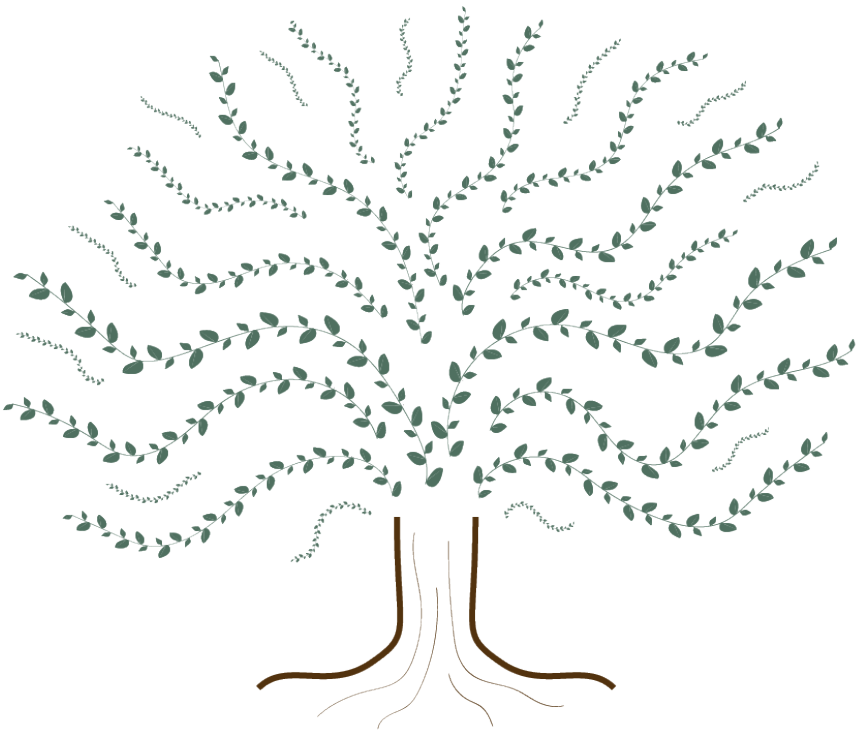


DESIGNING: LUNG CANCER RESEARCH AND TREATMENT CENTER

A Design Thesis Submitted to the Department of Architecture
North Dakota State University

By
Jessica Grones

In Partial Fulfillment of the Requirements for the Degree of
Master of Architecture

Cindy Urness AIA NCARB
Primary Thesis Advisor

Stephen Wischer
Thesis Committee Chair

September 2022
Fargo, North Dakota

THESIS PROPOSAL

THESIS RESEARCH

DESIGN SOLUTION

THESIS PROPOSAL

Emotional well-being is important for everyone. It can be hard to encompass a healthy mentality when cancer is a prevalent factor in your life. People affected by cancer spend a lot of time in a hospital, a place that is usually harsh and cold. Hospitals are designed to help you heal physically, but it is becoming increasingly known that mental health is just as important as physical health. Hospitals should be designed with emotional wellbeing in mind. Researching the affects cancer has on people emotionally will provide insight on how to design a hospital that will promote emotional well-being and enhance the lives of those who spend the majority of their time there.

THESIS ABSTRACT

Figure 01: Tree

Figure 02: Mushrooms

THESIS NARRATIVE

Imagine hearing the words, “You have cancer”. How would you respond? Being diagnosed with cancer is scary and often, traumatizing. In a world where people are starting to open up about mental health and emotional wellbeing, there is an understated importance of the trauma cancer patients go through. Not only do they have to undergo chemotherapy, surgery, and constant hospital visits, they have to be able to mentally prepare and handle this newfound life of theirs. The emotional impact cancer has on everyone involved is a topic that should be talked about more.

Cancer patients, their family support, and caregivers all undergo challenging circumstances when cancer comes knocking at the door. It is a vigorous and draining roller coaster to fight for your life every day. So, while cancer is being fought, who is there to help combat depression? 15-25% of people diagnosed with cancer, also suffer from depression. Studies have shown that a person’s mental health and social wellbeing can affect the success of treatment. Leaving room to wonder how mental health is being supported. One factor to help combat depression is family support.

However, family members aren’t resilient to the mental affects cancer has on them. The may not have to physically fight cancer, but they too, must mentally prepare for the burden placed on them. Family members are commonly associated with feelings of helplessness and fear. So, how do family members cope with this newfound stress? Do they rely on doctors to help?

Medical oncologists also suffer from depression. They are trained to hold themselves with excellence, remaining strong and resilient, while their patients’ lives depend on them. Doctors are less likely to seek mental health care than anyone else. They are trained to not show weakness and depression is viewed as a weakness. Cancer affects everyone involved in the process of treatment. So, what aspects of design can be implemented to improve survival rates and the emotional wellbeing of those affected by cancer?

With the main motive focused on the mentality of those affected by lung cancer, the typology will be a hospital with a research and treatment center for lung cancer patients. The hospital will encompass healing architecture to influence the users in a way that will provide comfort.

Figure 03: Water Droplets

CASE STUDIES:

The University of Virginia, University Hospital Expansion / Perkins and Will

Ann & Robert H. Lurie Children's Hospital of Chicago / ZGF Architects + Solomon Cordwell Buenz + Anderson Mikos Architects

The University of Pennsylvania Hospital / Foster + Partners

UNIVERSITY OF VIRGINIA HOSPITAL

Architects: Perkins and Will
Area: 440000 ft^2
Year: 2020
Photographs: Todd Mason Photographer
MEP Engineers: BR+A Consulting Engineers Inc., Valley Engineering
Structural Engineering: Walter P. Moore & Associates
Landscape: Rhodeside and Harwell

Figure 04: Emergency Exterior


Figure 05: Lobby


Figure 06: Wood Ceiling

Patients and staff are offered an enhanced and dignified experience at the University of Virginia Health System's emergency department, Including the in-patient bed tower. The heart of the design approach is positive patient, family and staff experiences. The expansion provides many benefits to the hospital.

* Connects patients and staff to the calming effects of nature
* Reduces environmental impact
* Allows for greater flexibility in use of space
* Accommodates evolving medical technology and best practices

To enter the new emergency department and bed tower, patients and family have to walk through a landscaped, semicircular welcome area. The space curves outwards as if walking into open, outstretched arms. Inside there is a 28 foot tall atrium with windows towering over you, allowing natural light to flood the space.

A celestial feel is created by using 12 foot in diameter circular sky lights and a constellation of recessed ceiling lights - "as though one is looking up at a starry sky".

A feeling of brightness and warmth is created by using a light colored wood ceiling that contrasts with white floors and ceilings.

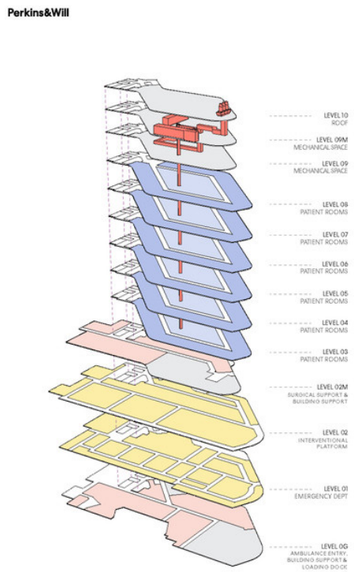


Figure 07: Spatial Program

The building employs net-zero water design strategies, including a 50,000-gallon cistern under the ambulance bay that captures gray water for use in heating and cooling, and several green roofs that mitigate water runoff.

The lower level is where ambulance bays are located. Patients arriving by ambulance can be readily transported to the care area by an elevator that is dedicated for them.

Designed to meet high environmental performance standards

Figure 08: Emergency Exterior

Figure 09: Ambulance Bay

Figure 10: Lunch

Figure 11: Lobby

Figure 12: Circular Hallway

Daylight and views to the outdoors are provided for break rooms, eat-in kitchens, and other “back of house” areas.

For most hospitals, operating suites are located at the buildings core. However, in this design, the operating rooms have an adjoining glass corridor with views to the outdoors. This serves the surgical teams, who spend countless hours in an enclosed space performing surgey, respite between operations.

12 secure behavioral health rooms provide a safe, calming environment for patients in acute mental health distress. A dedicated pediatric check-in and waiting room welcomes the patients with bright yellow couches, child-sized seating, a playfully shaped ceiling light, views to the light-filled atrium, and an interactive wall for children to play with.

The bed tower was designed with curved walls to maximize patient privacy. The curved walls block direct views into the rooms of patients in the existing adjacent hospital. The curves improve sight lines between medical staff and patient rooms as well.

ANN & ROBERT H. LURIE CHILDREN'S HOSPITAL

Architects: Anderson Mikos Architects, Solomon Cordwell Buenz, ZGF Architects
Area: 116128 m^2
Year: 2012
Photographs: Nick Merrick © Hedrich Blessing
Structural Engineer: Magnusson Klemencic Associates
MEP: Affiliated Engineers
Landscape: Carol Yetken Landscape Architect
Interior Design: ZGF Architects

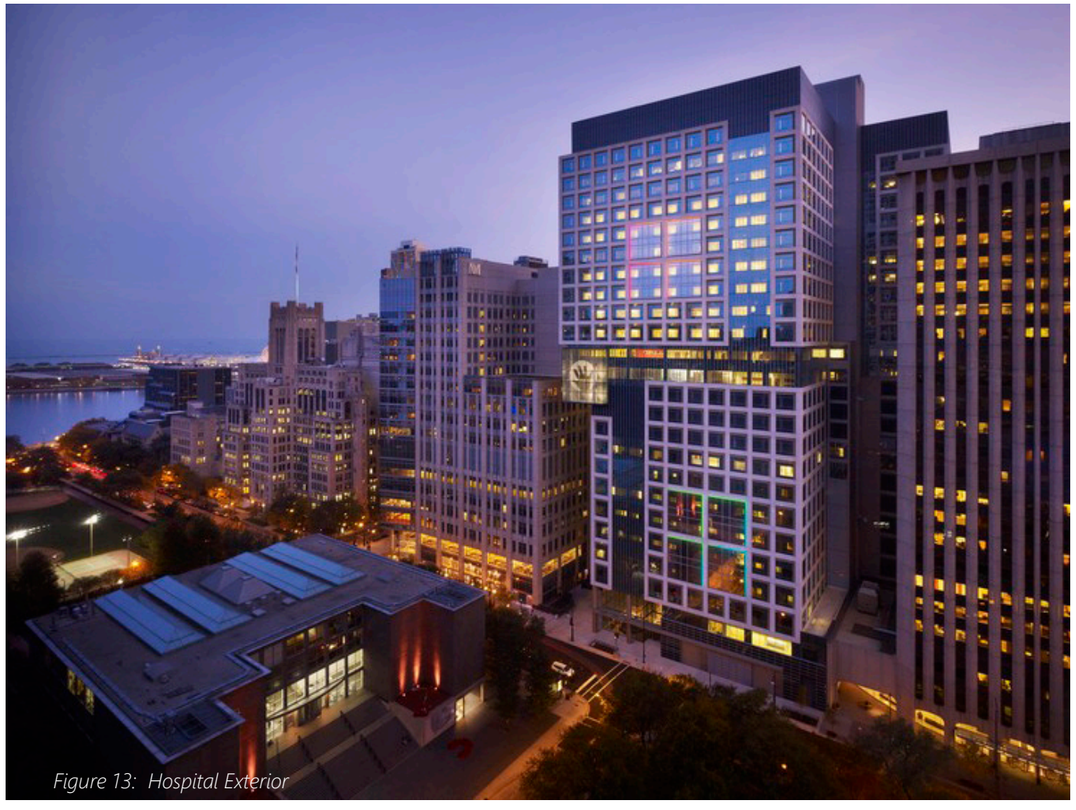


Figure 13: Hospital Exterior

SCB teamed with Zimmer Gunsul Frasca Architects, LLP and Anderson Mikos Architects, Ltd to design the new hospital. It is situated at a prominent urban location in Chicago overlooking Seneca Park and adjacent to the Museum of Contemporary Art and the historic Water Tower.

A pedestrian bridge to the central parking facility, two bridges to the adjacent Prentice Women's Hospital, a sky garden, and sky lobby and overlook are special features included in SCB's exterior scope of work. Interior features included are a freestanding oval elevator bank, a tree house, entertainment stage, healing garden, garden market themed food court, illuminated information desks, aquarium, Captain Streeter coffee bar, and a suspended whale exhibit.

A whimsical experience is created by incorporating playful touches like life sized whale sculptures and colorful murals. The entrance lobby is animated to ease the tense environment for parents and children.

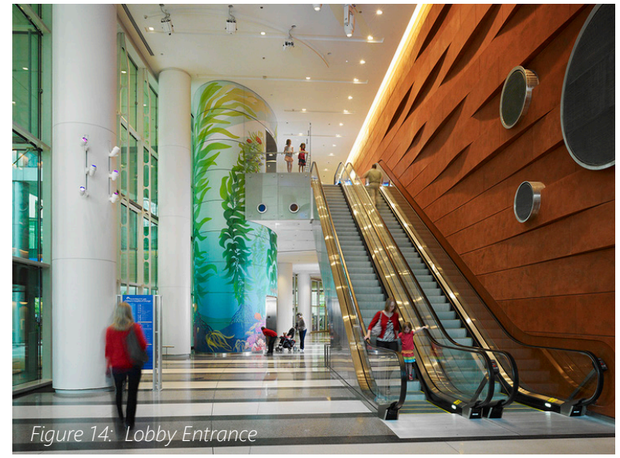


Figure 14: Lobby Entrance

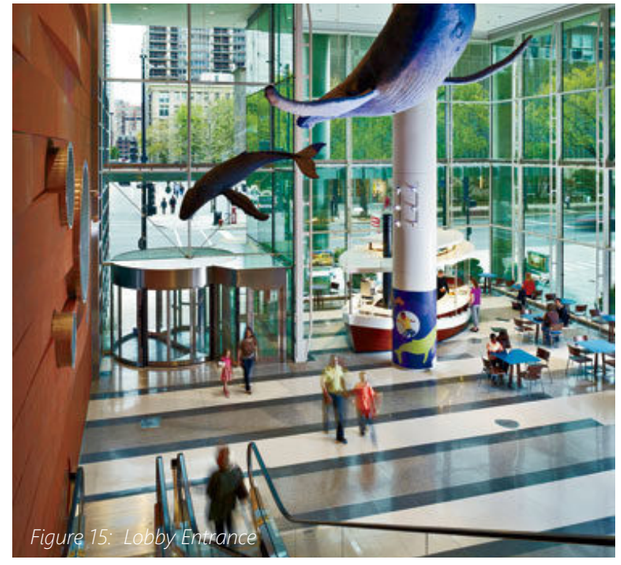


Figure 15: Lobby Entrance

Figure 16: Waiting Area

Figure 17: Hallway

Diffused lighting is used to direct visitors and orient them.

Figure 18: Patient Room

Lighthearted diversions are incorporated in patient rooms by using pops of color and having themed installations.

Figure 19: Sky Garden

The 11th floor has a sky garden, providing kids and their family a place for relaxation and recreation.

ORGANIZATION

Representation of the Building Stack.

VERTICAL TRANSPORT

Vertical Transportation Throughout the Building.

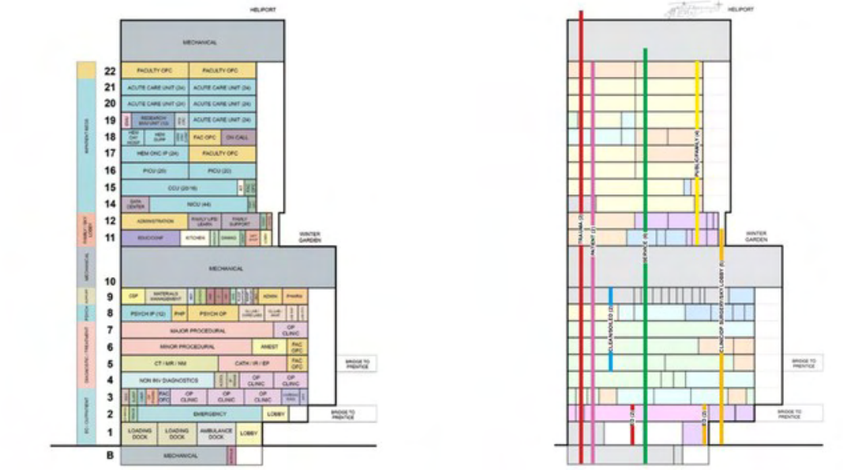


Figure 20: Spatial Program

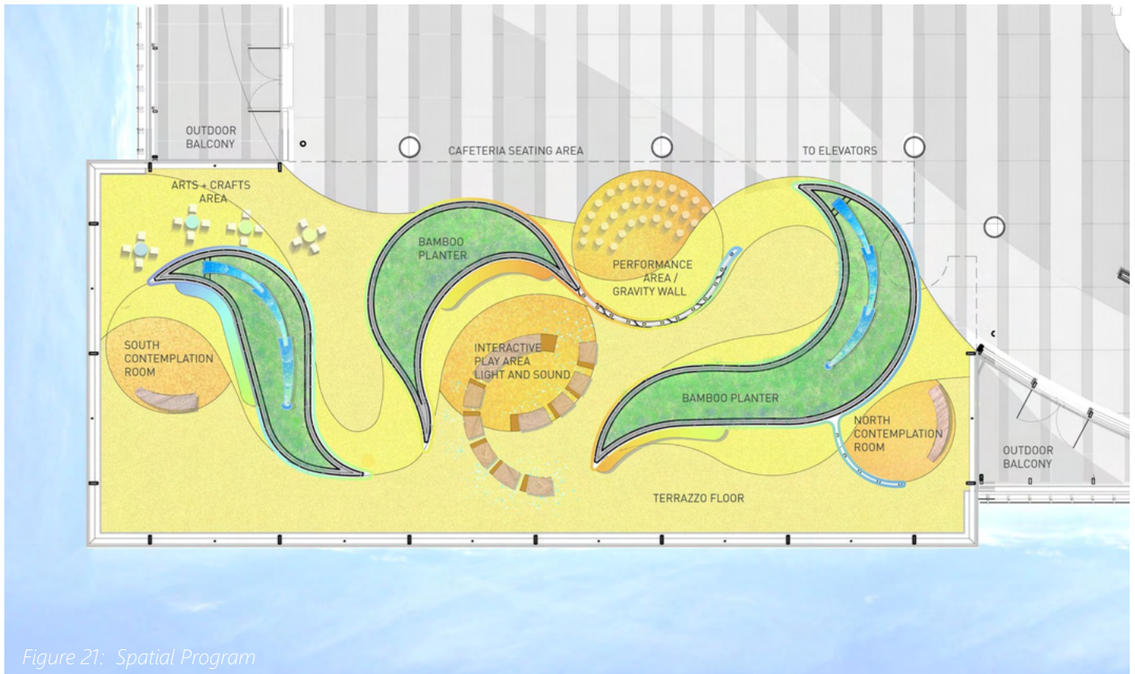


Figure 21: Spatial Program

UNIVERSITY OF PENNSYLVANIA HOSPITAL

Architect: PennFIRST (Foster + Partners, HDR, BR+A, LF Driscoll, Balfour Beatty and Penn Medicine)
Collaborating architect: HDR
Main contractor: LF Driscoll/Balfour Beatty
Mechanical engineers: BR+A
Landscape consultant: Ground Reconsidered / Olin
Lighting engineers: Claude Engle Lighting

Figure 22: Hospital Exterior

"Designed to completely redefine the future of healthcare" - Foster+Partners


Figure 23: Tree Sculpture

The Penn Museum was used as a reference point for the pavilion. It has a long and linear form that tapers and curves at the end.

The exterior facade is organized in horizontal rows of copper-hued aluminum and glass bands. This mimics the surrounding buildings brick work based on color.

With the "human experience in mind", the interior of 16 floors was designed. The ground floor is filled with artwork, including a tree-like sculpture by Maya Lin and a colorful mural by Odili Donald Odita. The lower levels contain large open arrival spaces across the floors.

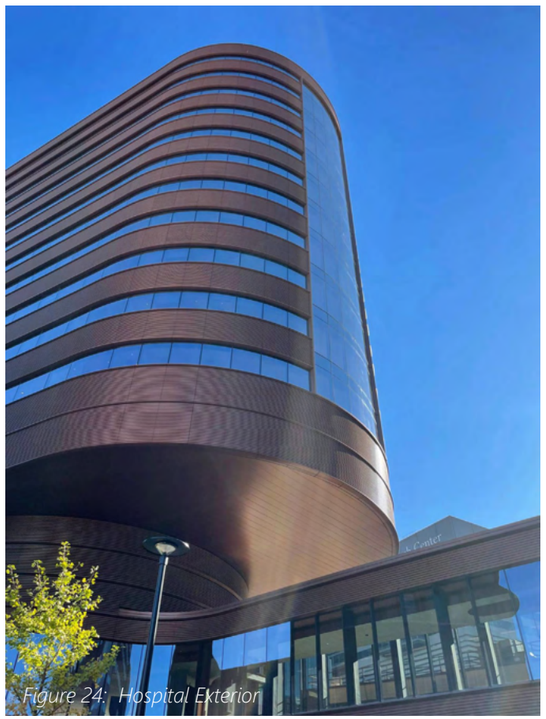


Figure 24: Hospital Exterior

Figure 25: Hospital Exterior

"Working collaboratively, we developed innovative ways to research and completely rethink patient care with the wellbeing of staff and patients along with long term flexibility at the heart of our approach." - Foster+Partners

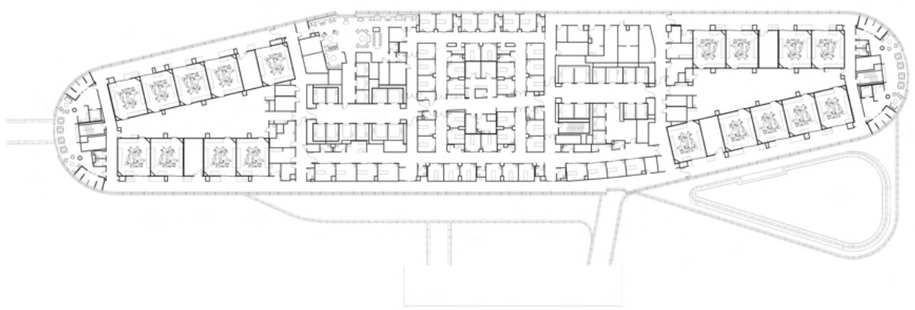


Figure 26: Floor Plan

Figure 27: Floor Plan

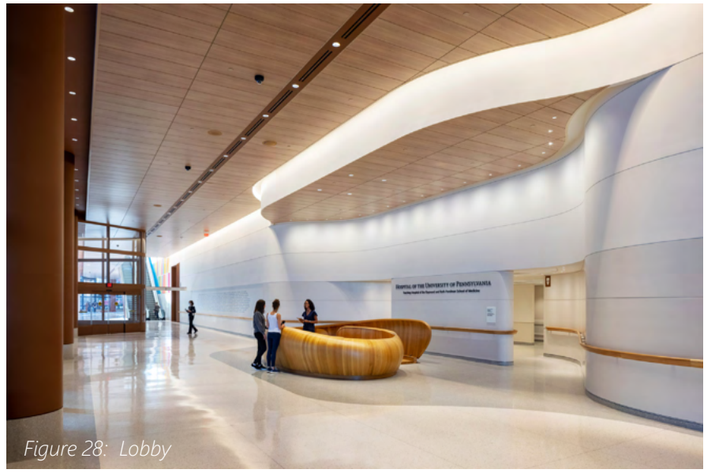


Figure 28: Lobby

Figure 29: Patient Room

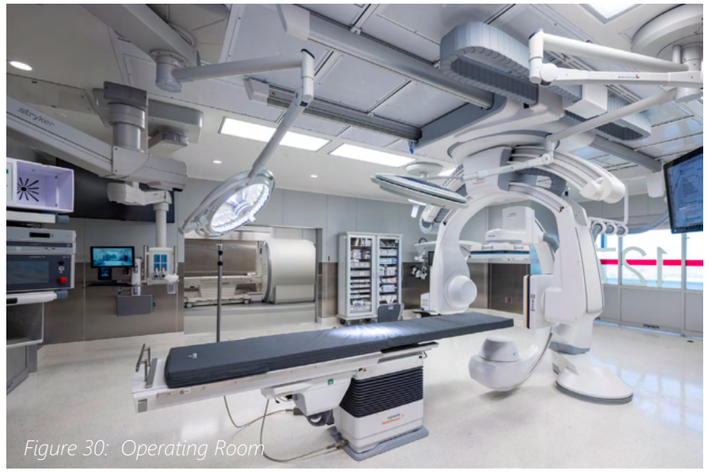


Figure 30: Operating Room

A wayfinding system is created for visitors and staff by using indirect lighting and illuminating spaces with diffused light throughout the interior.

Flexible and adaptable layouts were applied to the care floors and rooms, following the major expectations hospitals faced during the peak of the corona-virus pandemic.

The care floors have a flexible planning system allowing a typical 72-bed floor to be transitioned into smaller care units.

The inpatient rooms, a total of 504, have a user-centric design. They can be similarly reorganized to maximize patient comfort. Hosting a variety of different functions, including surgeries and intensive care and also offer space for visitors to sleep.

Staff wellbeing was also prioritized. Private areas containing sweeping views out to the surroundings, flexible furnishings, and also day-lit surgery suites provide ease and relaxation for staff.

Figure 31: Plant

Cancer is one of the top leading causes of death. On average, 600,000 people die of cancer every year. One of the most common leading causes of cancer death is lung cancer, making up almost 25% of all cancer deaths. The statistics alone don't account for those who don't have the means to seek treatment. Therefore, it is assumed this number is even more. The number of people affected by cancer can multiply by ten or more when family members and caregivers are taken into consideration. The psychological impact cancer has on people is overwhelming at the least. It is well above justifying the need to reduce the psychological impact on people affected by cancer.

Architecture can impact people's lives through well thought out design. Integrating calming and comforting design solutions to a research and treatment center will provide patients and caregivers a positive outlook for their emotional wellbeing. It is also possible to create spaces that integrate with one another to ease the transition from doctor to patient to family. This can greatly reduce the cause of depression and increase mental health, giving people a step up when they are dealing with one of the most devastating occurrences in their life.

Figure 32: Flower

PROJECT EMPHASIS

The focus of the project is implementing design solutions to improve emotional wellbeing. There are a few major points to include in the design process. The important factors to analyze are as follows:

Site Context

It is important to choose a location that is in close proximity to a large population while also providing a quiet place to reduce stress and anxiety from city distractions.

Spatial Programming: Internal Wayfinding

Strategically programming the spaces in the building will play an important role in the overall design. It is important to research and study the best way to place the major project elements in the building including but not limited to the research center, surgery center, therapy center, inpatient and outpatient rooms, consultation rooms, and the visitor center.

Design Aesthetic

Aesthetic plays an important role in the development of the design. It should provide a sense of comfort and happiness. Aesthetic is also a part of internal wayfinding. Visitors should be able to find their way through the hospital without relying on excessive signage. Instead, architecture and interior elements can provide direction with bold colors and distinctive changes in appearance.

Surgery Center
Every hospital has operating rooms for conducting surgery. This building will have a designated wing for a surgery center that will be in close proximity to the intensive care unit.

ICU/ Inpatient Rooms
With a surgery center, there needs to be inpatient rooms for recovery. There will be an intensive care unit which is for patients that are extremely unwell and require critical care. Inpatient rooms will be provided for patients that need to stay for medical attention on a daily basis.

Research Center
The researchers, doctors, and other staff will need offices to work in and labs to conduct their studies. The research center will be located farther away from the surgery and inpatient rooms since patients and visitors won't need to utilize this space.

Therapy Center
A therapy center will be included in the building to provide mental care for the patients, family members, and doctors. There will be rooms of different sizes to accommodate groups of two or more.

Visitor Center
It is important for the emotional well-being of patients to have a place to hangout with their families and loved ones outside of their respective rooms. Not all patients have the ability to leave so a visitor center will be provided as a place to relax and recuperate.

Dining Center
Every hospital needs a cafeteria to provide food to patients, doctors and others. The dining center will be in close proximity to the visitor center.

Parking
A parking ramp will be located near the entrance with designated spaces for doctors and visitors.

USER	**NUMBER OF USERS**
Clients	
Patients	200-300
Family Members/Visitors	200-900
Physicians	
Oncologists	10-15
Physicians Assistant	10-15
Anesthesiologists	3-5
Nurses	40-50
Medical Technologists	10-15
Therapists	6-8
Pharmacists	4-6
Administration	
Medical Admissions Clerk	5-10
Medical Records Clerk	5-10
Human Resources Manager	1-2
Technology Specialist	2-5
Coding Specialist	2-5
Custodians	10-15
Maintenance Staff	8-10

USER/CLIENT DESCRIPTION

Figure 33: Squirrel

The site is located Southwest of Fish Lake Reservoir in northern Minnesota. The site is in a heavily wooded area with a large variety of deciduous and coniferous trees. It is located next to the Canosia State Wildlife Management Area, a state park that is newly underway to becoming full of trails. The new trail head was roughed out in fall of 2019 into the spring of 2020, completely derived from volunteers. This park is still a work in progress and is only getting better over time, creating a valuable community recreation area.

Being near a major city like Duluth, the site is near a large population. Providing a location that is well known by Minnesotans, it is easy to get to and utilize. It is also important to provide a sense of tranquility with the site. Next to Canosia State Park is an untouched forest area that will provide a secluded and serene context for the purpose of this project. This location also allows staff and visitors to utilize the trails at Canosia State Park.

Figure 34: Map

Figure 35: Close Up Map

Theoretical

1. Answer the question, what design elements can be incorporated to improve mental health?
2.Bring awareness to mental health in cancer patients, family members, and medical oncologists.

Physical

1. Create a hospital center that is highly correlated to the outdoors without sacrificing the sterile environment.
2. Provide an indoor garden in the hospital in a way that won't affect the health of the patients.

Social

1. Provide a treatment center that fosters a community within the cancer world and provides therapeutic qualities.
2. Provide a therapy center for the whole community and educate people on mental health risks.

GOALS OF THE THESIS PROJECT

Figure 36: Flowers

Research Direction

The list below will provide important information for the premise of this thesis.

Thesis Question

What aspects of design can be implemented to improve the emotional wellbeing of those affected by lung cancer?

Thesis Research

1. Explore articles and readings on topics related to depression in cancer patients, family members, and oncologists
2. Explore articles and readings on how to improve emotional well-being
2. Research how architecture affects mental health
3. Conduct case studies on highly influential hospital designs

Design Methodology

Exploration

Be curious. Ask questions. Understand it. Every design needs knowledge of the proposed use of a building, the site it will occupy, and the affects it will have on the community. Collect data related to the design premise and use that information to start formulating ideas that will conclude the question at hand.

Ideation

Using the information gathered during exploration, brainstorm ideas that will represent the knowledge of the subject. Create and test prototypes to reflect back on the main premise. How is the question being solved or indicated in the design? What can change to help improve the overall concept?

Implementation

Implement proposed design concepts to create a design solution to the premise. Further refine the design in accordance to the best possible outcome.

Documentation of the Design Process

1. Research

The research portion will be documented in the Thesis Book containing these topics:

- Results from Research about Thesis Topic
- The Typological and Precedent Research
- Historical, Social and Cultural Context
- Site Analysis
- Spatial Program and Performance Criteria

2. Schematic Design

Schematic design will be documented using these methods:

- Hand sketches - Bubble diagrams, Ideas
- Hand Modeling - Unify shape, Prototypes
- SketchUp - Concept modeling
- Revit - Refine concept models, Test prototypes

3. Design Development

Design development will be documented using these methods:

- Revit - Builds model
- Lumion - Renders Model
- Photoshop - Adds finishing touches to renders
- InDesign - Collects all renders in Thesis Book

PLAN FOR PROCEEDING

WEEK	PHASE	TASK AND GOALS
October 17- October 21	Thesis Research	
October 24- October 28	Thesis Research	
October 31 - November 4	Thesis Research	
November 7 - November 11	Thesis Research	
November 14 - November 18	Thesis Research	
November 21 - November 25	Thesis Research	
November 28 - December 2	Thesis Research	
December 5 - December 9	Thesis Research	
December 12 - **December 15**	Thesis Research	**Thesis Research Due Dec. 15**
January 9 - January 13	Schematic Design	
January 16 - January 20	Schematic Design	
January 23 - January 27	Schematic Design	
January 30 - February 3	Design Development	
February 6 - February 10	Design Development	
February 13 - February 17	Design Development	
February 20 - February 24	Design Development	
February 27 - March 3	Design Development	
March 6 - March 10	Design Development	**Midterm Thesis Review**
March 13 - March 17	Design Development	
March 20 - March 24	Design Development	
March 27 - March 31	Design Development	
April 3 - April 7	Rendering	
April 10 - April 14	Rendering	
April 17 - April 21	Rendering	
April 24 - April 28	Rendering/Finalize Thesis Book	**Physical Exhibit Due April 24**
May 1 - May 5	Finalize Thesis Book	
May 8 - **May 10**	Finalize Thesis Book	**Theis Book Due May 10**

THESIS RESEARCH

In order to identify what aspects of design are related to the well being of hospital patients, family members and staff, case studies will be thoroughly investigated. Precedent research is an important part of the research process because it provides a great starting point for a design approach. Using the data gathered from case studies in relation to aesthetic design, spatial layout, and moral responsiveness will highlight what design approach works and what design approach doesn't.

Learning about the history of mental illness and the history of hospitals will give important data that can be used in relation to one another to draw conclusions from. Incorporating this information into the design process will ensure the design is engaging in the theoretical premise.

RESEARCH RESULTS

Figure 37: Research

UNIVERSITY OF VIRGINIA HOSPITAL

Lessons Learned

Patients and staff are connected to the calming effects of nature to reduce anxiety and promote a sense of peace.

Daylight and views to the outdoors are provided for break rooms, eat-in kitchens, and other “back of house” areas.

Inside there is a 28 foot tall atrium with windows towering over you, allowing natural light to flood the space.

Figure 38: Lobby

A feeling of brightness and warmth is created by using a light colored wood ceiling that contrasts with white floors and ceilings.

For most hospitals, operating suites are located at the buildings core. However, in this design, the operating rooms have an adjoining glass corridor with views to the outdoors. This serves the surgical teams, who spend countless hours in an enclosed space performing surgery, respite between operations.

The building employs net-zero water design strategies, including a 50,000 gallon cistern under the ambulance bay that captures gray water for use in heating and cooling, and several green roofs that mitigate water runoff.

Contribution to the Decision-Making Process of Design

1. Include the calming effects of nature
2. Utilize bright and warm aesthetics
3. Incorporate large windows with views to the outdoors
4. Include views to the outdoors near the operating suites
5. Employ a net-zero water design strategy

Figure 39: Wood Ceiling

Figure 40: Hospital Exterior

ANN & ROBERT H. LURIE CHILDREN'S HOSPITAL

Lessons Learned

A pedestrian bridge to the central parking facility, two bridges to the adjacent Prentice Women's Hospital, a sky garden, and sky lobby and overlook are special features included in SCB's exterior scope of work. Interior features included are a freestanding oval elevator bank, a tree house, entertainment stage, healing garden, garden market themed food court, illuminated information desks, aquarium, Captain Streeter coffee bar, and a suspended whale exhibit.

A whimsical experience is created by incorporating playful touches like life sized whale sculptures and colorful murals. The entrance lobby is animated to ease the tense environment for parents and children.

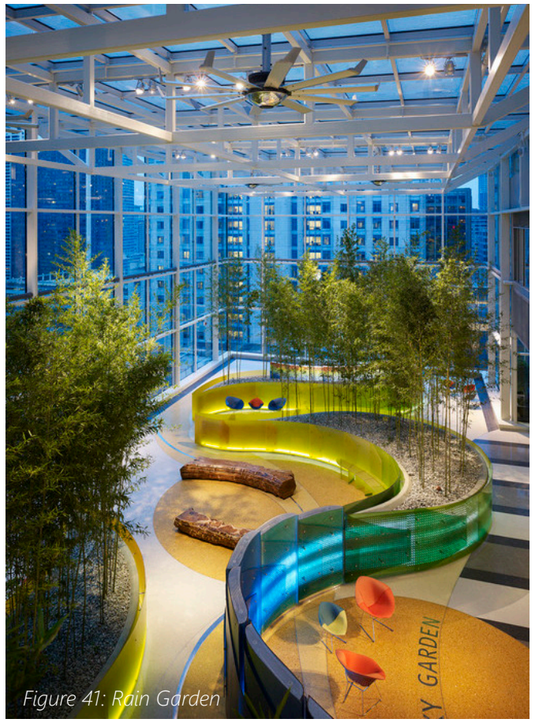


Figure 41: Rain Garden

Diffused lighting is used to direct visitors and orient them.

Lighthearted diversions are incorporated in patient rooms by using pops of color and having themed installations.

The 11th floor has a sky garden, providing kids and their family a place for relaxation and recreation.

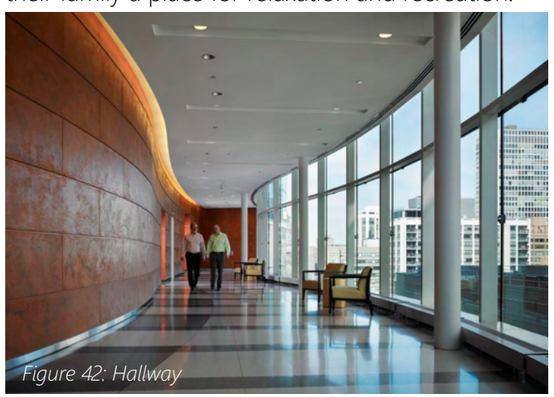


Figure 42: Hallway

Contribution to the Decision-Making Process of Design

1. Design a whimsical experience to ease the tension of patients and visitors
2. Use lighting to incorporate path way finding
3. Provide a place for relaxation
4. Incorporate a garden theme throughout common spaces

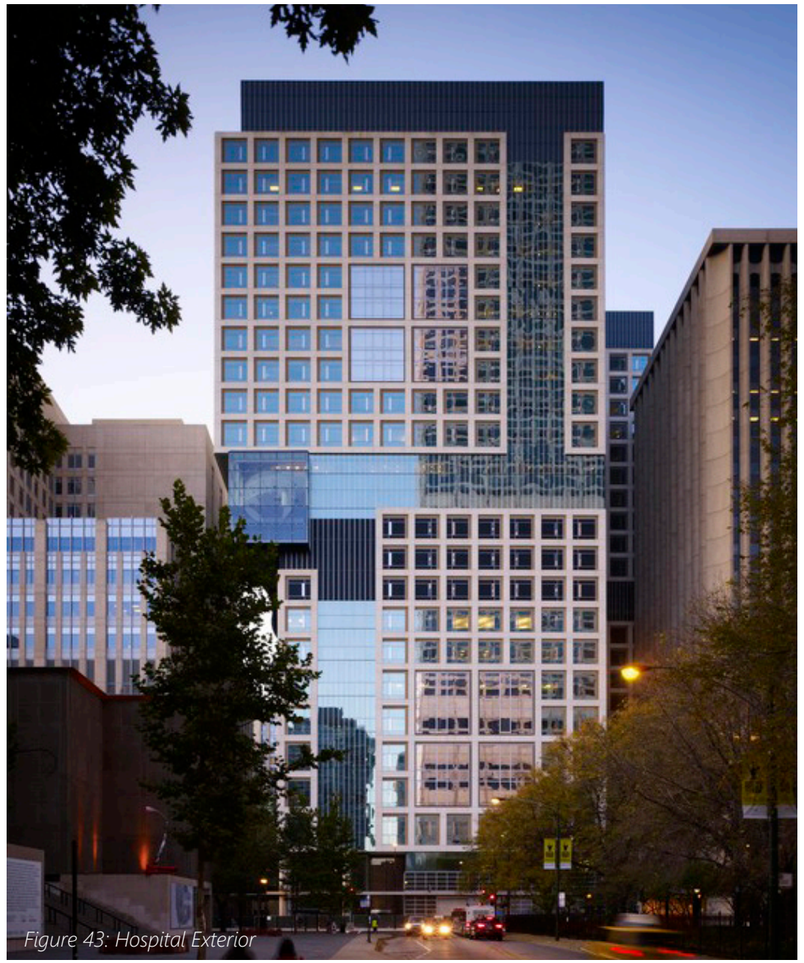


Figure 43: Hospital Exterior

UNIVERSITY OF PENNSYLVANIA HOSPITAL

Lessons Learned

A wayfinding system is created for visitors and staff by using indirect lighting and illuminating spaces with diffused light throughout the interior.

Flexible and adaptable layouts were applied to the care floors and rooms, following the major expectations hospitals faced during the peak of the corona-virus pandemic.

The care floors have a flexible planning system allowing a typical 72-bed floor to be transitioned into smaller care units.

The inpatient rooms, a total of 504, have a user-centric design. They can be similarly reorganized to maximize patient comfort. Hosting a variety of different functions, including surgeries and intensive care and also offer space for visitors to sleep.

Staff wellbeing was also prioritized. Private areas containing sweeping views out to the surroundings, flexible

Figure 44: Operating Room

Figure 45: Lobby

PRECEDENT RESEARCH

Contribution to the Decision-Making Process of Design

1. Create a way finding system using diffused lighting
2. Design flexible and adaptable spaces
3. Hospital rooms should have the ability to turn into smaller units
4. Staff areas should also incorporate views to the outdoors

Figure 46: Hospital Exterior

Historical

Hospital's in the United States were only associated with the poor. Wealthy families nursed their ill at home. When the world started to industrialize later in the century and medical practices grew in their sophistication and complexity, having families support their own ill became a hard burden. It became prevalent knowledge that people needed support and hospitals were a sure way of doing that.

Large hospitals, consisting of a thousand beds or more, started emerging around the states. When designing hospitals back then, the idea of mental health wasn't on anyones mind. Hospitals were there to physically help heal people in need. In the photos to the right, there is natural daylight showing. However, the spaces seem daunting.

It is important to acknowledge that medical practices have come a long way and it is now an important priority to create spaces that are comfortable and calming for hospital patients.


Operating Room scene at the Philadelphia General Hospital, c. 1925

Figure 47: Operating Room 1925

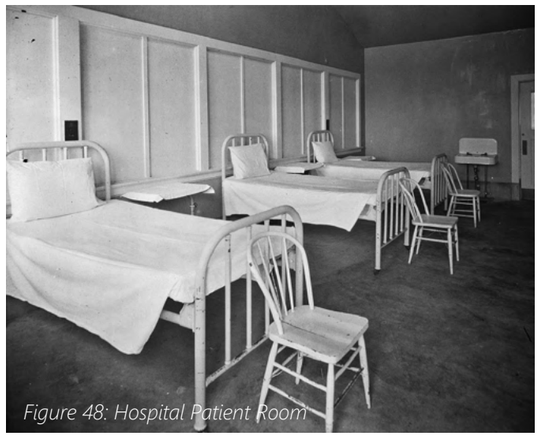


Figure 48: Hospital Patient Room

Figure 49: Operating Room

Figure 50: Emergency Bay

Figure 51: Rooms and Hallway

Figure 52: Reception Space

Social

It is becoming more and more common to discuss mental health and how to cope with depression, anxiety, and more. Design trends have been increasing their tactics on how people resond to different spaces. It's important to think about how a person will react to different materials, colors, and textures.

The photos to the left all incorporate a calming aesthetic. Using wood textures, green and blue colors and allowing natural light filter through the spaces as much as possible.

SITE ANALYSIS

Context

Figure 53: Site Map

Located Southwest of Fish Lake Reservoir in northern Minnesota. The site is in a heavily wooded area with a large variety of deciduous and coniferous trees.

The site is near a large population. It is easy to get to and utilize.

The site is untouched forest land that will provide a secluded and serene context for the purpose of this project.
This location also allows staff and visitors to utilize the trails at Canosia State Park.

Figure 54: Duluth Map

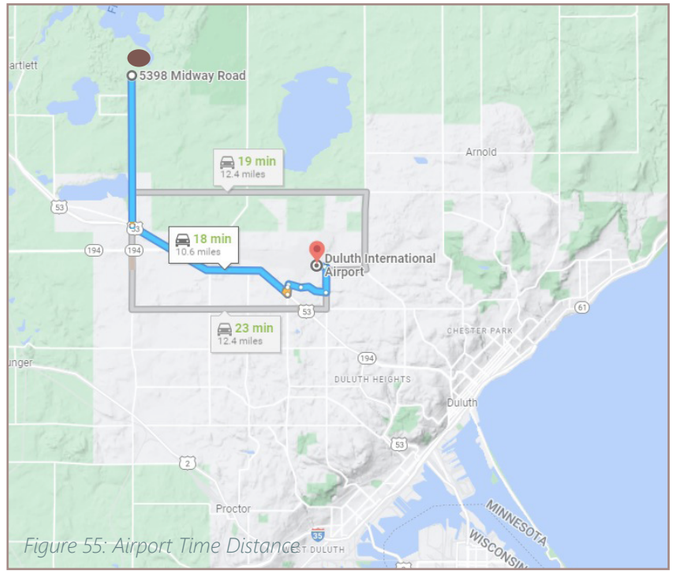


Figure 55: Airport Time Distance

Approximately 20 mins from the Duluth International Airport

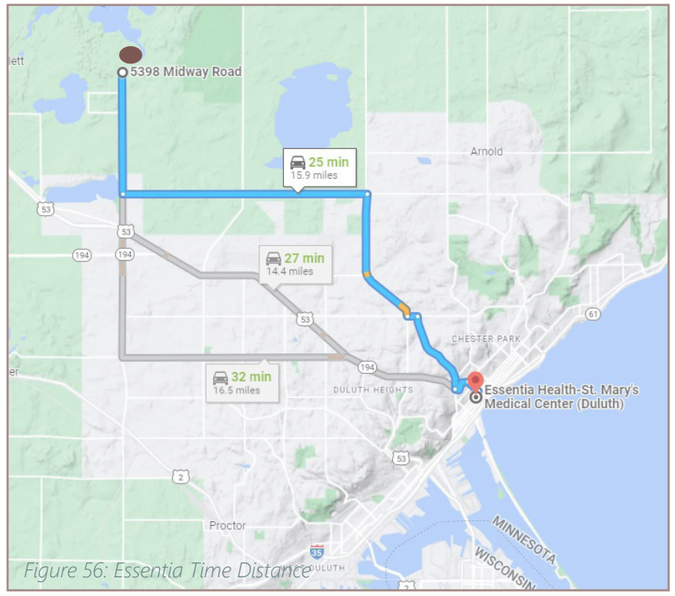


Figure 56: Essentia Time Distance

Approximately 30 mins from Essentia Health Medical Center

Climate

Duluth Weather Averages

Annual High Temperature	49 Degrees F
Annual Low Temperature	30 Degrees F
Average Annual Precipitation	30.96 Inch
Average Annual Snowfall	85 Inch

Wind Rose

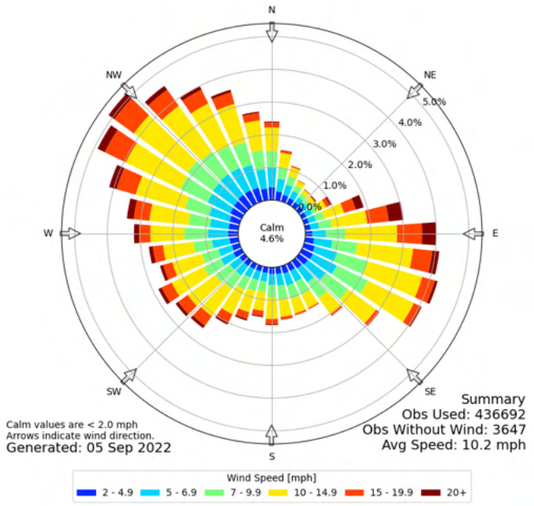


Figure 57: Wind Rose

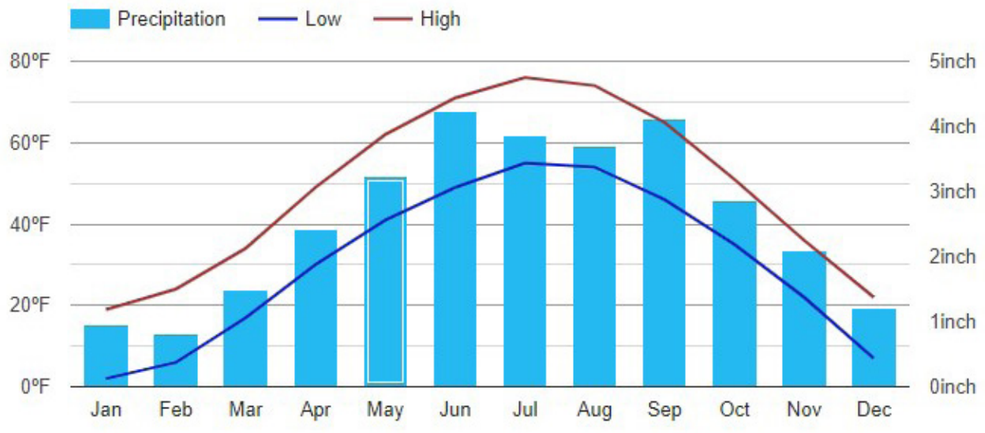


Figure 58: Climate Chart

Solar Exposure

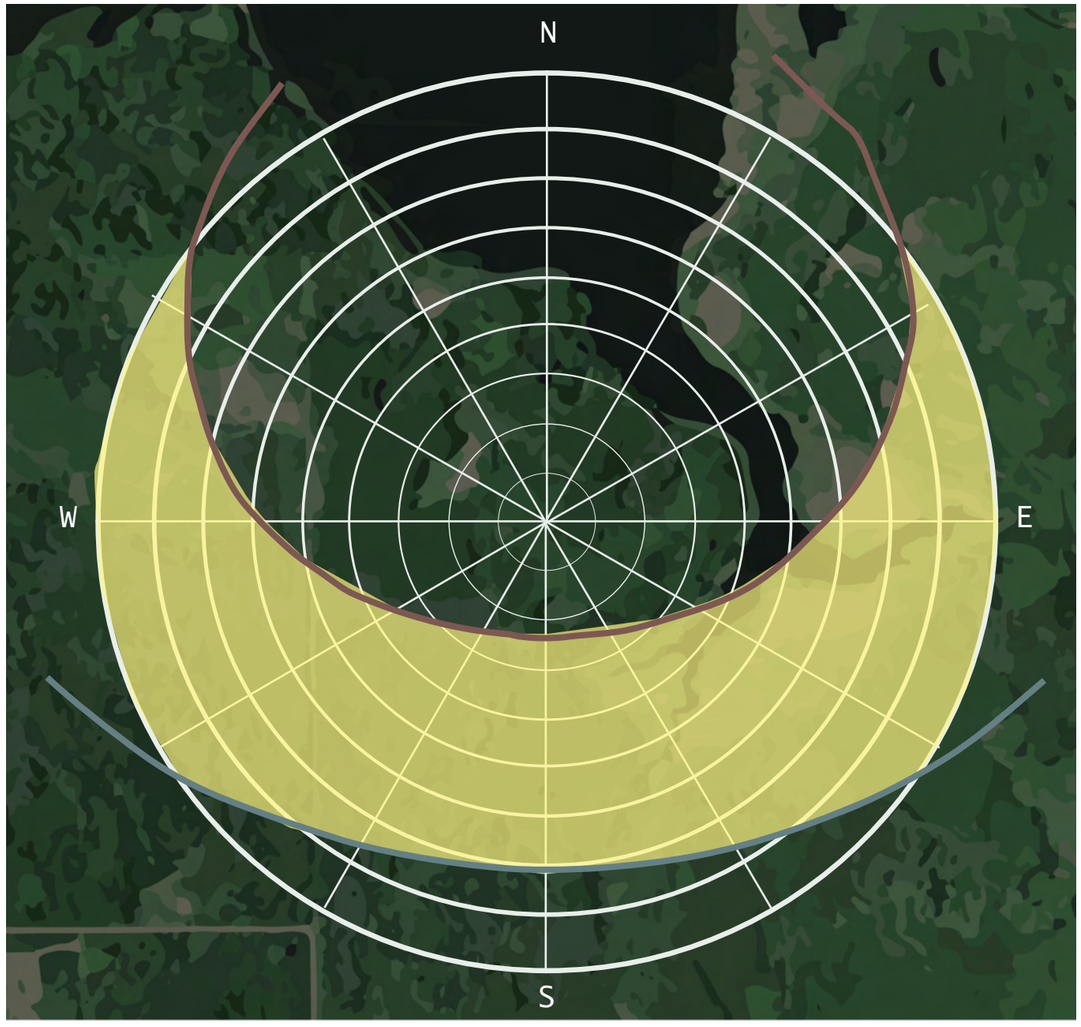


Figure 59: Sun Diagram

Topography

Figure 60: Topography

Soil Conditions

Typical profile
A - 0 to 5 inches: sandy loam
Bw - 5 to 34 inches: sandy loam
2BC,2C - 34 to 80 inches: very gravelly sand

Allowable Soil Bearing Pressure (PSF): 2000

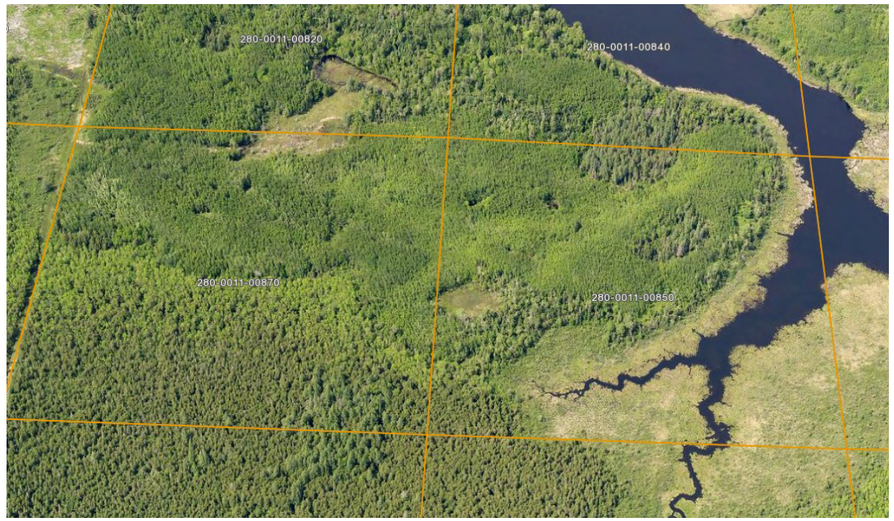


Figure 61: Orthographic 1

Figure 62: Orthographic 2

Deciduous Species

Maple *Figure 63: Maple*

Oak *Figure 64: Oak*

Basswood *Figure 65: Basswood*

Birch *Figure 66: Birch*

Beech *Figure 67: Beech*

Aspen *Figure 68: Aspen*

Coniferous Species

Fir *Figure 69: Fir*

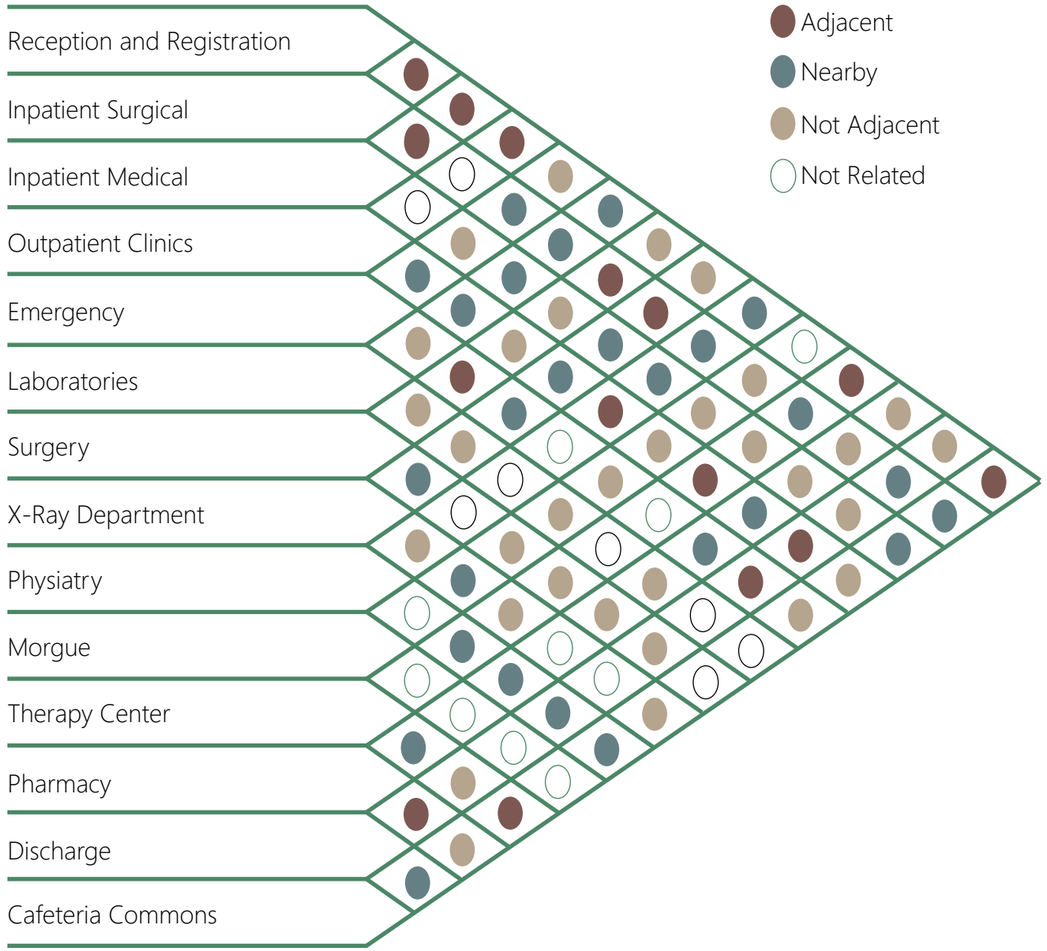
Pine *Figure 70: Pine*

Spruce *Figure 71: Spruce*

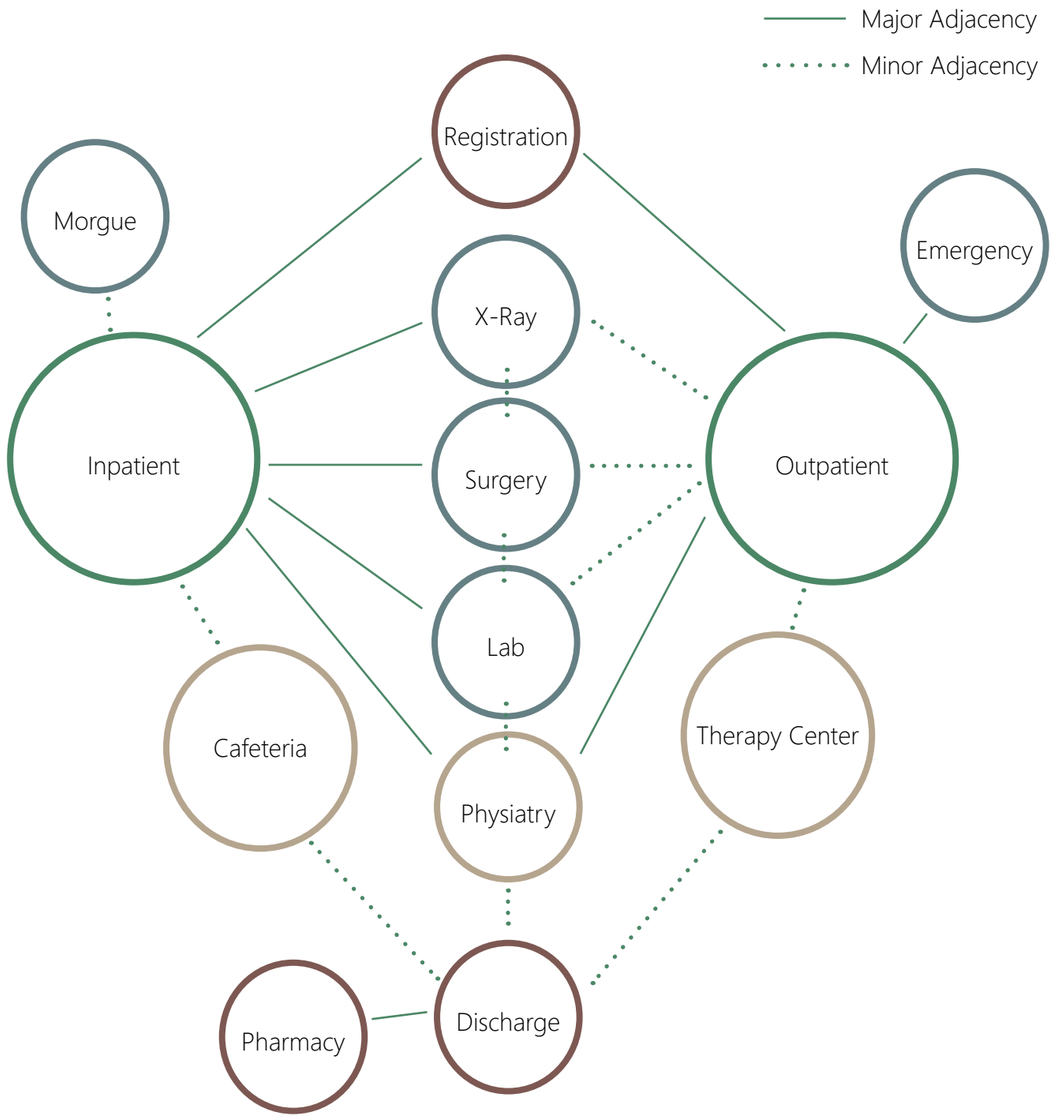
Cedar *Figure 72: Cedar*

SPATIAL PROGRAM

Interaction Matrix



Interaction Net



Psychological Impacts

Performance Measure:
How users experience the space in terms of sight, smell, and sound. The sensory experiences, along with aesthetic design, play a big role on psychological impact. Since depression is common among patients and medical professionals, the goal is to help improve emotional well-being. Analyzing the sensory experience among everyone will provide a concrete bases for a good design approach.

Performance Measure Source:
Conducting psychological studies on cancer patients, family members and medical staff. The studies will take place at other hospitals around the world to determine a standard mental health between patients and staff members in a hospital.

Performance Analysis:
Analyzing different types of aesthetics in relation to emotional well-being is an important aspect for this performance criteria. Understanding how people react to different colors, materials, and textures will help understand what aesthetic appearance will benefit staff and patients. To do this, surveys will be taken from staff and patients from hospitals and used to determine the best solution to improve emotional well-being.

Performance Judgment:
Once people are able to experience the spaces in the newly constructed hospital, surveys will be taken on the staff and patients there to judge whether or not the objective was met. If the survey outcomes are better than other hospital surveys, then the performance criteria was met. If the survey outcomes are the same or worse, then the performance criteria was not met and in need of improvement.

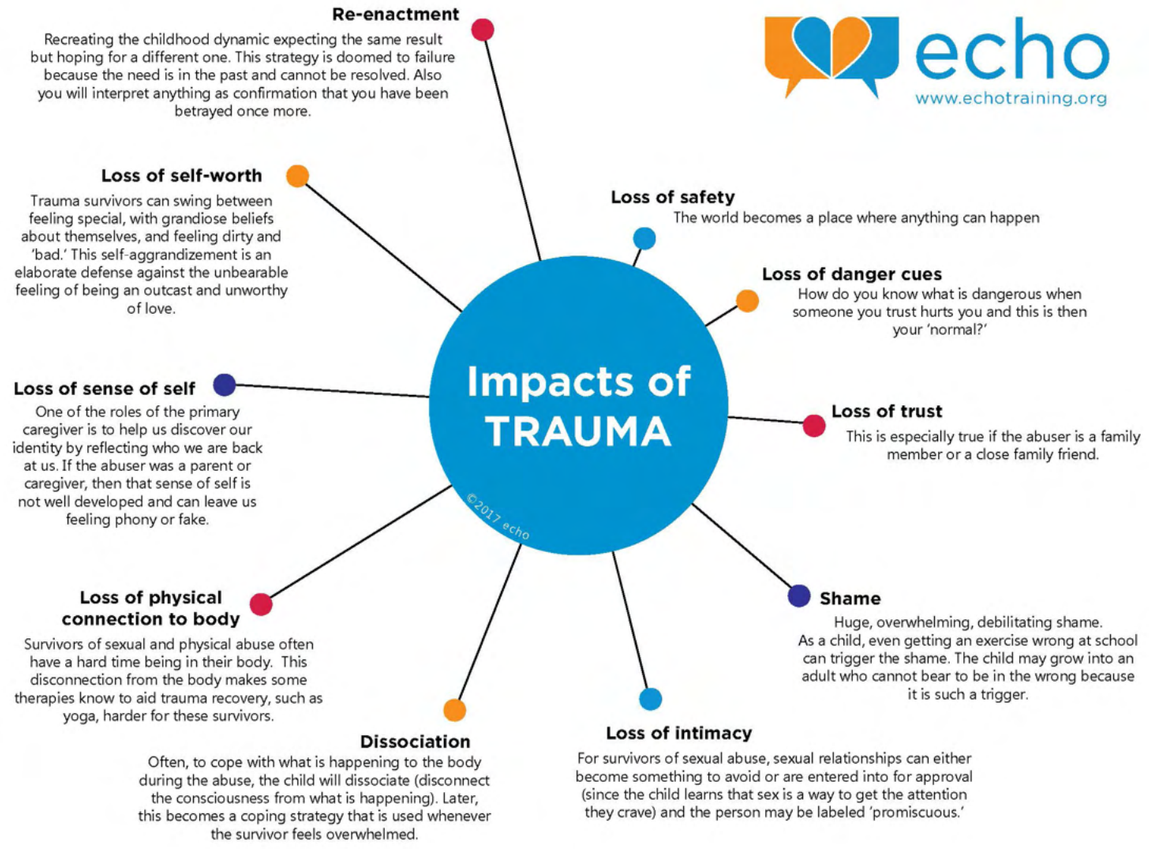


Figure 73: Impacts of Trauma

Behavioral Performance

Performance Measure:
Oncologists and nurses are at the forefront with every obstacle cancer patients go through. It can be hard to endure and there should be more consideration in design approach when it comes to building a hospital. The medical staff's performance will be measured in terms of patient outcomes and their emotional perception. The environment doctors live in should induce a calming aura.

Performance Measure Source:
Gathering data from studies done on medical staff's performance in relation to their environment and surveys taken on their emotional well-being will provide a good bases for this performance analysis.

Performance Analysis:
The performance of oncologists in different hospitals provides data that includes the relation of space and aesthetic to performance ability. For example, an oncologist that works in a dark cramped space with no natural light may have a decrease in performance ability than compared to working in a space with more room and natural daylight. Spaces can include offices, patient rooms, conference rooms, operating rooms and more.

Performance Judgment:
Using the data gathered from oncologists' performance in other hospitals and comparing it to the performance of oncologists in the newly designed hospital will define whether the performance criteria was met for the behavioral performance category.

PERFORMANCE CRITERIA

Figure 74: Behavioral Performance

THESIS DESIGN SOLUTION

Forest Bathing *"Taking in the atmosphere of the forest"*

When we are surrounded by nature, we turn off our worries and obsessive thinking.

Plants and trees naturally emit a substance called phytoncide, offering stress reducing benefits.

Breathing in forest air increases the level of natural killer cells in our blood. A Japanese study showed NK cells increase in activity by those who forest bathe. Our body uses these NK cells to combat infections and cancers.

Benefits of Forest Bathing:

- Reduces stress and anxiety
- Strengthens immunity
- Lifts mood
- Improves sleep
- Boosts attention
- Sparks creativity

DESIGN SOLUTION

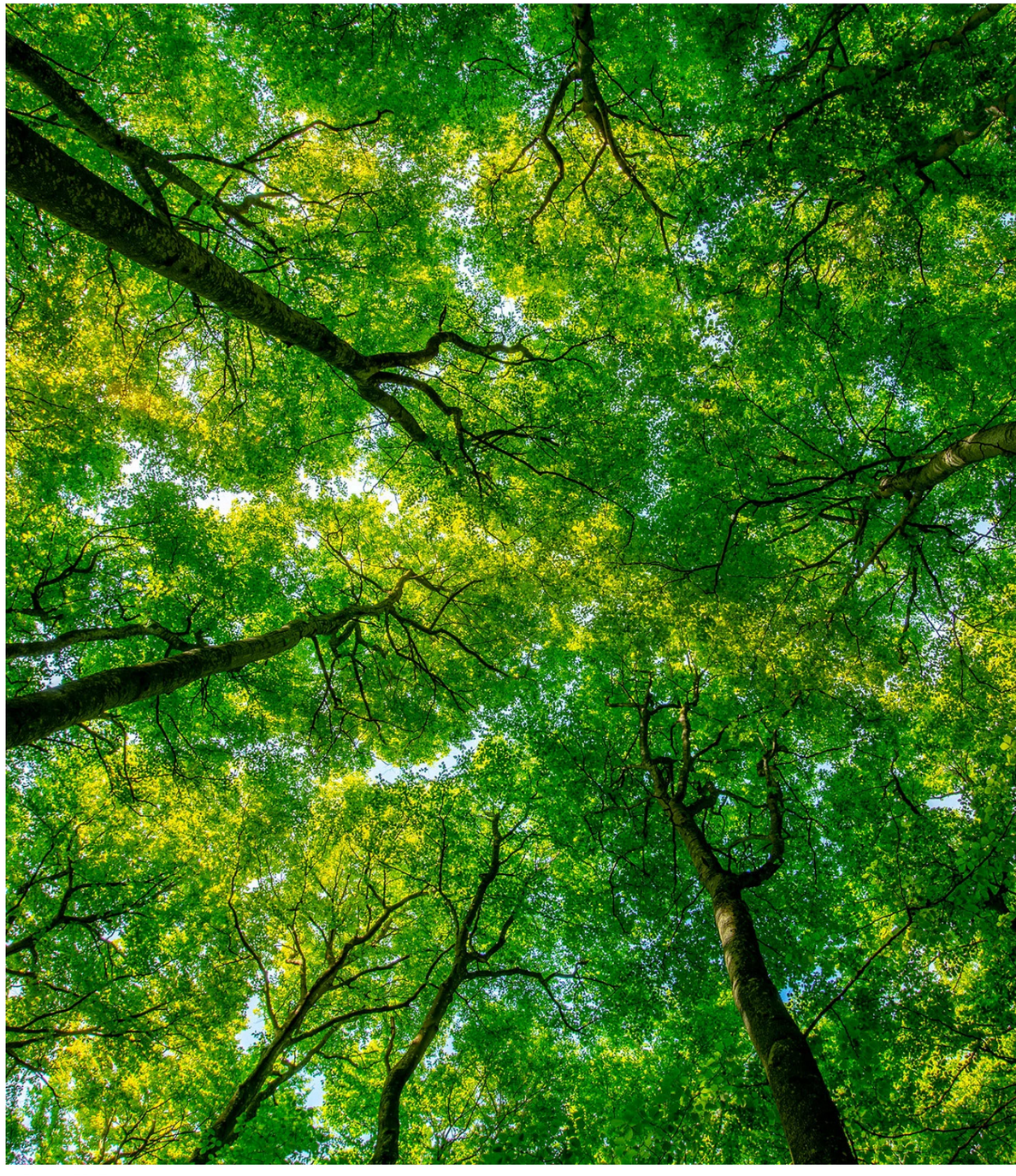


Figure 75: Trees

Internal Wayfinding

Trying to find directions through a hospital can be confusing and frustrating. Maneuvering through the building should be intuitive and clear to eliminate stress.

Organizing Wayfinding:

- Use less signage
- Incorporate bold colors
- Create distinctive changes in appearance
- Use large windows to aid in direction

Nature

The use of indoor plants transforms the hospital stay. Plants help improve your overall sensory experience. Using greenery provides privacy, comfort, and even aids in directing visitors through the hospital.

Benefits of Indoor Plants:

- Promotes healing
- Decreases stress
- Increases productivity

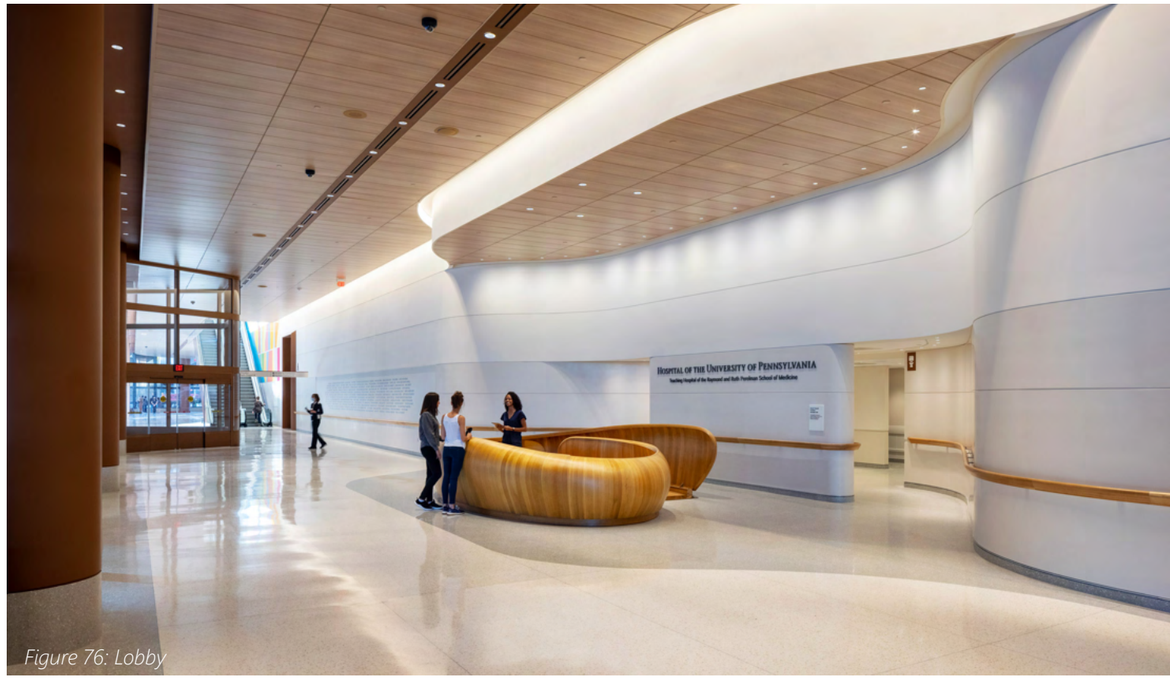


Figure 76: Lobby

Figure 77: Sky Garden

Natural Design Elements

Research shows that incorporating organic materials, such as wood, into the built environment, can improve occupant comfort, reduce stress and contribute to improved health indicators. Along with using natural materials, increasing natural daylight throughout the building will improve the mood of patients, visitors, and staff.

Benefits of Exposure to Wood :

- Drop in cortisol, the hormone linked to negative impacts of stress
- Lower levels of blood pressure and heart rate
- Improved focus and concentration

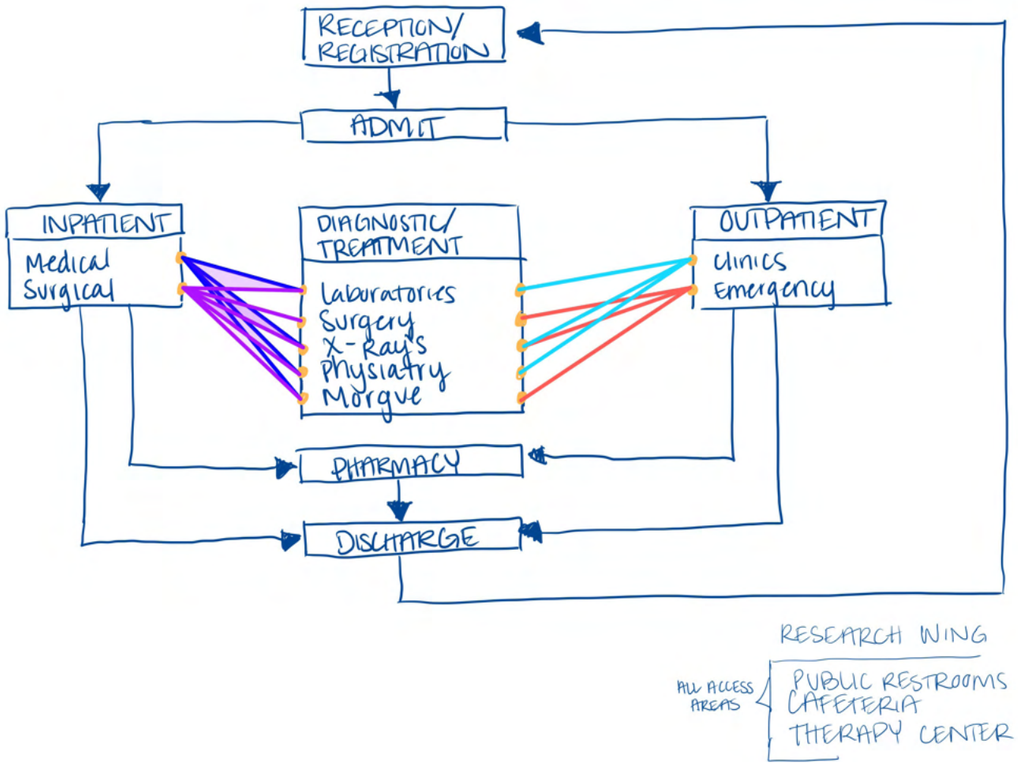
Benefits of Natural Daylighting:

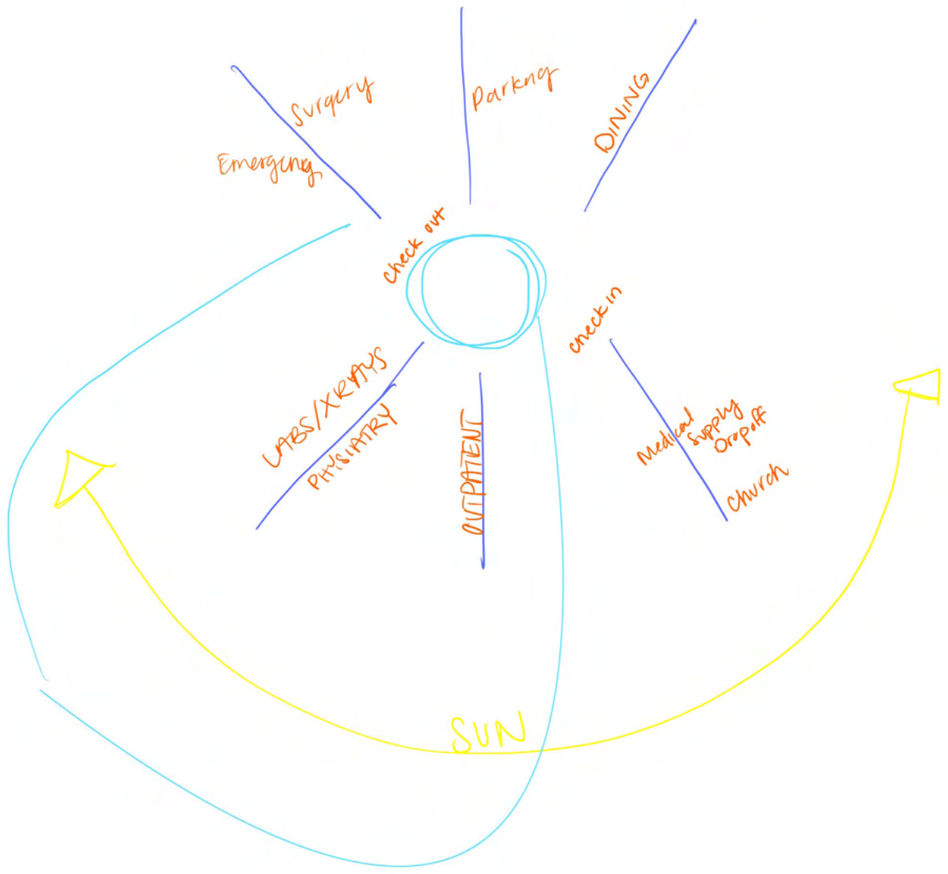
- Produces vitamin D and supports bone health
- Lowers blood pressure, preventing disease, and promoting good mental health
- Produces serotonin, providing more energy and helps to keep you calm, positive, and focused

Figure 78: Common Space

Figure 79: Hallway

PRE-DESIGN


RECEPTION/ REGISTRATION
ADMIT
INPATIENT
Medical
Surgical
DIAGNOSTIC/ TREATMENT
Laboratories
Surgery
X-Rays
Physiatry
Morgue
OUTPATIENT
Clinics
Emergency
PHARMACY
DISCHARGE
RESEARCH WING
ALL ACCESS AREAS
PUBLIC RESTROOMS
CAFETERIA
THERAPY CENTER

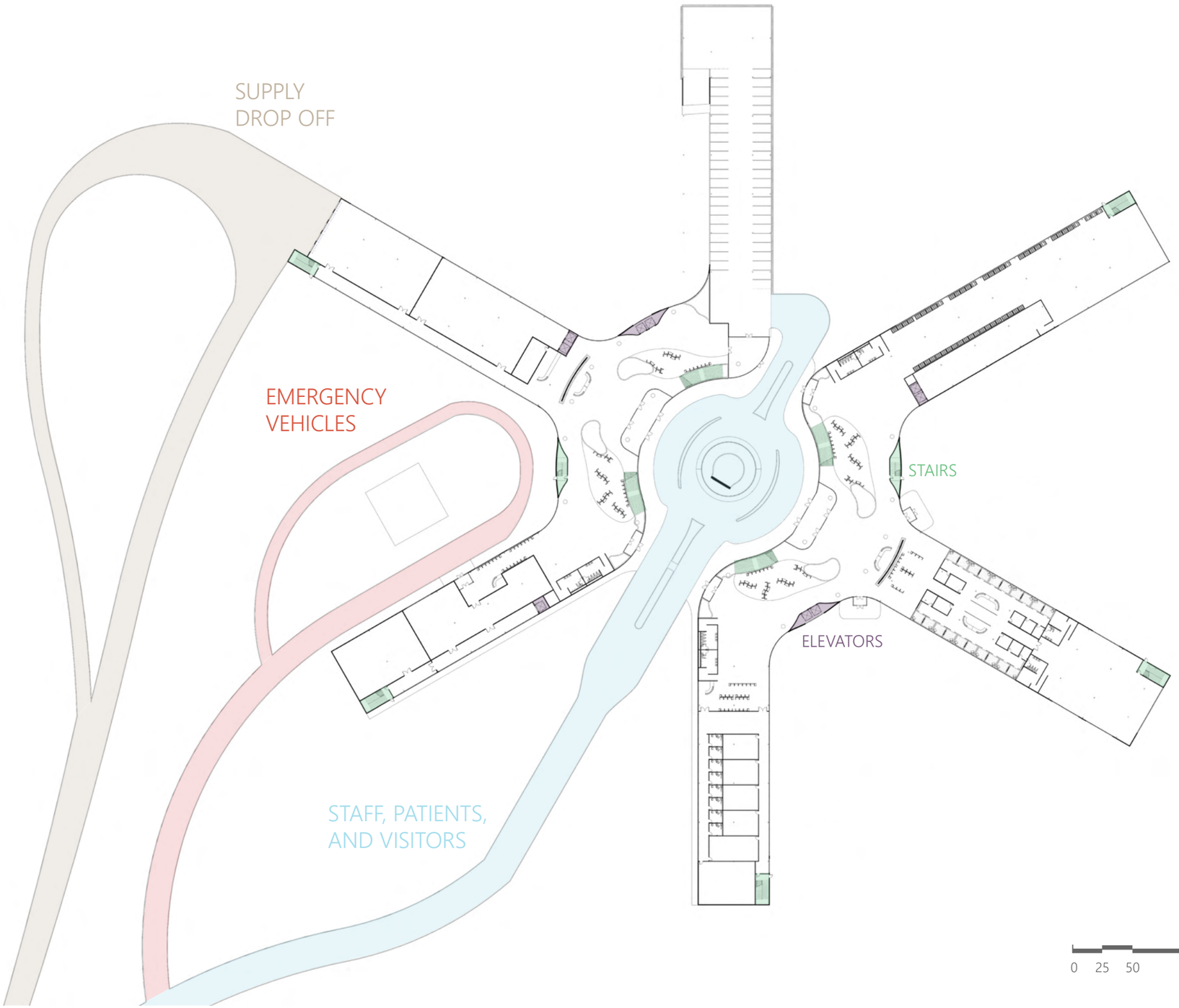

Surgery
Parking
DINING
Emergency
Check out
Check in
LABS/XRAYS
PHYSIATRY
OUTPATIENT
Medical Supply Drop off
Church
SUN

DESIGN

CIRCULATION

To reduce confusion and simplify circulation patterns, al
patients, visitors, and staff enter the building through th
central roundabout. They are directly brought to check-
drop off, parking, and check-out/pickup. The emergenc
room and loading dock each have a separate access ro
and entrance to prevent traffic disruption. The vehicular
access and approach roads are designed to be intuitive

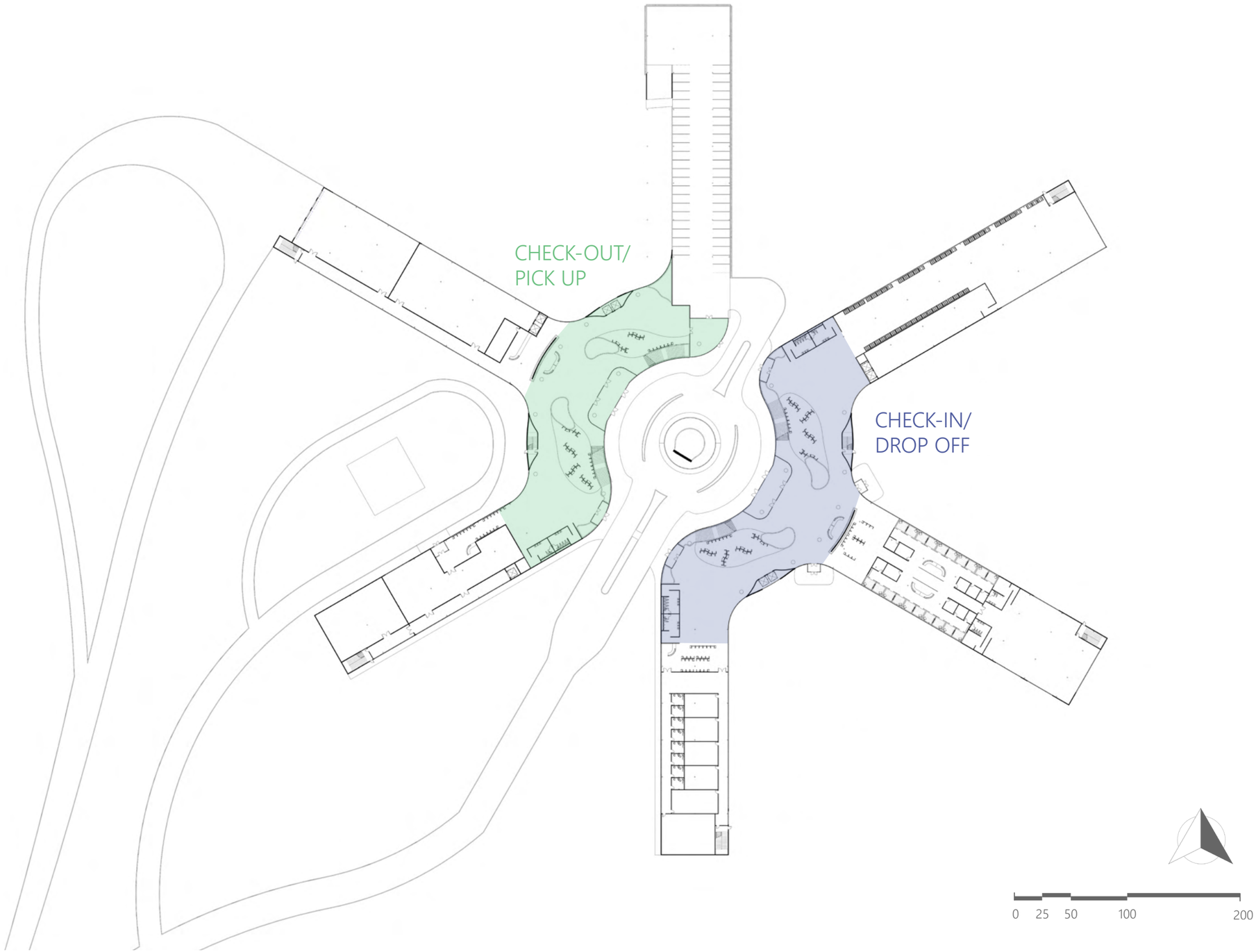
and clear to eliminate stress while driving.



SPATIAL PROGRAM

Strategically programming the spaces in the building helps reduce the traffic footprint and increases productivity among the workers. From the central location, the hospital branches out into “wings” that separate the different uses of the building. The first floor is separated into two portions, one houses the check-in lobby and one houses the check-out lobby.

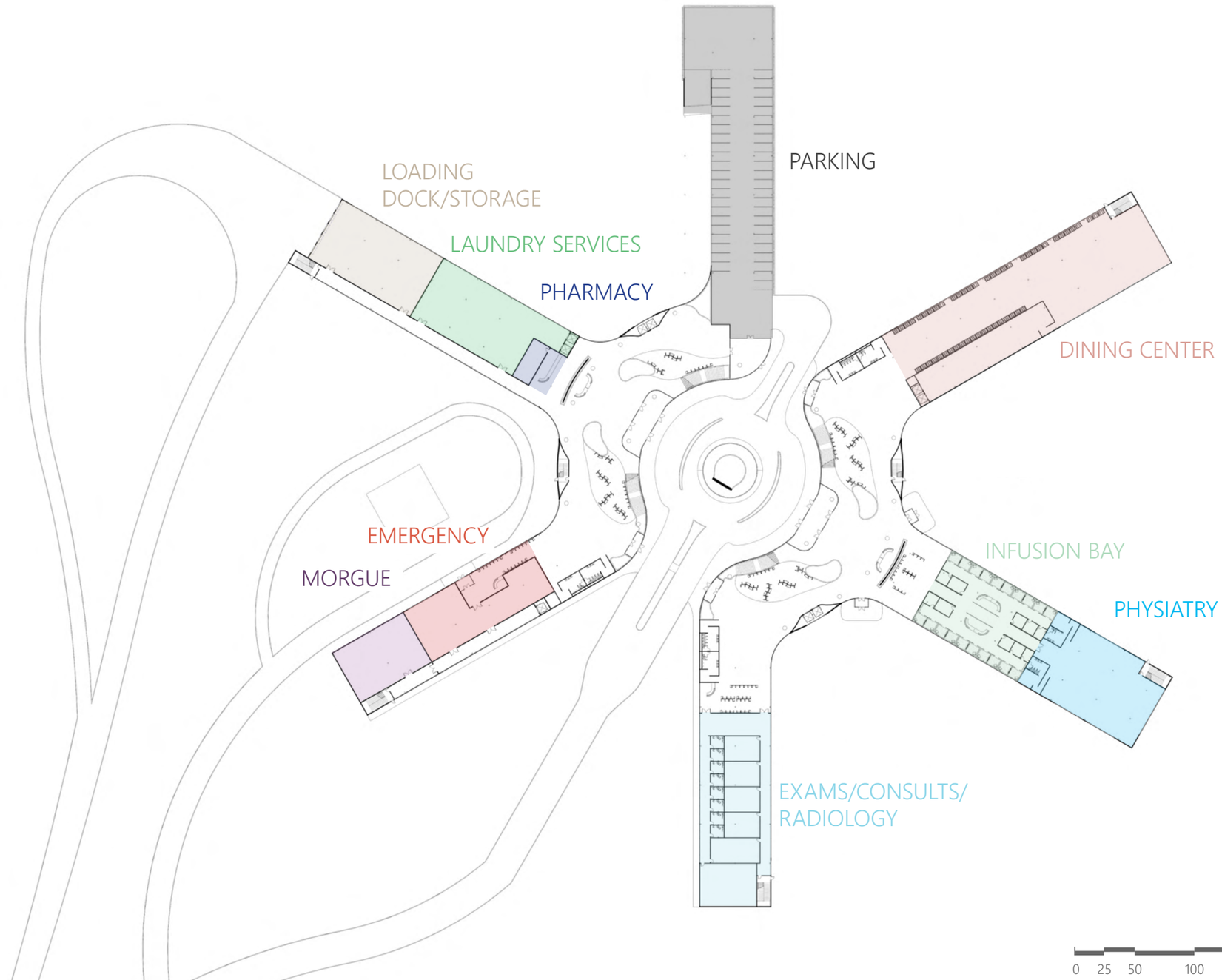
- Reduces traffic disruption
- Keeps movement flowing through the building
- Provides a dignified exit for the patients leaving the hospital, that may require assistance



DESIGN

LEVEL 1

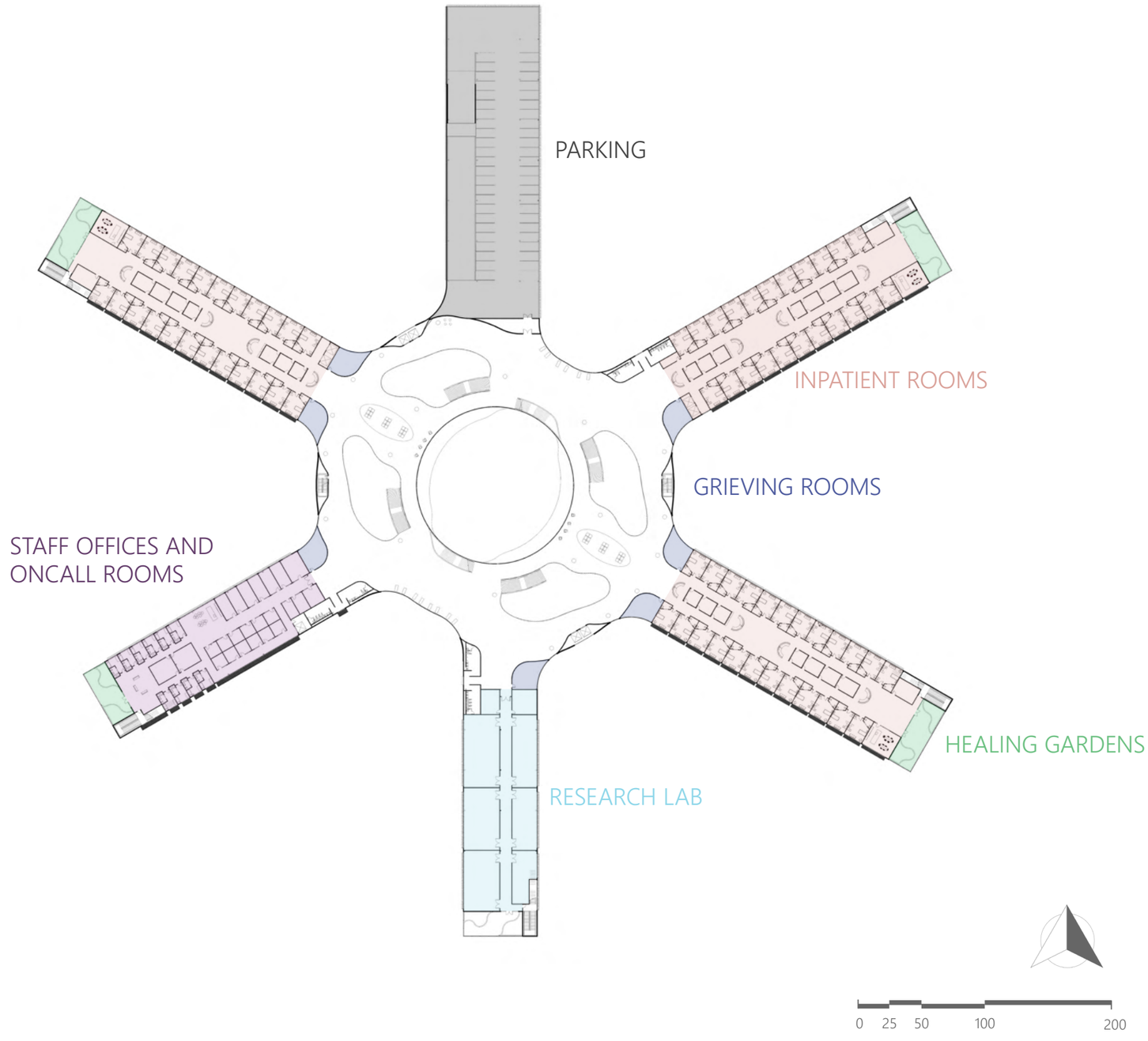
- Outpatient services are located on the first floor for easy access in and out of the building
- Emergency room and morgue are separated from higher traffic areas
- Loading dock is farthest from the central point to reduce vehicular traffic
- Pharmacy is located directly behind the check out desk
- Dedicated parking ramp provides easy access to each floor



DESIGN

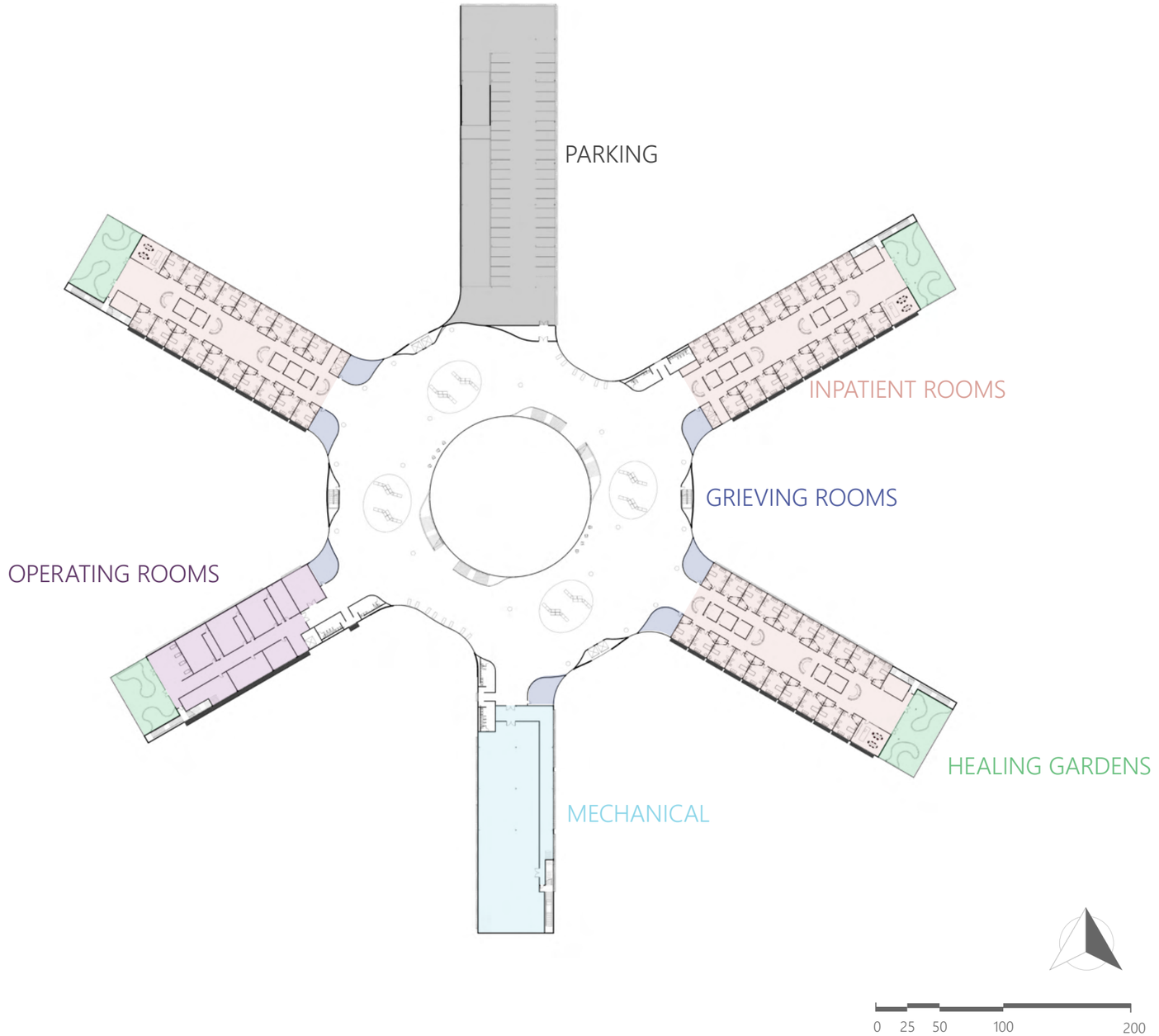
LEVEL 2

- Three wings are dedicated to inpatient rooms
- Staff offices and on call rooms are directly above the emergency room for more efficient time responses
- Grieving rooms are provided at the front entrance of each wing for private family meetings
- A healing garden is located at the end of each wing providing easy access from any location



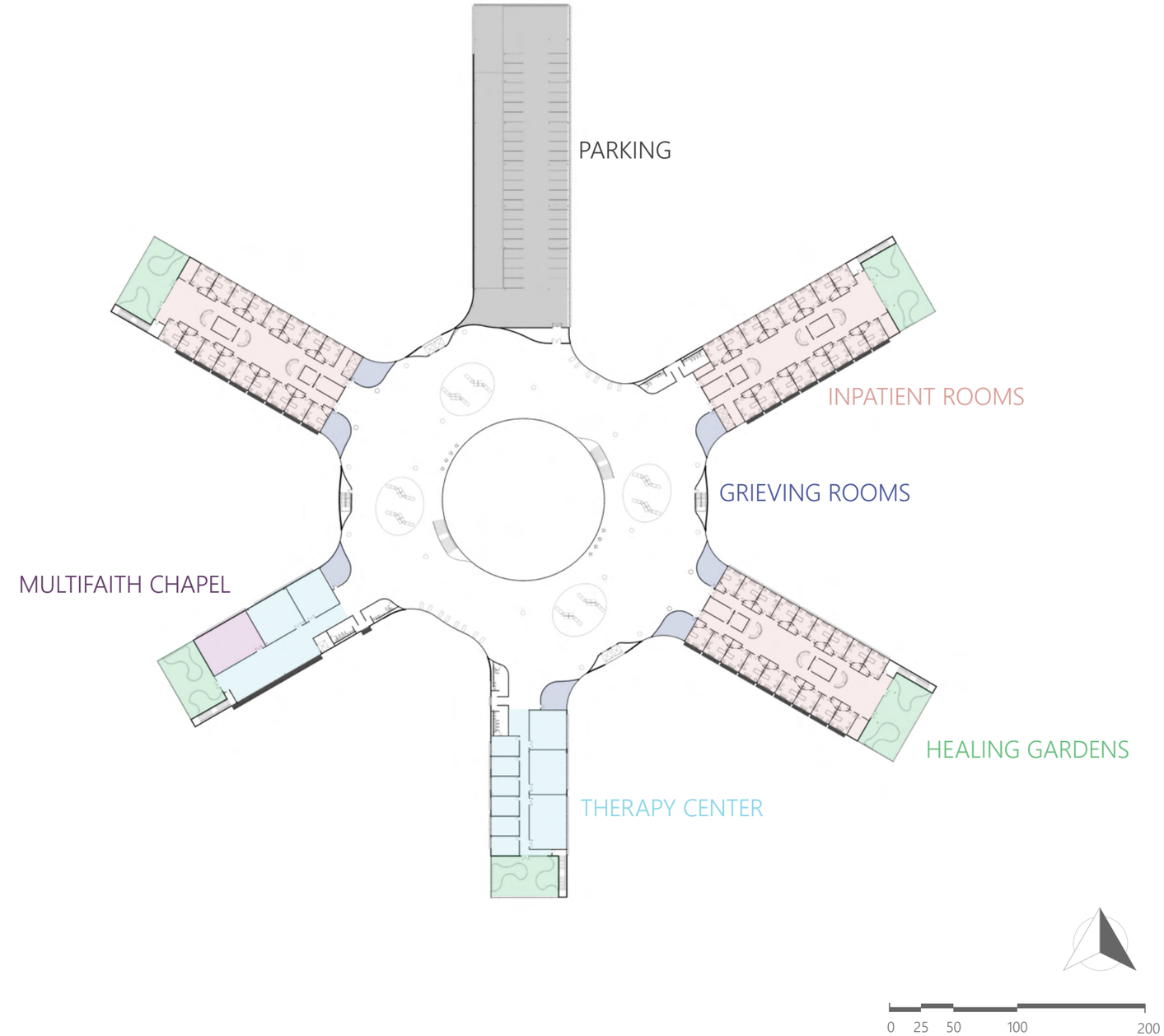
LEVEL 3

- More inpatient rooms are located in the same three wings for simplified internal wayfinding
- Grieving rooms are located in the same place for better visualization
- Operating rooms are located directly above the staff offices, on call rooms, emergency room and morgue
- One wing is dedicated to mechanical space for the whole building



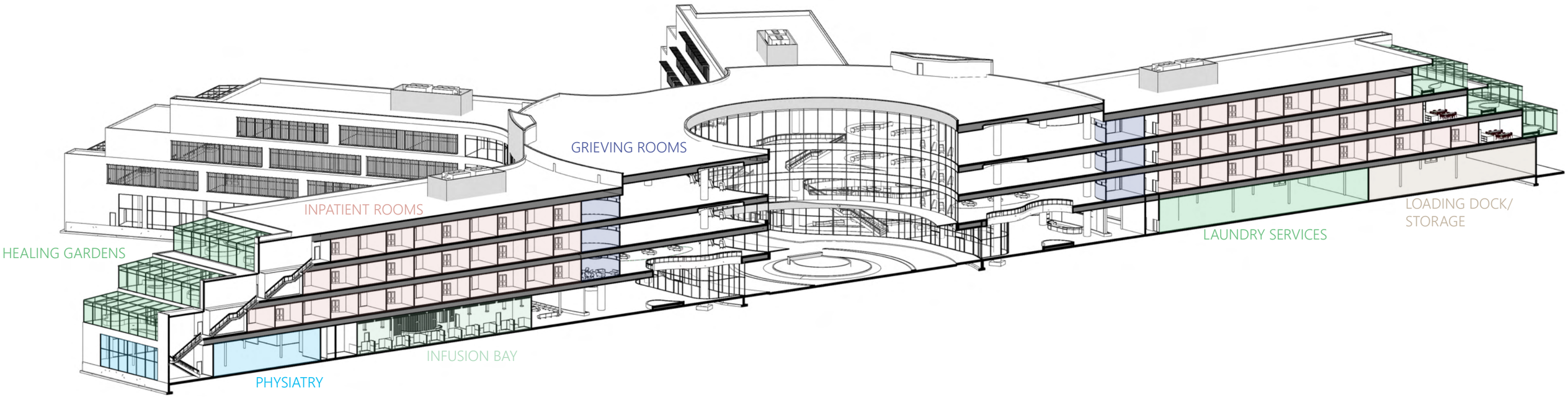
LEVEL 4

- The inpatient rooms on the fourth floor are Intensive Care Units for those in critical condition
- The ICU has restricted access and is on the top floor to reduce traffic and noise
- A therapy center is placed on the fourth floor providing different room sizes for one on one meetings and larger group meetings as needed
- A multifaith chapel is on the fourth floor for a more private location and is in close proximity to those who are losing loved ones in the ICU



DESIGN

BUILDING SECTION



SITE PLAN

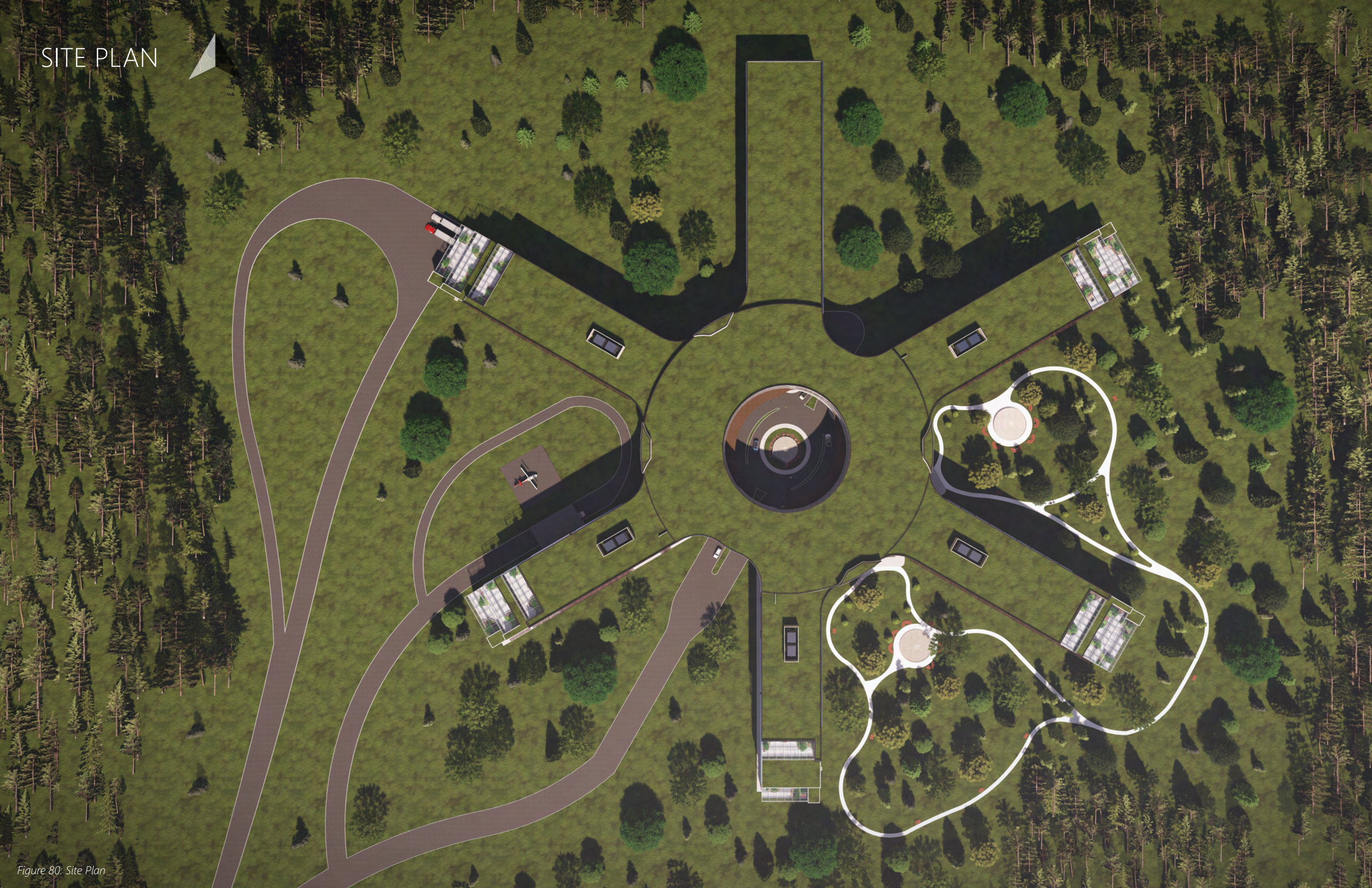


Figure 80: Site Plan

Figure 81: Building Entrance

This is where the staff, patients, and visitors enter the building. The road leading up to the entrance was designed to be intuitive and clear to alleviate stress on the commute.

Figure 82: Central Point

This central point makes it easy to visualize where you need to go. You can see the floors are color coded by the columns and you can see the placement of the stairs and where each of them will take you.

Figure 83: Check In Desk

The check in desk is centered when coming through the front doors. The diffused lighting and wood ceiling guides visitors to the check in desk for simple internal wayfinding. The lobby also provides direct access to the walking paths outside for everyone to use.

Figure 84: Check In Lobby

There are garden beds on display in the lobbies to ease tension in patients and visitors. The wood accents and light fixtures create a nice distraction from the hospital smells and noises.

Figure 85: Infusion Bay

This is the infusion bay. Each patient has their own private and secluded space with a direct view of the forest, water fountain, and walking paths. Drop down wood ceilings provide a warm and comfortable atmosphere and a living wall enhances the space with life and greenery.

Figure 86: Walking Paths

This render shows the water fountain and walking paths outside. These walking paths put forest bathing into effect and help induce all those wonderful benefits from it.

Figure 87: Nurses Station

Here is one of the nurses stations. There is a decorative backdrop to draw your attention to the front of each wing. Each hallway ends with a view of the outdoors to prevent feeling closed off from nature.

Figure 88: Grieving Room

This render shows one of the grieving rooms. Having a living wall and garden bed can help boost your mood in a time when people are feeling down and having Floor to ceiling windows provides ample daylighting with forest views.

Figure 89: Second Floor

This is the second floor. The Ambient lighting and wood ceiling create a defined and warm seating area here. There are privacy booths and chairs provided for a more secluded space when people want to be alone.

Figure 90: Staff Lounge

The staff lounge has a decorative accent wall behind a living wall and garden bed to bring life into the space. The lowered wood ceiling creates a warm and calming aroma and having views of the outdoors helps the doctors relieve stress.

Figure 91: Healing Garden

A healing garden is placed at the end of each wing and on every floor for everyone to use.

A built-in bench is placed around the gardens for seating while still having ample room for maneuvering around with a wheelchair.

Figure 92: Third Floor View

This view shows how the central roundabout is visible on every floor and aids in preventing people from getting lost. It is easy to visualize where you need to go and how to get there from this central location.

Figure 93: Exterior View

HEALING ARCHITECTURE

LUNG CANCER RESEARCH AND TREATMENT CENTER

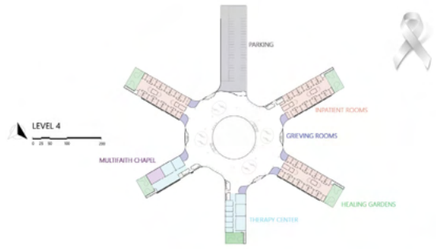
DULUTH, MINNESOTA

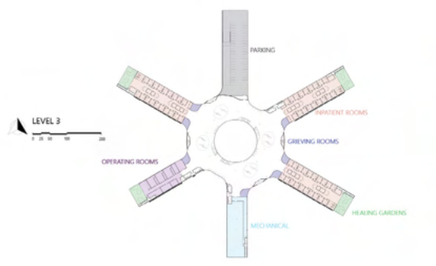
The site is located Southwest of Fish Lake Reservoir in northern Minnesota. It is in a heavily wooded area with a large variety of deciduous and coniferous trees. The site provides a secluded and serene context while still being in close proximity to a large population.

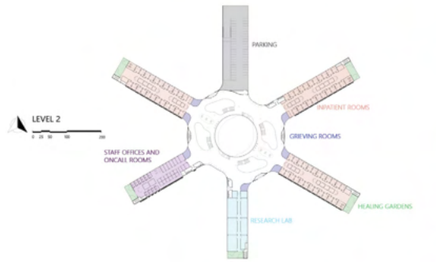
- Approximately 20 minutes from the Duluth International Airport
- Approximately 30 minutes from Essentia Health Medical Center in Duluth

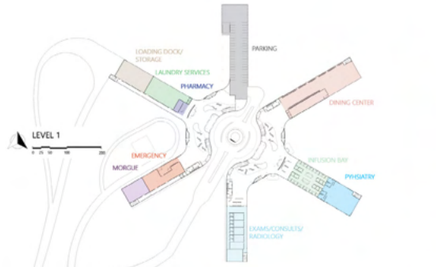
FOREST BATHING · *Taking in the medicine or atmosphere of the forest*

When we are surrounded by nature, we turn off our worries and obsessive thinking. Breathing in forest air increases the level of natural killer cells in our blood. A Japanese study showed NK cells increase in activity by those who forest bathe. Our body uses these NK cells to combat infections and cancers. Plants and trees naturally emit a substance called phytoncide. Their antimicrobial properties influence immunity, improve sleep, lift mood and attention, and boost creativity. The affects of forest bathing alone can improve the emotional well-being of cancer patients, their families, and caregivers.









CIRCULATION AND SPATIAL PROGRAMMING

To reduce confusion and simplify circulation patterns, all patients, visitors, and staff enter the building through the central roundabout. They are directly brought to check-in/drop off, parking, and check-out/pickup. From this central location, the hospital branches out into "wings" that separate the different uses of the building. The first floor is separated into two portions, the first portion houses the check-in desk, dining center, and outpatient services while the second portion houses the check-out desk, emergency room, and morgue. Separating check-in from check-out reduces traffic disruption and keeps movement flowing through the building. The overall layout simplifies circulation patterns, reduces the building footprint, and increases natural daylight in all spaces throughout the building.

THESIS PREMISE

It can be hard to encompass a healthy mentality when cancer is a prevalent factor in your life. Cancer is one of the top leading causes of death. On average, 600,000 people die of cancer every year. One of the most common leading causes of cancer death is lung cancer, making up almost 25% of all cancer deaths. The number of people affected by cancer can multiply by ten or more when family members and caregivers are taken into consideration.

Cancer patients, their family support, and caregivers all undergo challenging circumstances when cancer comes knocking at the door. Being diagnosed with cancer is scary and often traumatizing. Not only do they have to undergo chemotherapy, surgery, and constant hospital visits, they have to be able to mentally prepare and handle this newfound life of theirs. Studies have shown that a person's mental health and social well-being can affect the success of treatment. Leaving room to wonder how mental health is being supported.

Architecture has the ability to create meaningful spaces. In this case, architecture is used to create a healing environment. Hospitals can engulf a sense of serenity and peacefulness, when designed accordingly. Exposure to nature also contributes to a sense of health and wellbeing. By incorporating natural design aesthetics, stress and anxiety is reduced while instilling positive emotions in patients, staff, and visitors. Providing a greater overall experience. This Lung Cancer Research and Treatment Center is designed through the eyes of the patient, the family members, and the caregivers.

THESIS SOLUTION

Internal Wayfinding

Strategically programming the spaces in the building helps reduce the traffic footprint and increases productivity among the workers. The spatial program reduces confusion for patients and visitors, allowing for a more comfortable hospital experience. Architecture and interior elements provide direction with different colors and distinctive changes in appearance.

Nature

The use of indoor plants transforms the hospital stay. Plants promote healing, decrease stress, and are shown to increase productivity for the caregivers in the hospital as well. Plants also improve your overall sensory experience. Greenery provides privacy, comfort, and even aids in directing visitors through the hospital. The addition of water features help mask hospital sound as well.

Natural Design Elements

Research shows that incorporating organic materials, such as wood, into the built environment, can improve occupant comfort, reduce stress and contribute to improved health indicators. Along with using natural materials, increasing natural daylight throughout the building will improve the mood of patients, visitors, and staff. The use of natural design elements offer patients a comforting, supportive and healing environment.

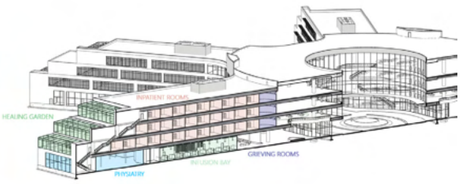
PLANTERRA *• We believe a healthcare setting can also be a peaceful and calming place to recover.*

Planterra is a leading provider of interior landscape services and plant rentals serving corporate campuses of the Fortune 500, medical facilities, hospitality properties and premier retail destinations. Planterra works directly with the hospital and healthcare staff to understand their goals and the needs of those working within the building. Planterra is used throughout the building to provide therapeutic healing gardens.

Therapeutic Healing Gardens

Allergy free indoor plants:
When installing healing gardens within a hospital setting, experts at Planterra use informed practices to ensure the plants chosen for any design are a safe, healthy addition to the environment. We offer allergy-free plant options that do not release airborne pollen.

Safe, sterile plant maintenance:
We use soil-less growing media in the live plants. Soil-less growing media allows plants to thrive in a sterilized, soil-less mixture, free of organic materials which could attract pests or mold. When it comes to watering, Planterra uses a self-contained technology called sub-irrigation. This system of water-wicking technology ensures that a precise amount of water will be supplied as the plants need it. When live plants are not an option, Planterra can install realistic replica plants to enhance the space. It also comes with a cleaning and dusting option to help maintain the sterility and safety of a medical environment.



BOARDS

THESIS PROPOSAL REFERENCES

Bey, L. (2019, November 6). Ann & Robert H. Lurie Children's Hospital of Chicago by ZGF Architects, Solomon Cordwell Buenz, and Anderson Mikos architects. Architectural Record RSS. Retrieved October 11, 2022, from https://www.architecturalrecord.com/articles/7471-ann-robert-h-lurie-childrens-hospital-of-chicago-by-zgf-architects-solomon-cordwell-buenz-and-anderson-mikos-architects

C. Pitceathly, P. Maguire, The psychological impact of cancer on patients' partners and other key relatives: a review, European Journal of Cancer, Volume 39, Issue 11, 2003, Pages 1517-1524, ISSN 0959-8049

James Parkes |11 November 2021 Leave a comment. (2022, February 3). Foster + partners completes hospital with striped facade for University of Pennsylvania. Dezeen. Retrieved October 11, 2022, from https://www.dezeen.com/2021/11/11/foster-partners-hospital-pavilion-university-pennsylvania/

Laurel L. Northouse, Maria C. Katapodi, Ann M. Schafenacker, Denise Weiss, The Impact of Caregiving on the Psychological Well-Being of Family Caregivers and Cancer Patients, Seminars in Oncology Nursing, Volume 28, Issue 4, 2012, Pages 236-245, ISSN 0749-2081

Luco, A. (2021, February 2). The University of Virginia, University Hospital Expansion / Perkins and will. ArchDaily. Retrieved October 11, 2022, from https://www.archdaily.com/956074/the-university-of-virginia-university-hospital-expansion-perkins-and-will?ad_source=search&ad_medium=projects_tab

Madjar, I., Kacen, L., Ariad, S., & Denham, J. (2007). Telling Their Stories, Telling Our Stories: Physicians' Experiences With Patients Who Decide to Forgo or Stop Treatment for Cancer. Qualitative Health Research, 17(4), 428–441.

Maggiora, M. V. della. (2019, January 14). Ann & Robert H. Lurie Children's Hospital of Chicago / ZGF architects + Solomon Cordwell Buenz + Anderson Mikos architects. ArchDaily. Retrieved October 11, 2022, from https://www.archdaily.com/909319/ann-and-robert-h-lurie-childrens-hospital-of-chicago-zgf-architects-plus-scb-architects-plus-anderson-mikos-architects?ad_source=search&ad_medium=projects_tab

Organization, Healio, & ImageObject. (2019, October 24). Depression in oncologists: For many, a closely guarded secret. Healio. Retrieved September 10, 2022, from https://www.healio.com/news/hematology-oncology/20191017/depression-in-oncologists-for-many-a-closely-guarded-secret

Parks and Trails. Canosia Township, St Louis County MN. (n.d.). Retrieved September 10, 2022, from http://www.canosiatownship.org/parks-and-trails/

Staczek, A. D. (2019, September 16). 10 elements of the Perfect Hospital Design - Architizer Journal. Journal. Retrieved September 8, 2022, from https://architizer.com/blog/practice/details/perfect-hospital-design/

THESIS RESEARCH REFERENCES

Akrherz@iastate.edu, D. H. (n.d.). IEM :: Site wind roses. Iowa Environmental Mesonet. Retrieved December 14, 2022, from http://mesonet.agron.iastate.edu/sites/windrose.phtml?network=MN_ASOS&station=DLH

Duluth, Minnesota - sunrise, Sunset, dawn and dusk times for the whole year. Gaisma. (n.d.). Retrieved December 12, 2022, from https://www.gaisma.com/en/location/duluth-minnesota.html

GIS. ArcGIS web application. (n.d.). Retrieved December 9, 2022, from https://gis.stlouiscountymn.gov/landexplorer/

Healthcare design tips for mobs. McMillan Pazdan Smith Architecture. (2022, June 29). Retrieved December 1, 2022, from https://mcmillanpazdansmith.com/advisors-blog/healthcare-design-tips-for-hospitals-and-mobs/

History of Hospitals. • Nursing, History, and Health Care • Penn Nursing. (n.d.). Retrieved December 15, 2022, from https://www.nursing.upenn.edu/nhhc/nurses-institutions-caring/history-of-hospitals/

Legal Information Institute. (n.d.). 24 CFR § 3285.202 - soil classifications and bearing capacity. Legal Information Institute. Retrieved December 15, 2022, from https://www.law.cornell.edu/cfr/text/24/3285.202

Minnesota's native trees. Minnesota Department of Natural Resources. (2022, September 19). Retrieved December 15, 2022, from https://www.dnr.state.mn.us/trees/native-trees.html

Nrcs. (n.d.). Web Soil Survey. Web soil survey - home. Retrieved December 9, 2022, from https://websoilsurvey.nrcs.usda.gov/app/

Robert F. CarrNIKA. for VA Office of Construction & Facilities Management (CFM)Revised by the WBDG Health Care Subcommittee. (2017, June 4). Hospital . WBDG. Retrieved December 1, 2022, from https://www.wbdg.org/building-types/health-care-facilities/hospital

"Somebody else's business": The challenge ... - wiley online library. (n.d.). Retrieved November 28, 2022, from https://onlinelibrary.wiley.com/doi/10.1111/jpm.12596

THESIS DESIGN SOLUTION REFERENCES

(DRT), P. (n.d.). Guidelines for intensive care unit design* : Critical care medicine. LWW. https://journals.lww.com/ccmjournal/Fulltext/2012/05000/Guidelines_for_intensive_care_unit_design_.26.aspx

Field, B. (2021, July 21). What is forest bathing?. Verywell Mind. https://www.verywellmind.com/what-is-forest-bathing-5190723

On the planning and design of hospital circulation ... - sage journals. (n.d.). https://journals.sagepub.com/doi/full/10.1177/1937586716672041

Pliska, S. (2020, April 24). Planterra interior landscaping and office plants. Planterra. https://planterra.com/

Thinkwooddev. (2022, September 16). Timber tonic: How wood and natural materials can transform healthcare facility design. Think Wood. https://www.thinkwood.com/blog/wood-healthcare-facility-design

Wood and health: Building performance: Naturally:wood. naturally. (2022, August 2). https://www.naturallywood.com/wood-performance/health/

PREVIOUS STUDIO EXPERIENCE

2ND YEAR

FALL 2019: EMILY GUO

- Project: Dwelling House - Leaf Creek
- Project: Boat House - A&H Rowing

SPRING 2020: RON RAMSEY

- Project: Bird House - Stronghold Habitat
- Project: Cripple Creek - Mackenzee Foster Home
- Project: Faculty Apartment - Sevens Loft

3RD YEAR

FALL 2020: ALENJERY NILOUFAR

- Project: Story Telling Architecture - Escape
- Project: Mini Thesis - Factory Farming: A New Take on Modern Farming

SPRING 2021: PAUL GLEYE

- Project: New American Exposition Center - Cultural Center
- Project: Dennis Lanz Design Competition - Musical Pavilions

4TH YEAR

FALL 2021: MARK BARNHOUSE

- Project: Highrise Capstone - La Cruise

SPRING 2022: AMAR HUSSEIN

- Project: Marvin Competition - Marvin Home
- Project: Urban Design - Bal Harbour