easy way finding by using lights, colors, nature themes and putting help desk close to each vertical access
- Promote communication between patients and their family and medical staff
- Joyful diversions and positive directions
- Take advantage of Tech

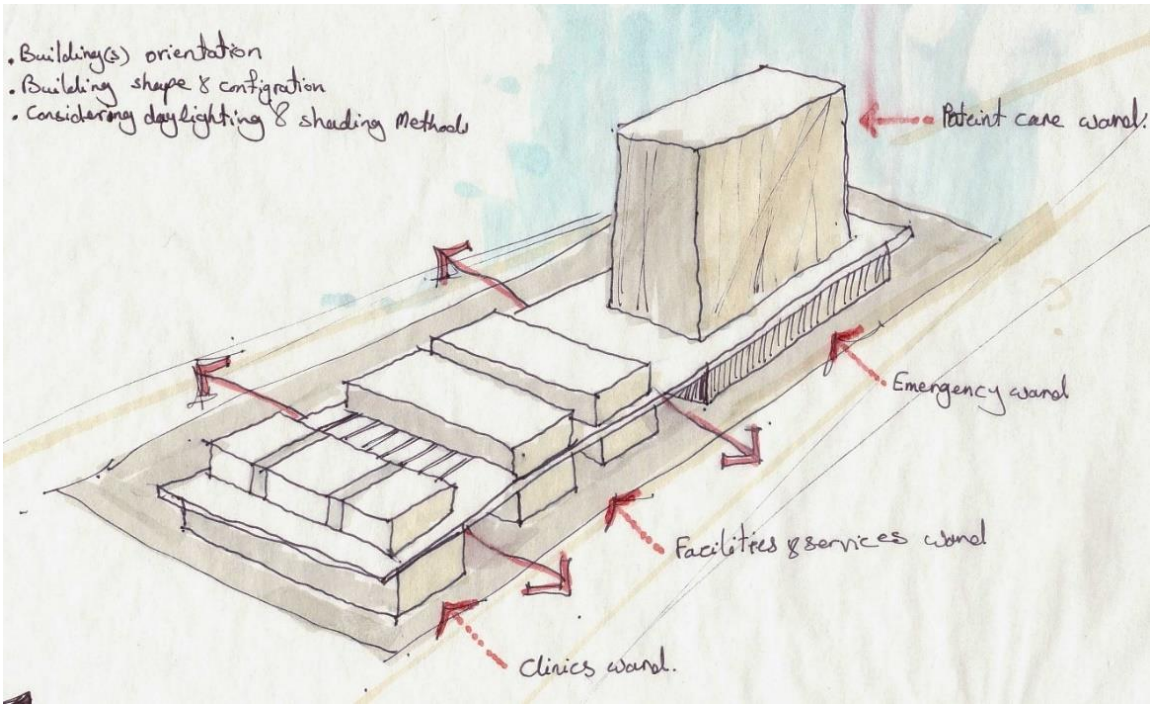


Figure 63. The initial sketch (Image credit by author)

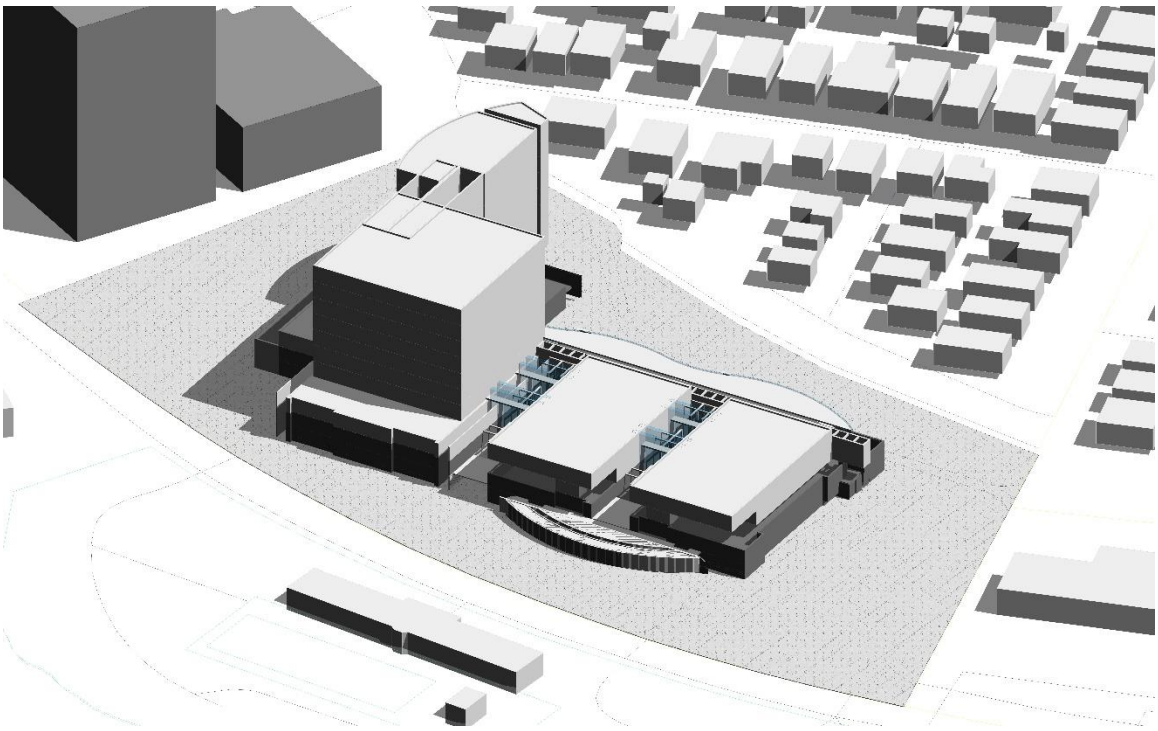


Figure 64. exploration for orientation of the building (Image credit by author)

There are 6 courtyards in this building that makes different parts of the building in the upper levels would connect each other by bridges. The following image indicates that the building itself is comprised of the programmatic components.

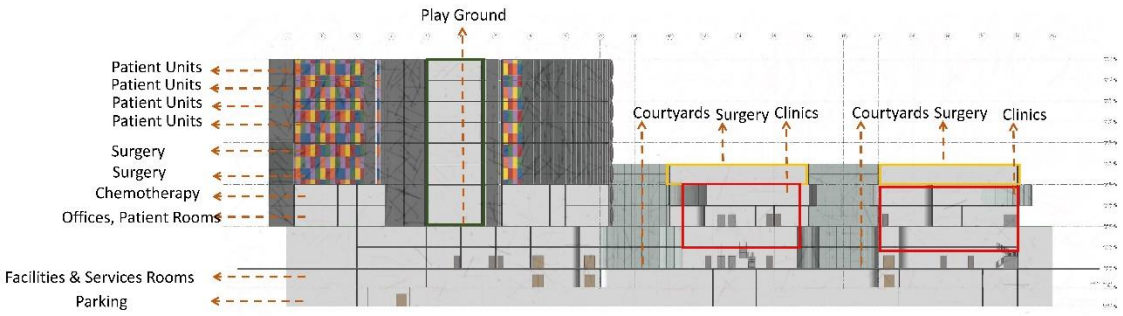


Figure 65. Building follows its program (Image credit by author)

7.2. Site design

The site situation making the emergency & ambulance entry accessible at the ground the level at the back of the site, and the hospital's primary entrance, lobby and Other public areas accessible at the front of the site.

Figure 66. Proposal site design plan (Image credit by author)

7.3. Floor plans

Ground Floor Plan

Figure 67. Ground Floor Level (Image credit by author)

First Floor Plan

Figure 68. First Floor Level (Image credit by author)

Second Floor Plan

Figure 69.Second Floor Level (Image credit by author)

Third Floor Plan

Figure 70. Third Floor Level (Image credit by author)

Fourth Floor Plan

Figure 71. Fourth Floor Level (Image credit by author)

7.4. Sections

By using color coding, understanding of vertical and horizontal connections would be much more understandable.

Section A

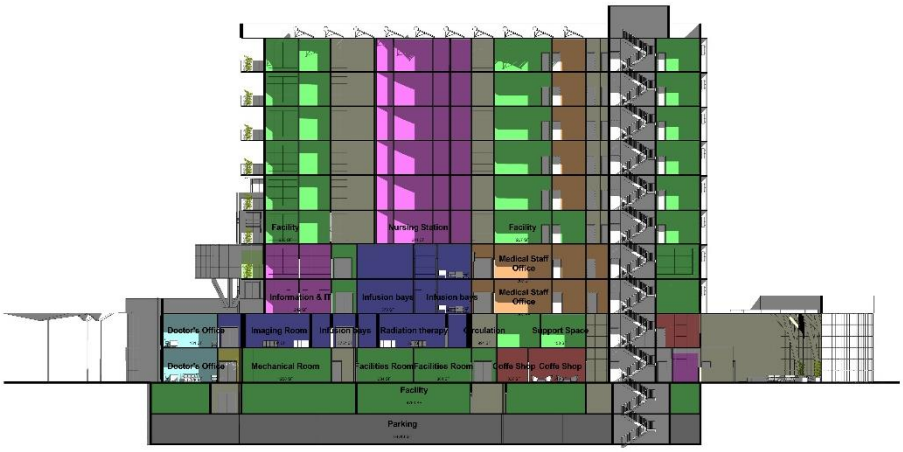


Figure 72. Section A (Image credit by author)

Section B

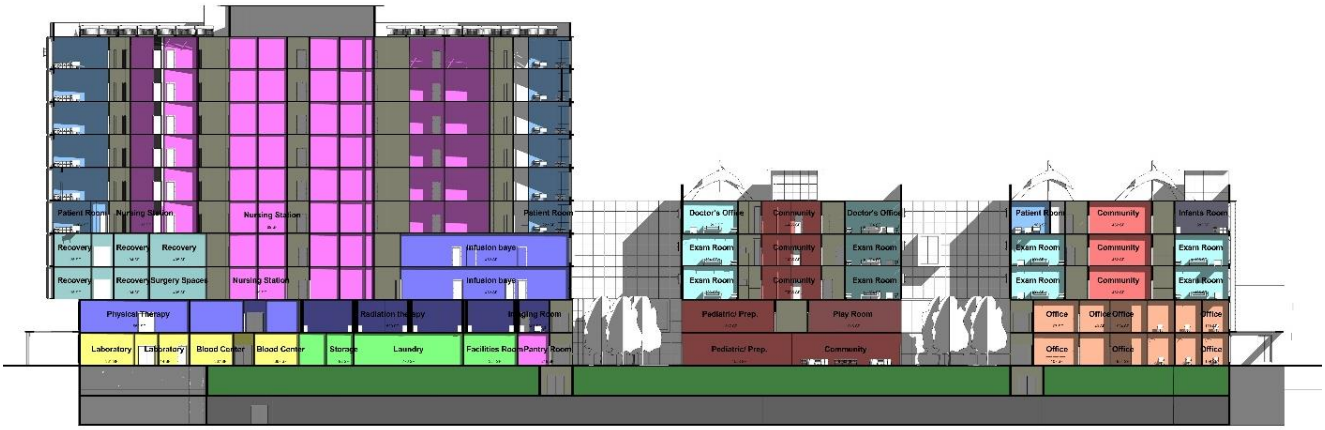


Figure 73. Section B (Image credit by author)

7.5. Elevations

Northeast Elevation

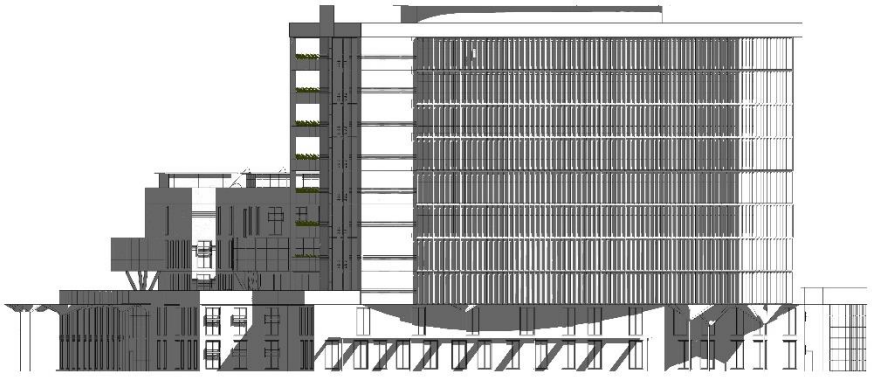


Figure 74. Northeast Elevation (Image credit by author)

Northwest Elevation

Figure 75. Northwest Elevation (Image credit by author)

Southeast Elevation

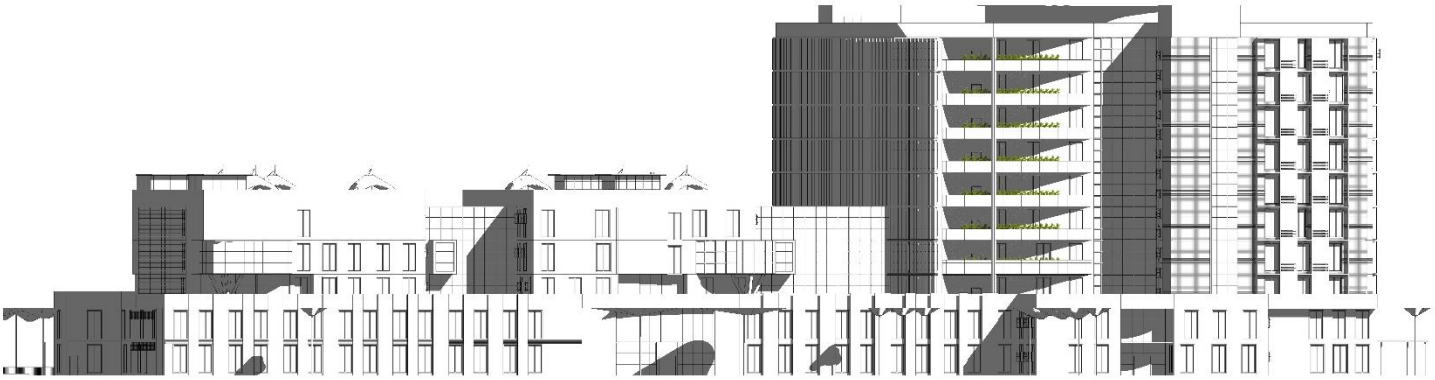


Figure 76. Southeast Elevation (Image credit by author)

Southwest Elevation

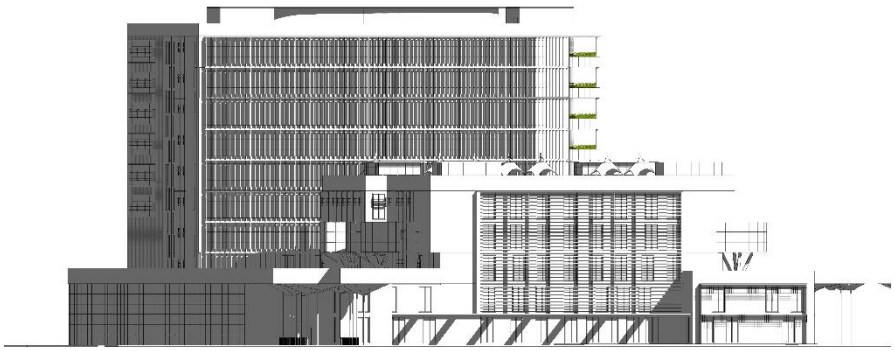


Figure 77. Southwest Elevation (Image credit by author)

7.6. 3D views

Figure 78. Revit model, Human's eye view (Image credit by author)

Figure 79. Revit model, bird's eye view (Image credit by author)

Figure 80. Revit Model, bird's eye view (Image credit by author)

Figure 81. Revit Model, Human's eye View(Image credit by author)

7.7. Interior design ideas

7.7.1. Main Lobby

A large open space with a forest theme. The wood columns are remind of trees. There are skylight on the roof to bring light inside of lobby. There is a main nursing station in the middle to orient the patients and their family. The author seeks to bring a felling of nature to the building by designing 6 courtyards, nature-related themes and by providing views to outside through the exterior glass wall. The following diagram indicates the circulation.

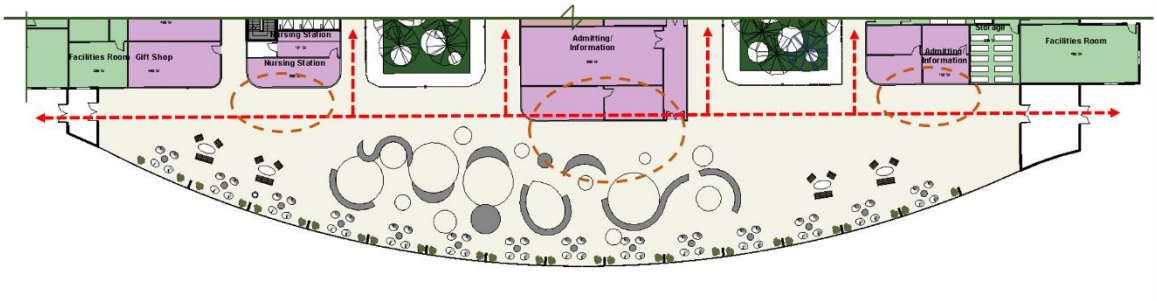


Figure 82. Enlarged Lobby's Plan (Image credit by author)

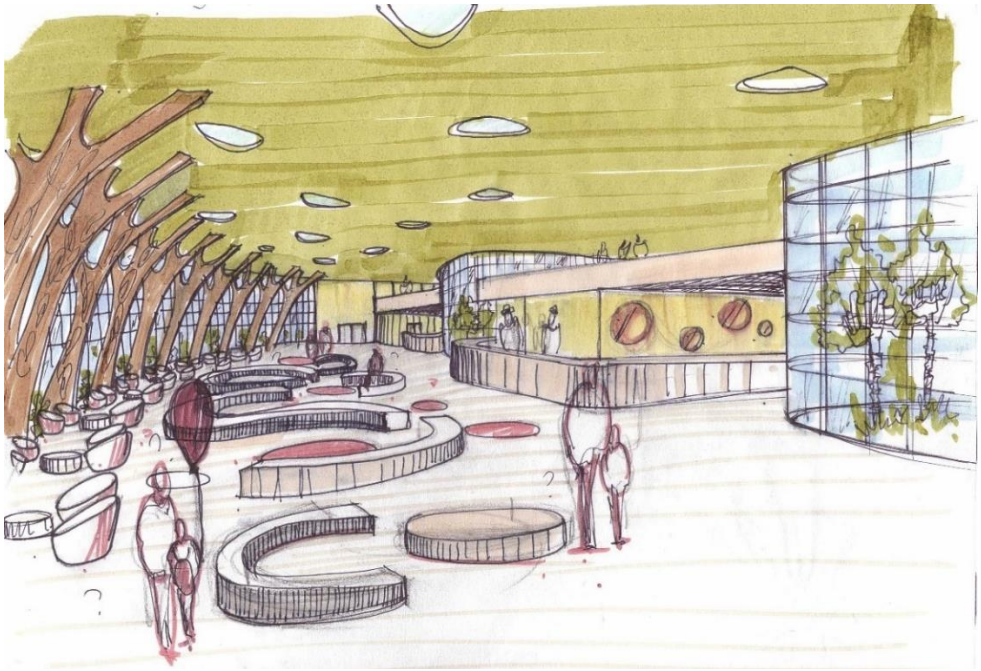


Figure 83. Proposal Lobby (Image credit by author)

7.7.2. Exam Room

The author tried to simplify the work zone by locating sink near the door, relocating of seating and doctor table. The idea behind the interior design is to provide a smooth and warm environment to agitate the children's stress. The center of the room is kept open to allow a 60-in. wheelchair turning area and the transfer of the patient to the exam table. The distance from the door to the corner of the room is needed for patient egress.[29] The following enlarged exam room's plan shows the division between different zones in one room and how they are working together.

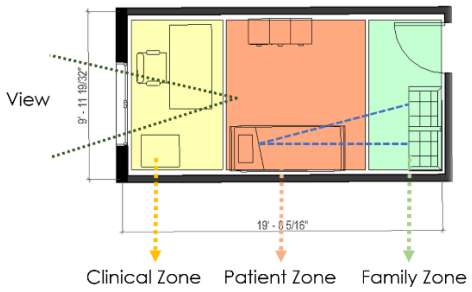


Figure 84. Enlarged exam room's plan (Image credit by author)

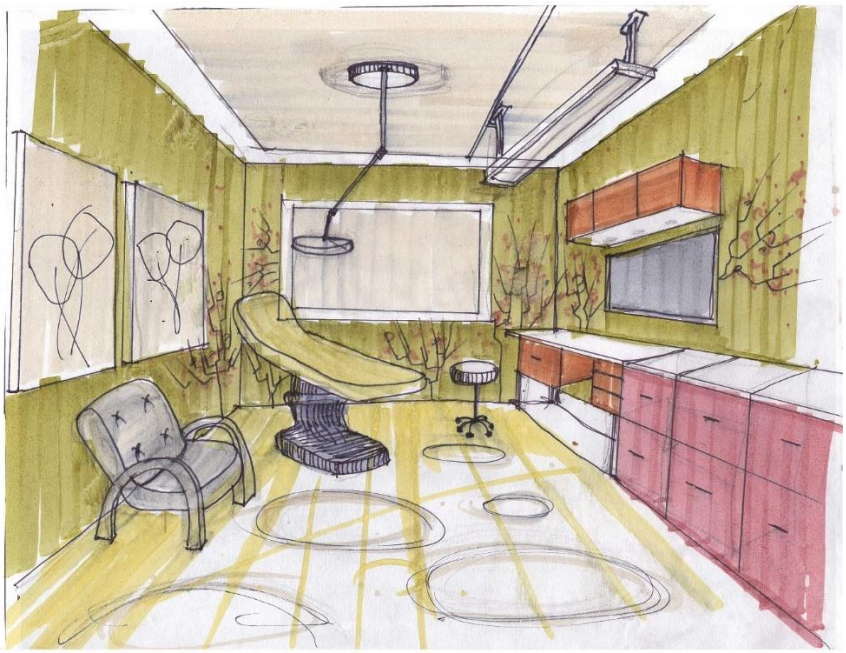


Figure 85. Proposal Exam room (Image credit by author)

[29] Midmark, an Effective Exam Room Design

7.7.3. Patient's Room

The author paid special attention to incorporating features to help the small patient feel better in her room, as we know the patient who has cancer might be hospitalized for 2 or 3 months. Same as exam room, the author tried to divide the patient's room to 3 zones such as care zone, family zone and clinical zone.

Care Zone: The care zone allows medical staff space and access to the patient. Family Zone: The care zone gives family and friends a comfortable area to visit with patients and it makes to promote the families participation.

View: The placement of windows by colorful louvers were designed specifically to be as energy efficient and joyful light reflection.

Clinical Zone: Therefore minimizing patient disturbances. By putting this zone close to the door, the author tries to minimize the patient disturbance and also help the patient in the emergency moment as soon as possible.

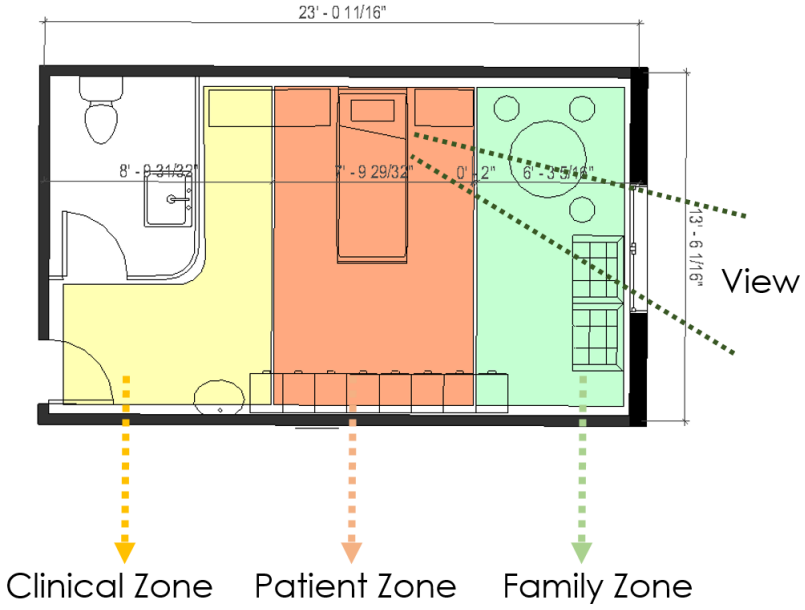


Figure 86. Enlarged Patient's Room Plan (Image credit by author)

Figure 87. Proposal Patient ‘room (Image credit by author)

7.7.4. Infusion Bay Room

The infusion's layout should allow for private, semiprivate or open bays. The infusion bays should be equipped with ample electrical outlets at shoulder height, storage, a guest chair and a TV for providing positive distractions. Hand-washing sinks and antibacterial gel stations should be added close to each bay to help prevent infections.

Figure 88. Proposal Infusion bay's Room (Image credit by author)

7.8. Sustainability design approach

Figure 89. Sustainability Design Approach (Image credit by author)

Sustainability, ties with the goal of this thesis. Thus, the author tried to define the design framework based on some important sustainable guidelines. These important sustainable features are shown on in Figure 84.

Actually, the author also conducted comparative analysis of shading devices for North and south elevations.

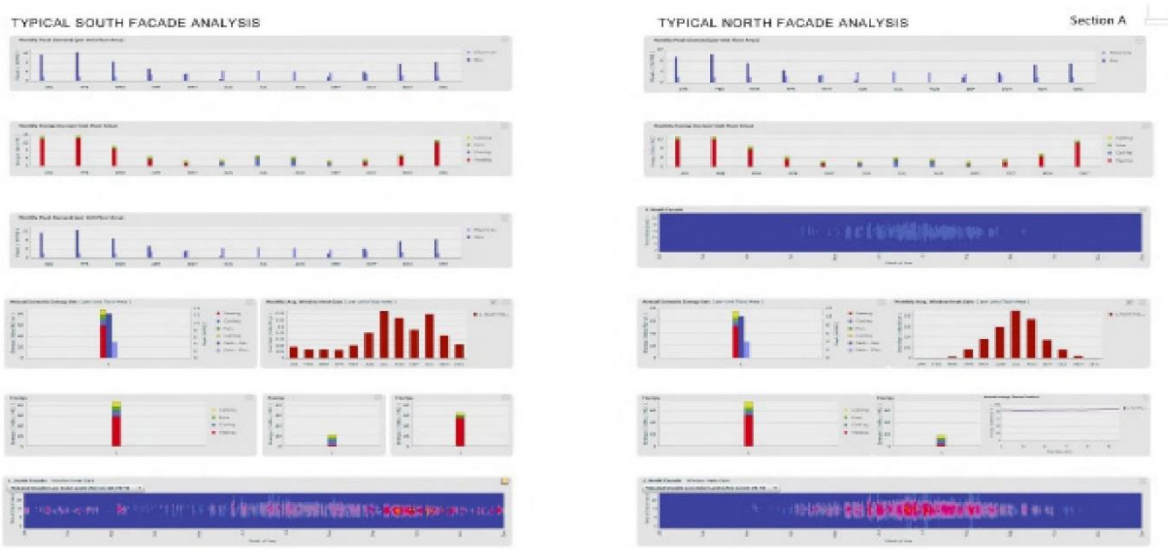


Figure 90. VELUX Daylight Visualizer Data (Image credit by author)

Figure 91. Comfen data for North & South Facades (Image credit by author)

After comparing the result, the writer came up with using the vertical shading devices for the south elevation. For a predominately south facing façade, a small amount of solar shading can be achieved using a fixed horizontal brise soleil. So, in the mornings and winter such a device cannot stop direct rays of the sun penetrating the building since the sun is much lower. However the heat gain and solar glare is greatly reduced in winter.[30]

The following images show the author's strategy for the south façade.

Figure 92. Part of South Facade of Proposed building (Image credit by author)

[30] Colt group America

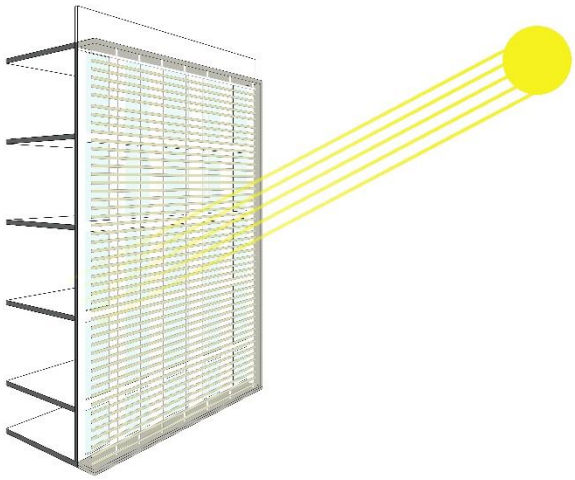


Figure 93. Author's strategy for the South Façade (Image credit by author)

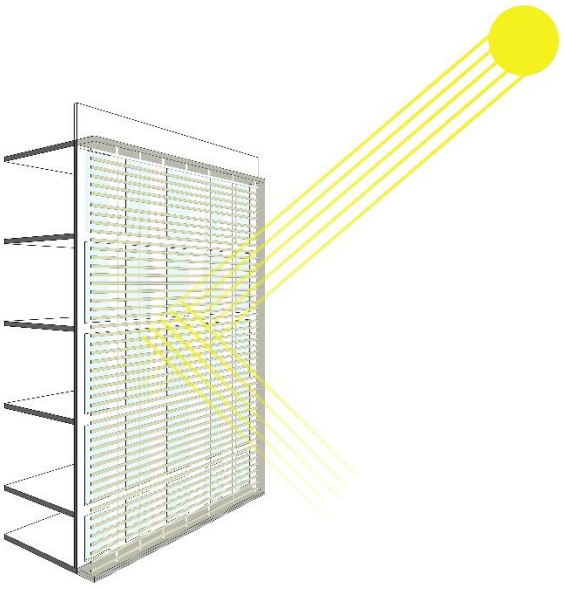
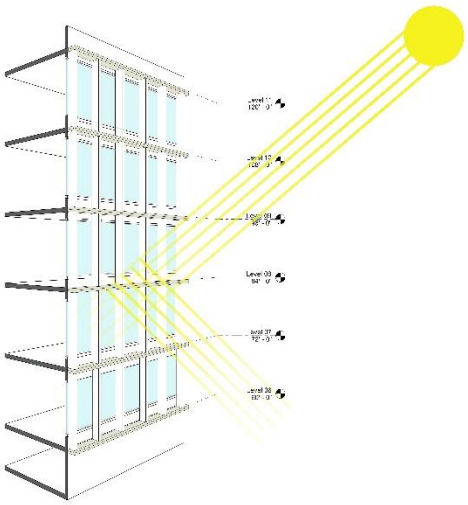


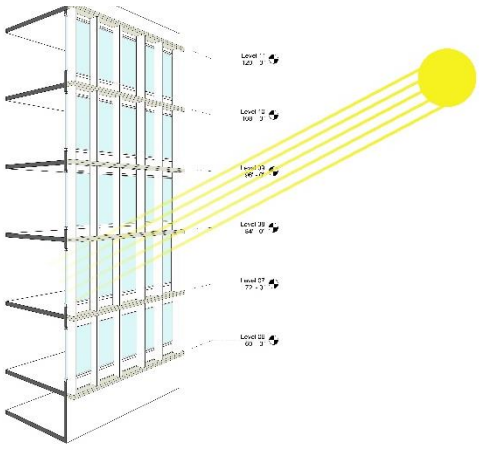
Figure 94.Author's strategy for the South Façade (Image credit by author)

The following images show the author's strategy for the Northwest and Northeast façades. In total, the whole vertical fins are distributed across eight levels, with a combined height of almost 108 ft. The Fins create an interesting visual buffer and provide a welcome distraction to the large and otherwise rather bland structure that lies beyond. The color and angle of the fins create an interesting, dynamic aesthetic that changes as you pass along the façade.



section 02 SUMMER

Figure 95.Author's strategy for the Northwest & North East Facades(Image credit by author)



section 02 WINTER

Figure 96. Author's strategy for the Northwest & NorthEast Facades(Image credit by author)

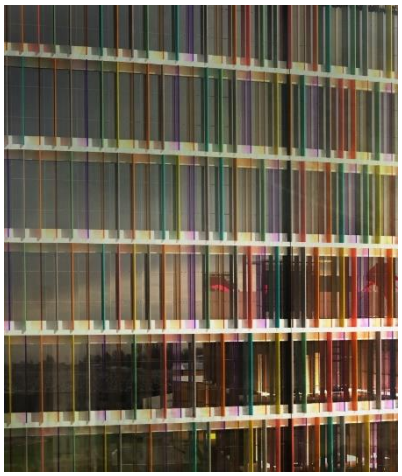


Figure 97. Part of North-West Facade of Proposal Building (Image credit by author)

The author also conducted another daylighting analysis with In format 360 plugin in Revit. The following image shows how much the interior spaces have daylighting during summer season.

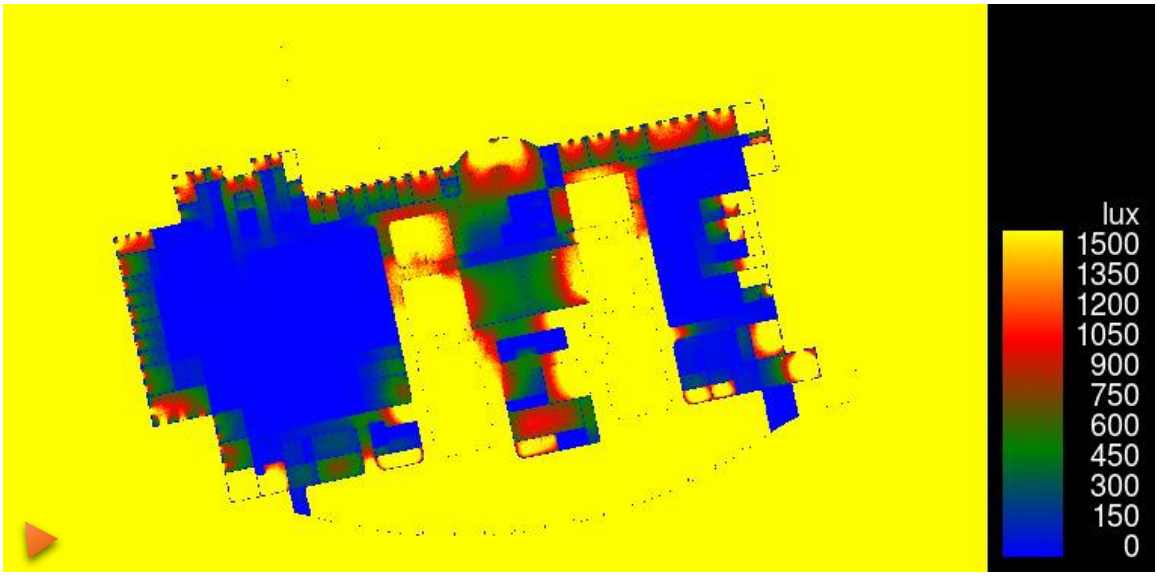


Figure 98. Daylighting Analysis (Image credit by author)

7.9. Conclusion

For improving the patient experience a healthcare facility designer should carefully consider the human factor in patient care and family satisfaction, understanding the roll of humanity in healing. As a final conclusion, I found the architecture is medicine.

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