DUNE

ΚΑΛΥΨΩ

2023 DANKING BHUJEL

DUNE

K A L U T O Q A N I Q

Danking Bahadur Bhujel

2023

M. Arch

Department Of Architecture

Texas A & M University

DUNE

K A L U T O Q A N I Q

Free snow particles accumulate and drift like sand grains in barchan dunes under the action of a steady wind, and the resulting drifting snow shapes are also known as barchans. The Inuit of Canada and Alaska refer to them as kalutoqaniq. When the winds die down, the drifted formations resolidify through sublimation and recrystallization. Winds erode the kalutoqaniq into the sculptured forms of sastrugi.

Dune is a proposed hospital project in one of the most remote areas of the United States, where the community is completely cut off from the rest of the world.

I think therefore I am...As I am WHERE *I do and think*

DUNE

ACKNOWLEDGEMENTS

I'd like to thank every friend who has inspired me and assisted me in getting to where I am today. This journey would not have been possible without the department's and the university's support. I am grateful to every professor who has taught me wonderful things in their classes and assisted me in incorporating those things into my design thinking.

Every wonderful discussion with my committee chair, Professor Ray Pentecost, has taught me to learn more and understand that what we design has a huge impact on everyone's health, which has caused me to reconsider the design approach with supporting evidence.

I am grateful for the wonderful discussions I have had with Professor Robert Brown, who has helped me understand the importance of landscape in the most extreme climates. I'd also like to thank Professor Carlos Baltazar for his assistance in understanding the climate of the region and the appropriate design solutions required in such climatic zones.

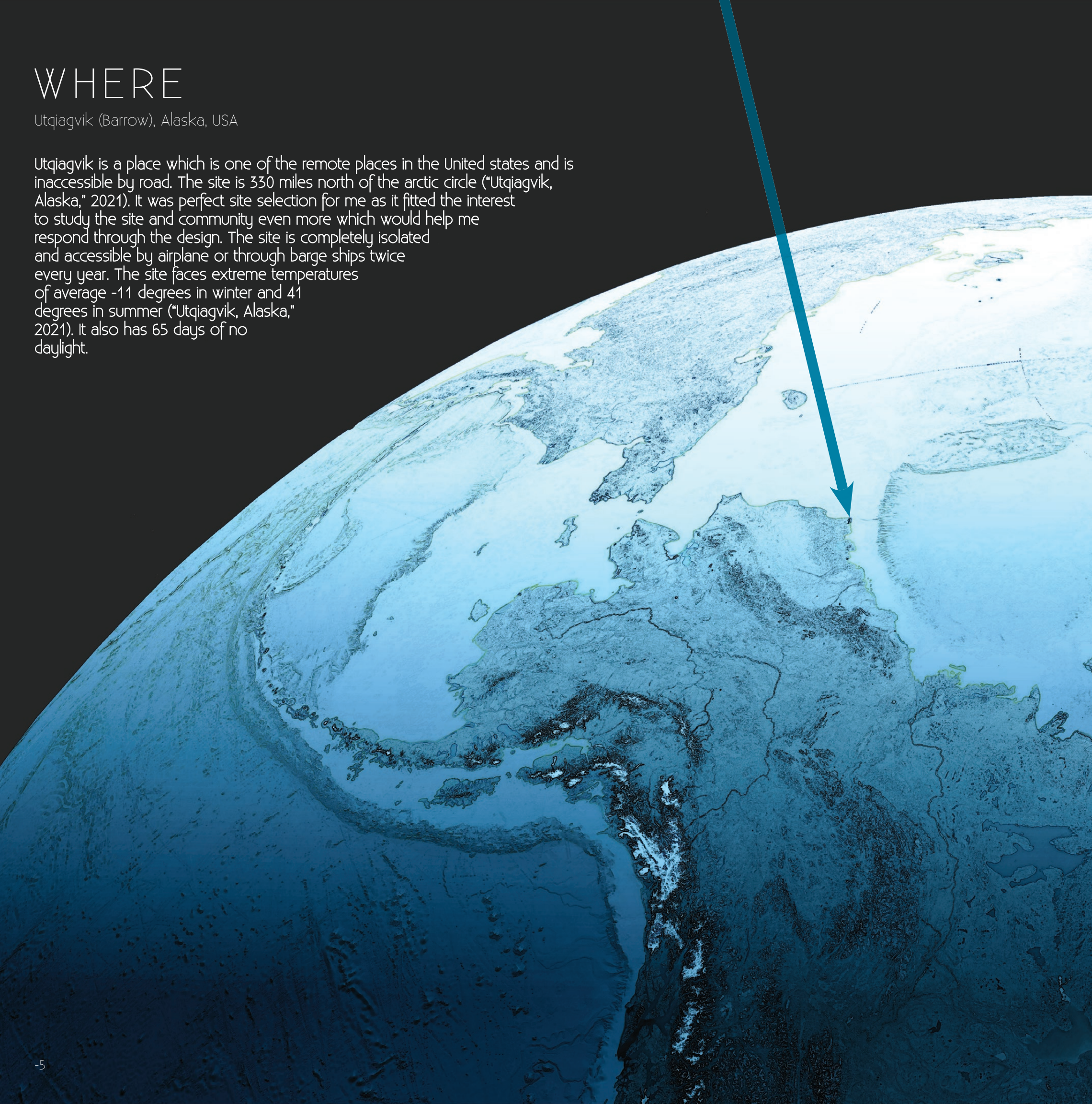
I would not have been able to design dune as it is now if Professor Marcel had not been my studio professor. His design consultations have kept me on track throughout the year.

Finally, I'd like to thank Jason Arnold, Principal and Owner of RIM Architects, who designed the Samuel Simmonds Memorial Hospital in Utqiagvik, right next to the Dune site, for taking the time to help me understand the site and tackle all of the challenges in order to come up with different design solutions.

WHERE

Utqiagvik (Barrow), Alaska, USA

Utqiagvik is a place which is one of the remote places in the United states and is inaccessible by road. The site is 330 miles north of the arctic circle ("Utqiagvik, Alaska," 2021). It was perfect site selection for me as it fitted the interest to study the site and community even more which would help me respond through the design. The site is completely isolated and accessible by airplane or through barge ships twice every year. The site faces extreme temperatures of average -11 degrees in winter and 41 degrees in summer ("Utqiagvik, Alaska," 2021). It also has 65 days of no daylight.



WHY

Utqiagvik (Barrow), Alaska, USA

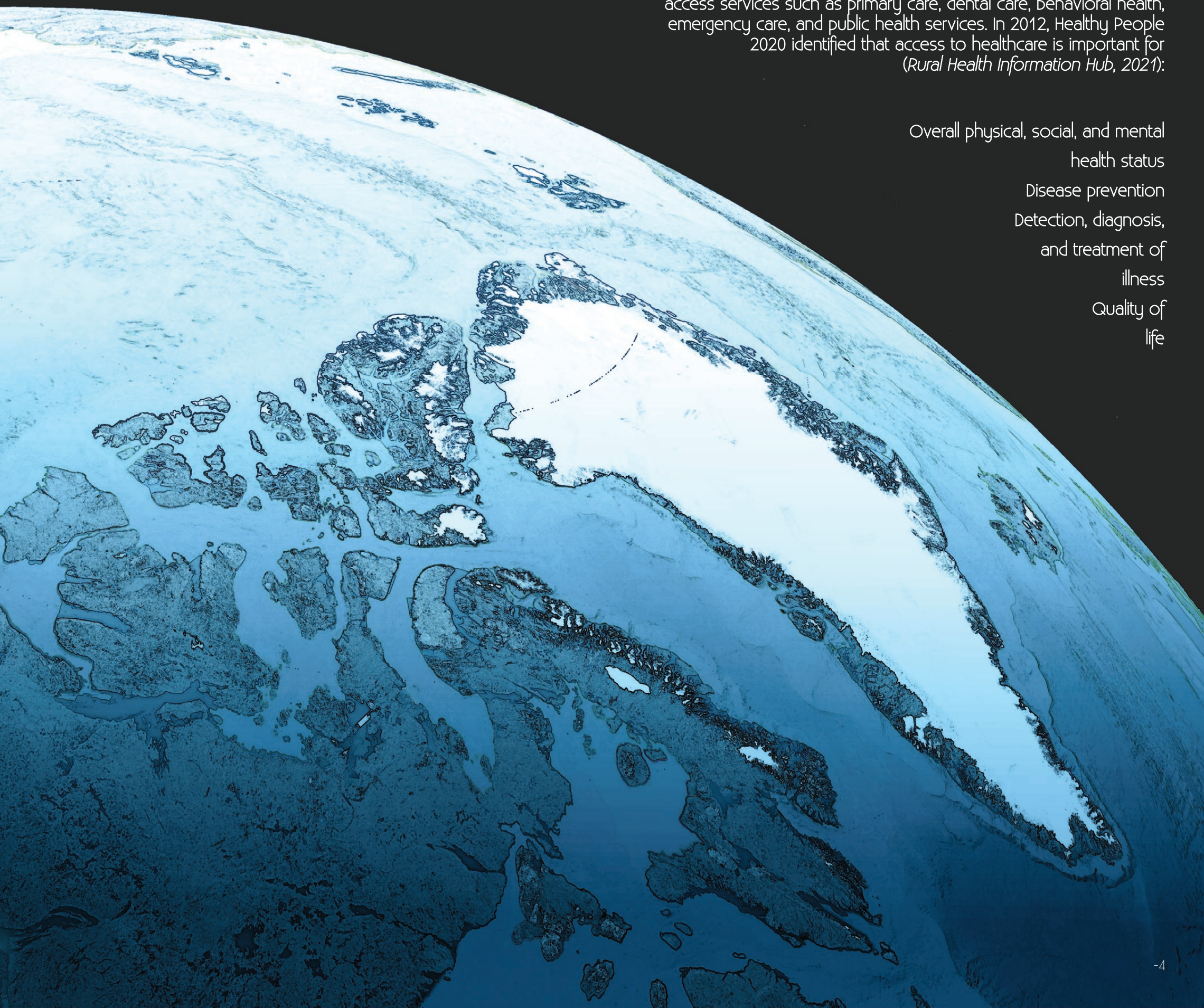
Access to healthcare services is critical to good health, yet rural residents face a variety of access barriers. Ideally, residents should be able to conveniently and confidently access services such as primary care, dental care, behavioral health, emergency care, and public health services. In 2012, Healthy People 2020 identified that access to healthcare is important for (*Rural Health Information Hub, 2021*):

Overall physical, social, and mental health status

Disease prevention

Detection, diagnosis, and treatment of illness

Quality of life



Utqiagvik (Barrow)

Rural populations are more likely to have to travel long distances to access healthcare services, particularly subspecialist services. This can be a significant burden in terms of travel time, cost, and time away from the workplace. In addition, the lack of reliable transportation is a barrier to care.

Due to the harsh conditions, people spend most of their time indoors and their health is depleting. Even the outdoor air quality is poor. Dust from unpaved roads may contain pollutants that can be inhaled or deposited on subsistence food sources.
(United States Environmental Protection Agency, 2017).

Chronic lower respiratory disease has been one of the leading causes of death.These factors are not driving people away because they have a place to call home. They believe in community and respect each other. The site has given almost 4000 people living there a sense of belonging.

QUESTIONS

Is healthcare design just to design a space for patients to be treated?

How can architecture respond to extreme climate?

How does architecture respond to permafrost?

How can healthcare and architecture merge to the context?

How can indoor architecture improve wellbeing of all users in a healthcare built environment?

How can we improve wayfinding?

How can we connect the outdoor environment to the indoor through architecture?

How is thermal comfort in response to architecture?

WHAT IS THE ARCHITECTURE OF ALL THIS?

Ray Pentecost

Committee chair

Juan Carlos Baltazar

Committee member

Robert Brown

Committee member

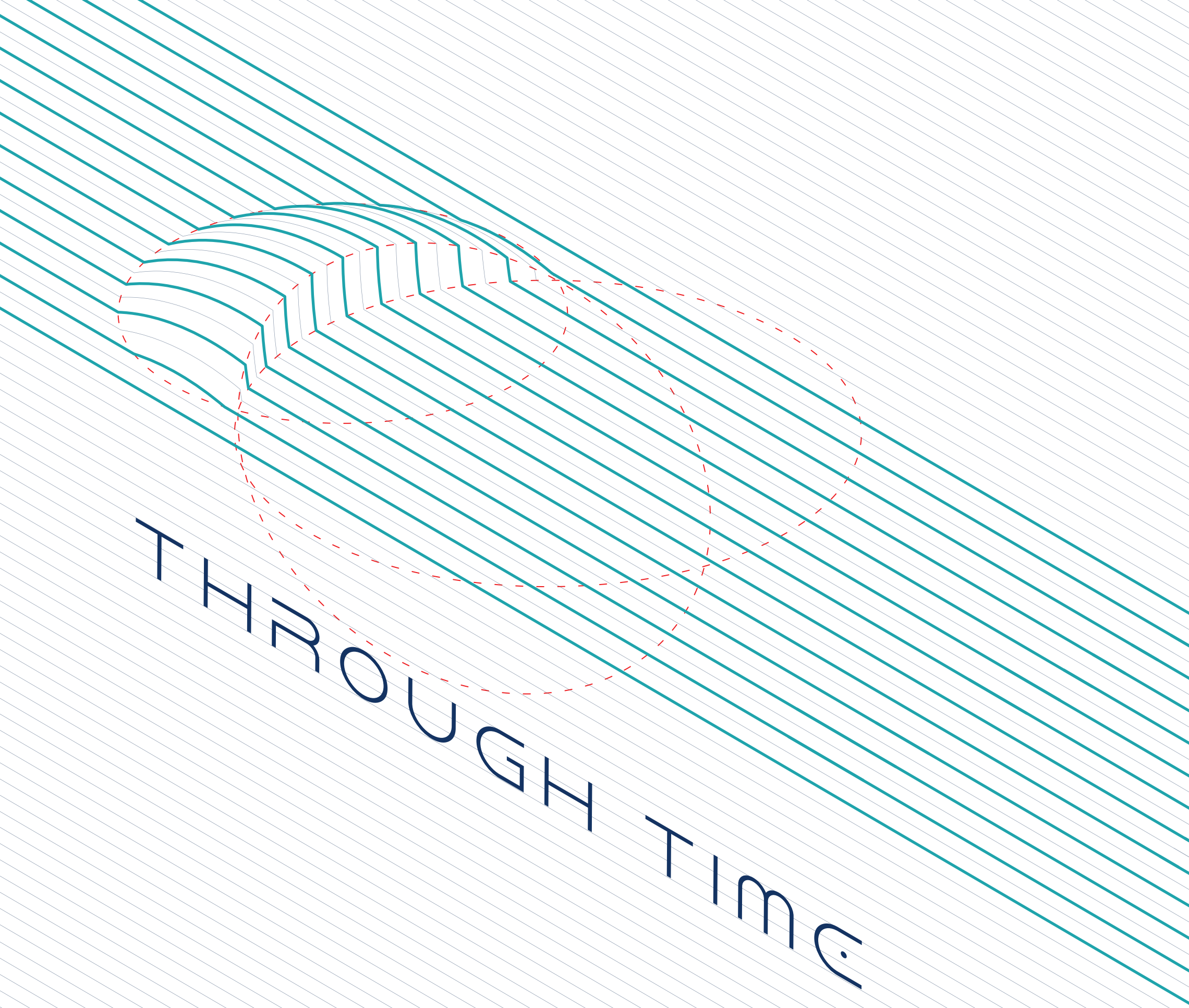
Marcel Erminy

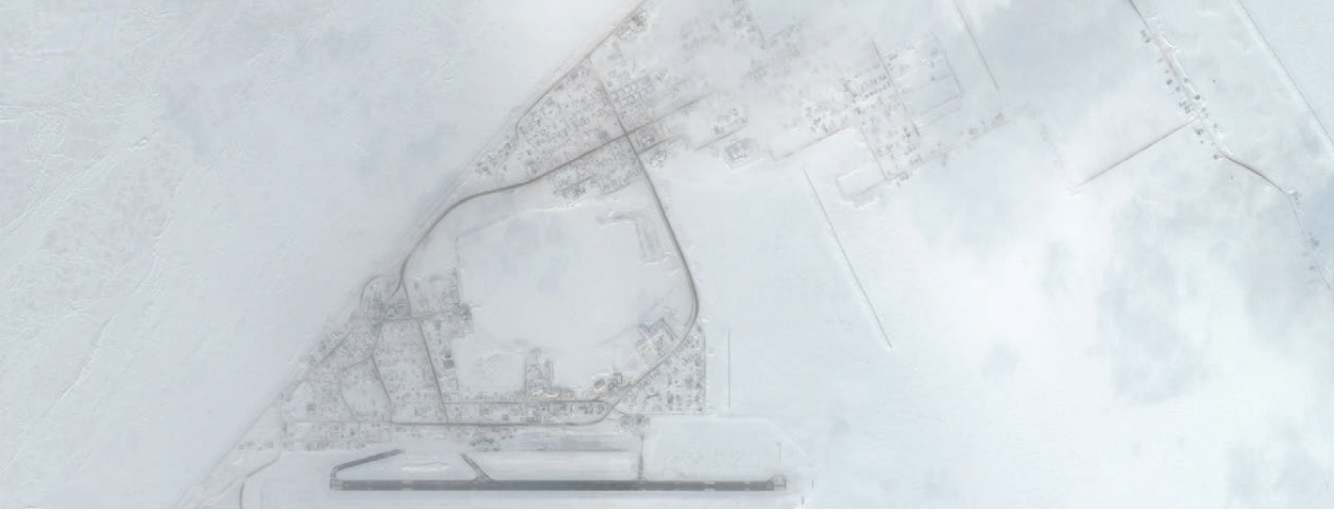
Studio Professor

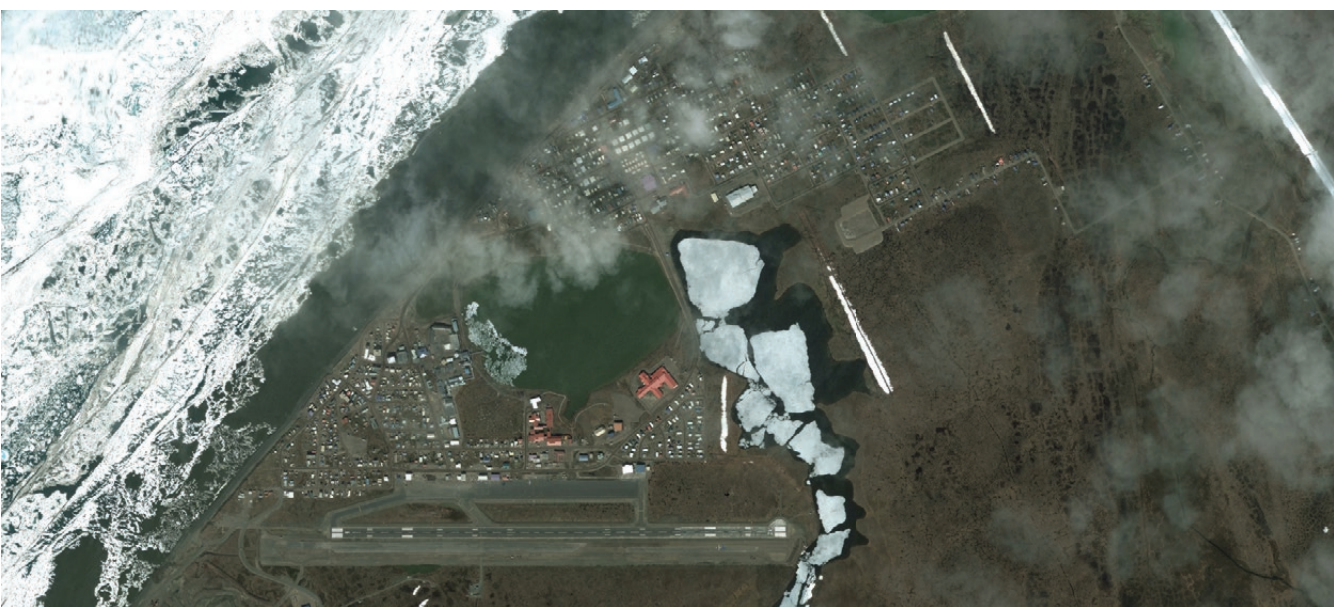
T H E T E A M

CONTENTS

Technology


THROUGH TIME





UTQIAGVIK THROUGH TIME

Frozen ground prevents burying waste in landfills, and many communities' resort to burning trash that creates air pollution.

The cold climate means people spend significant time indoors in homes and buildings where indoor air pollution can accumulate.

Electricity primarily comes from diesel generators that produce particulate and other air pollutants

Dust from unpaved roads may contain pollutants that can be inhaled or deposited on subsistence food sources."

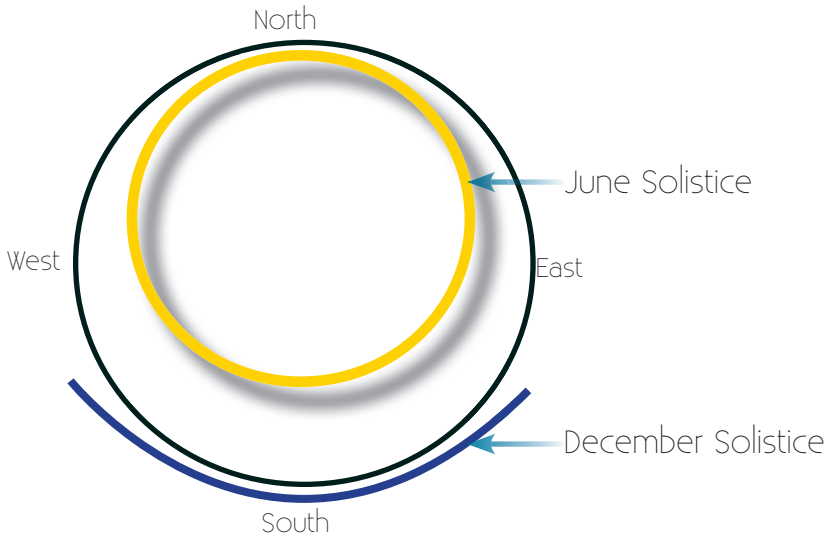
"Tribes in Alaska face unique challenges to protecting air quality and reducing health risks in their communities"
(USEPA, 2016)

53 % reported smoking few days a week
(NSB, 2015)

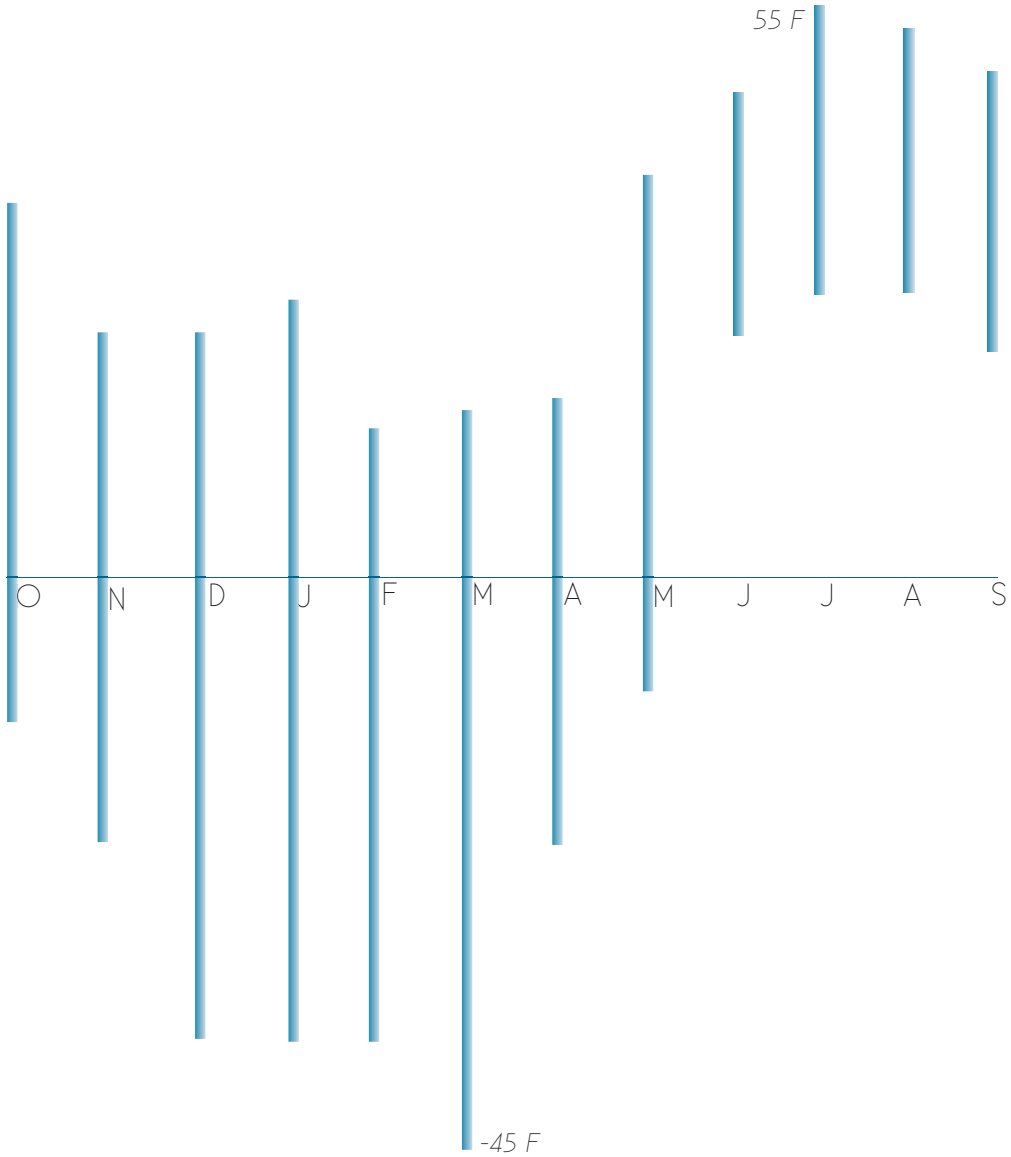
Chronic lower respiratory disease has been one of the leading causes of death

One-fifth of frozen soils at high latitudes are thawing rapidly and becoming unstable, leading to landslides and floods that release carbon into the atmosphere.
(nature)

Strong wind blows from the N-E direction which is why locals have put fences perpendicular to the direction to avoid snow gathering in their building and property



Almost 80 days without sunset and 65 days without sunlight



Sense of Presence

The path of light shapes life

-Olafur Eliasson

I have been very fascinated by the practice of Olafur Eliasson. He is an artist and an architect driven by the ongoing climate change. His works reflect his approach for people to feel everything around them with all of their senses. After studying the site and completing the programming, we came to a conclusion to design a hospital next to an existing one which would meet not only the required programs now but also respond to the challenges we face in designing a healthcare building.

Goals

Connection to the outdoors: this connection helps remove patients from the typical clinical feel. *(Rhode, 2018)*

Comfortable workspaces such as break rooms, open corridors, and adequate workstations can help enhance the workplace of the staff *(Int, Academy for Design and health)*

Good way finding can reduce stress and frustration for the visitor, increase functional efficiency, increase safety, and promote visitor accessibility *(Passini and Arthur 1992)*

Staff tend to feel happier and work better with access to large windows *(Paul,2015)*

A neighborhood organization will help with wayfinding and streamline the experience for the patients *(HFM)*


Transit Street
Yugit Street
Saya Street
Ahmoagak Street
Yugit Street
Sanatu Street
Kignak Street
Ligu Street
Qaiyaan Street
Ula Street
Ahgeak Street
Samuel Simmonds
Memorial Hospital
PLACE

P r e c e d e n t

Samuel Simmonds Memorial Hospital

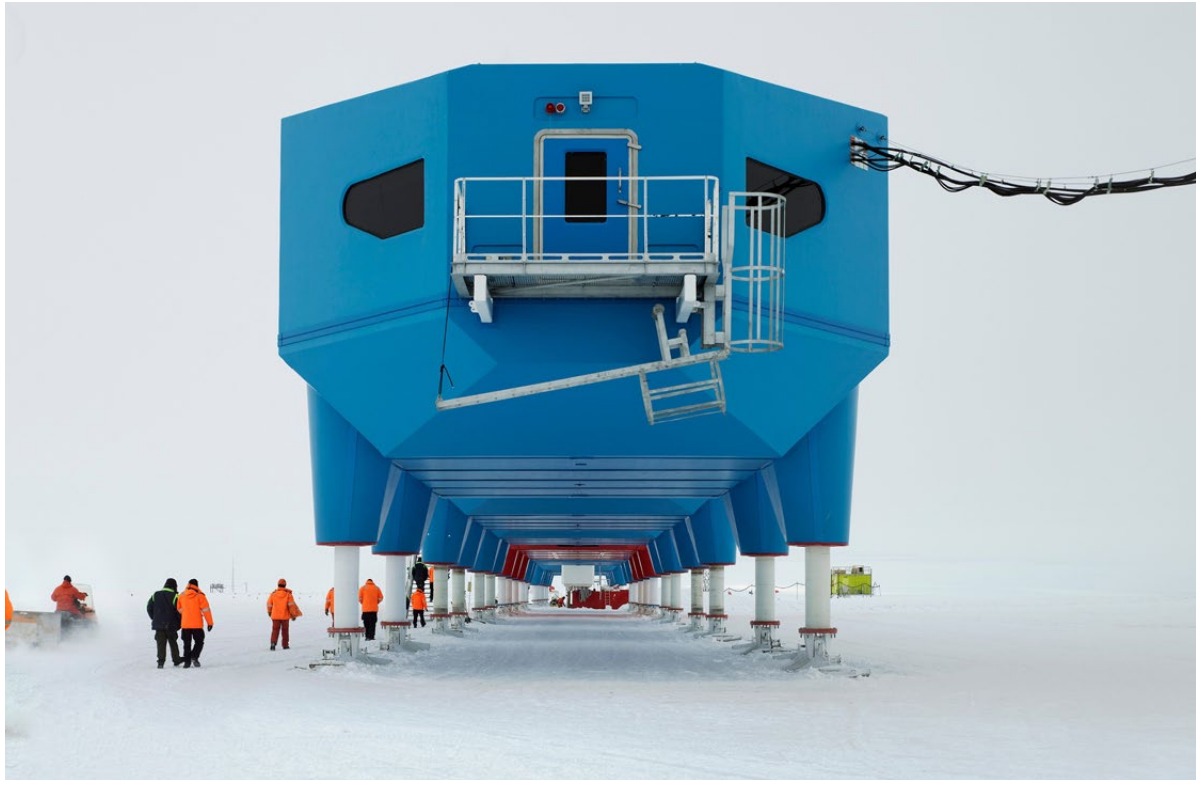
Location - Utqiagvik, Alaska
Date - 2009-2013
Client - Artic Native Slope Association
Team - RIM Architects

This project helped me to understand the site, community and design challenges. This project became the base to the project programming and design initiation.

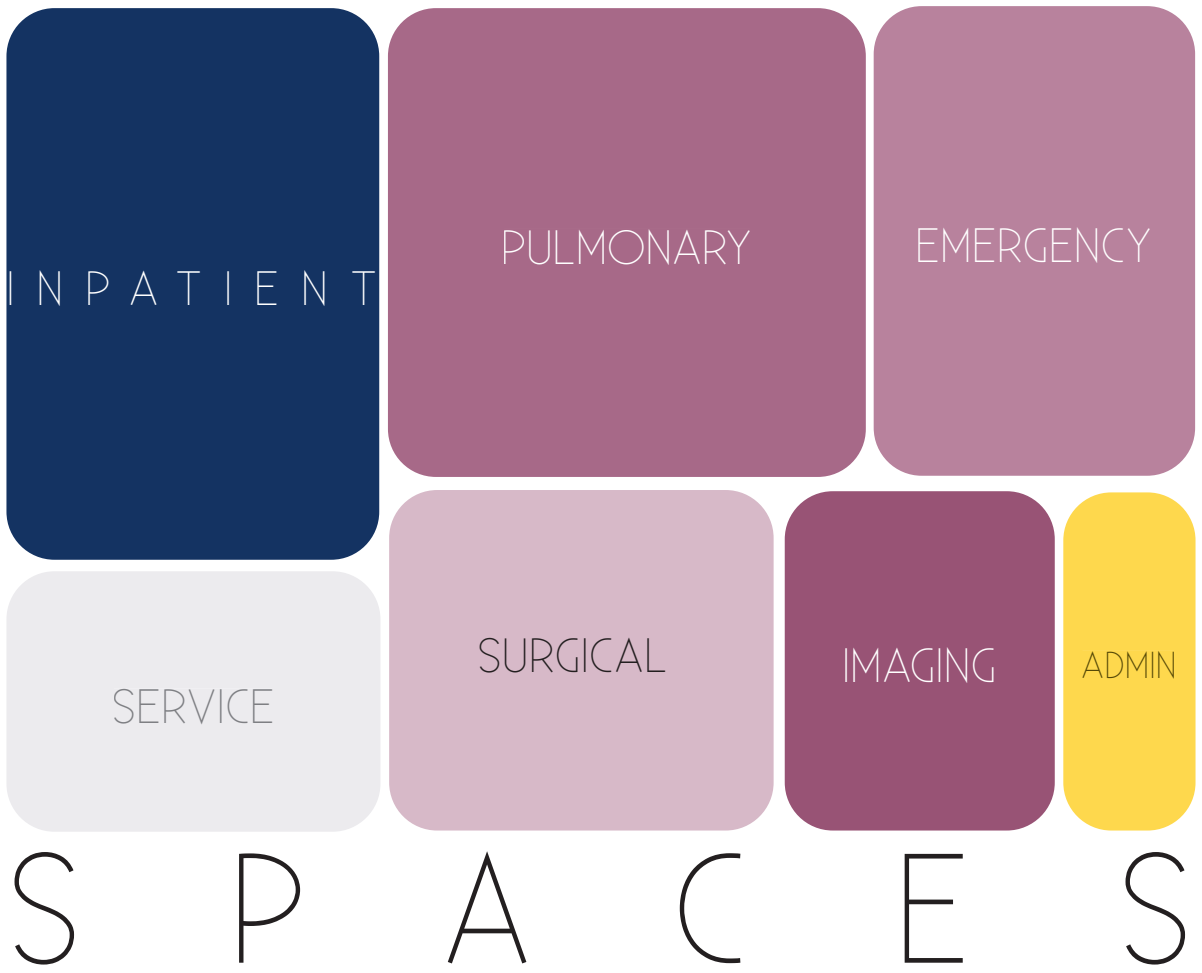
Halley VI British Antarctic Research Station

Location - Brunt Ice Shelf, Antarctica
Date - 2005-2013
Client - British Antarctic Survey
Team - HBA
AECOM

This project helped me understand how to improve the well being of researchers who have to spend most of their time in a tight envelope



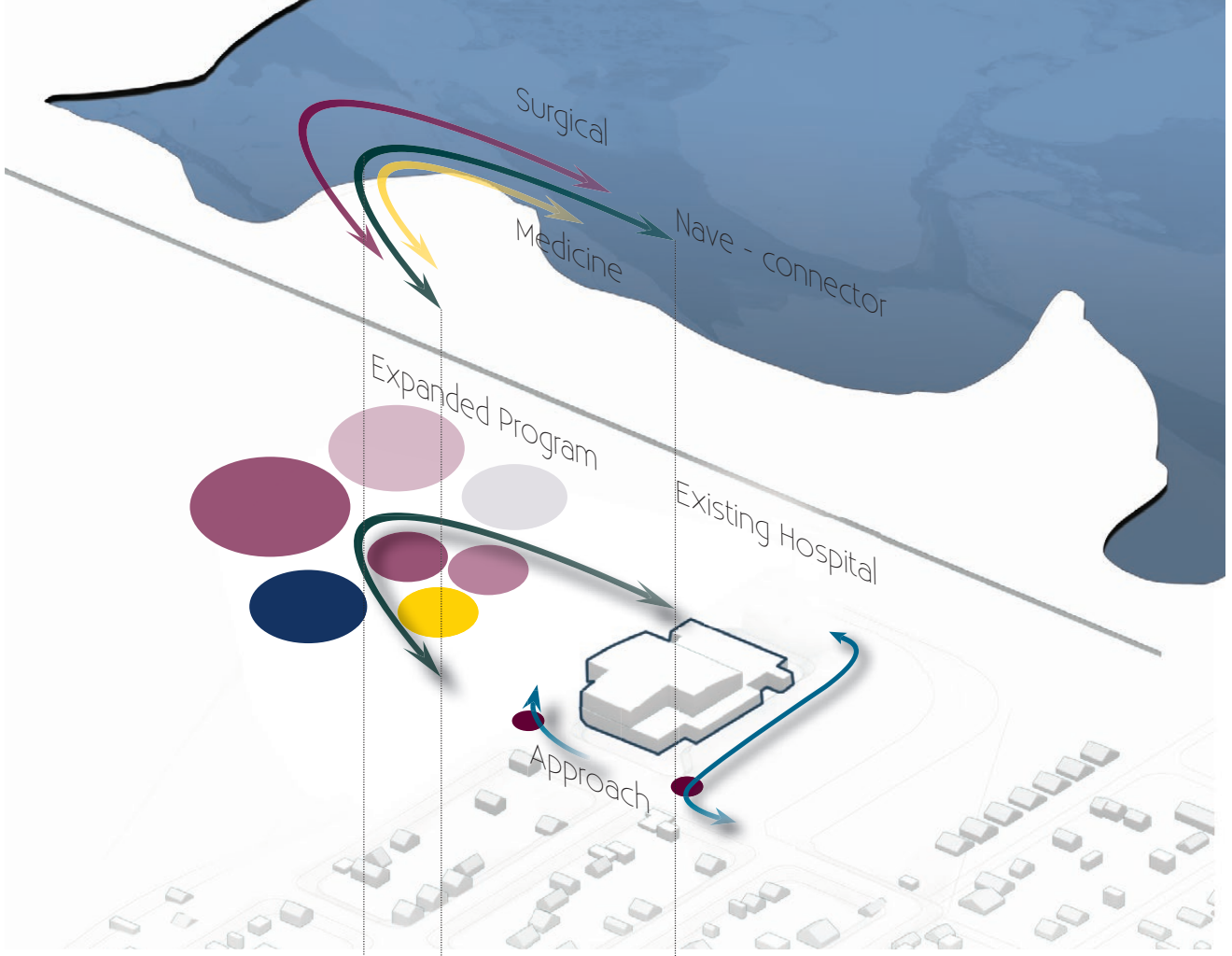
Programing



SPACES

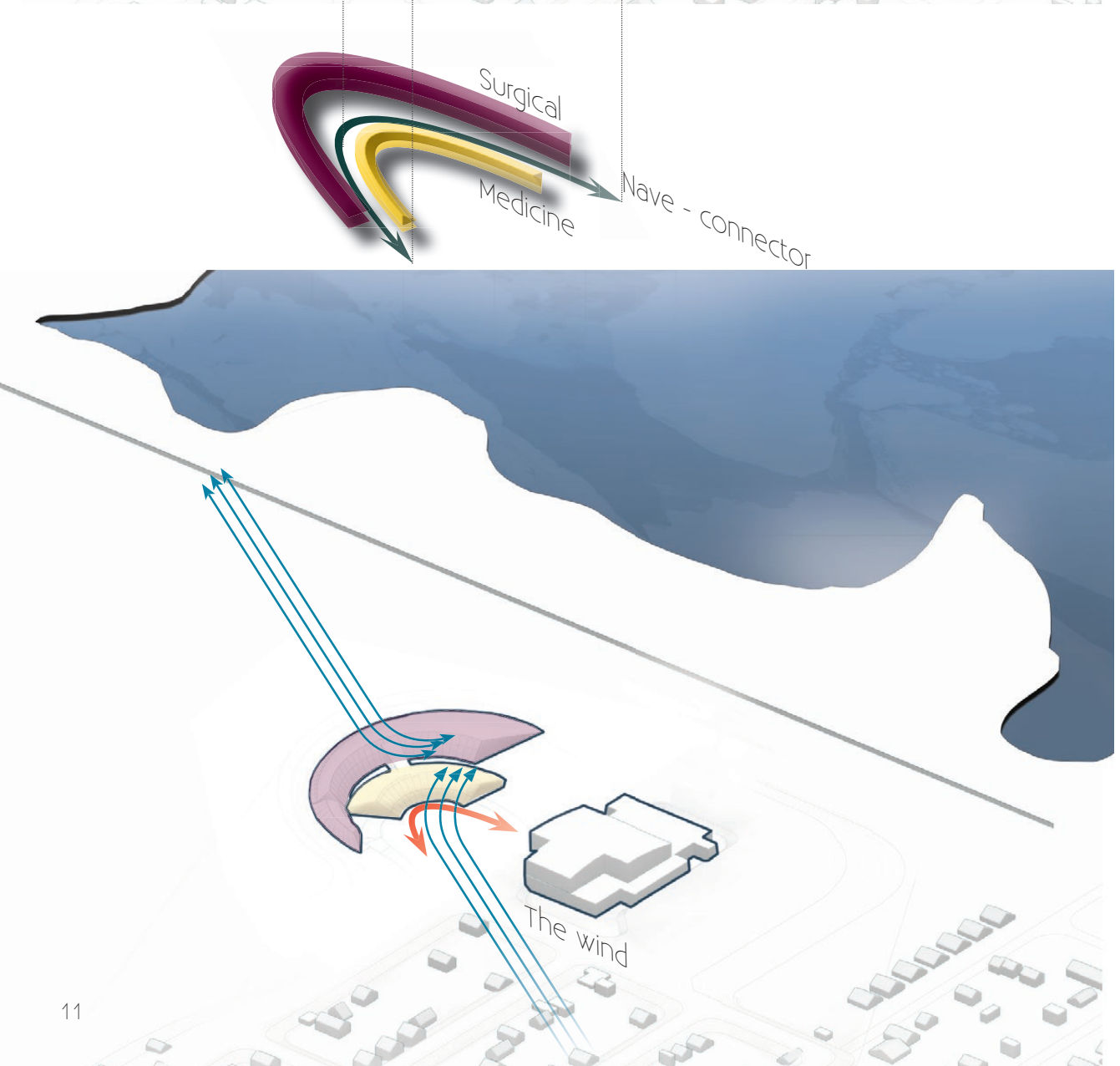
We decided to design the new building to the south of the existing hospital after studying the entire town. The existing programs were investigated, as well as the current health status of the residents. It was thought logical to include a surgical ward as well as a pulmonary department in the new design. However, it was necessary to maintain a smooth functional flow between two blocks.

Introduction



Design flow

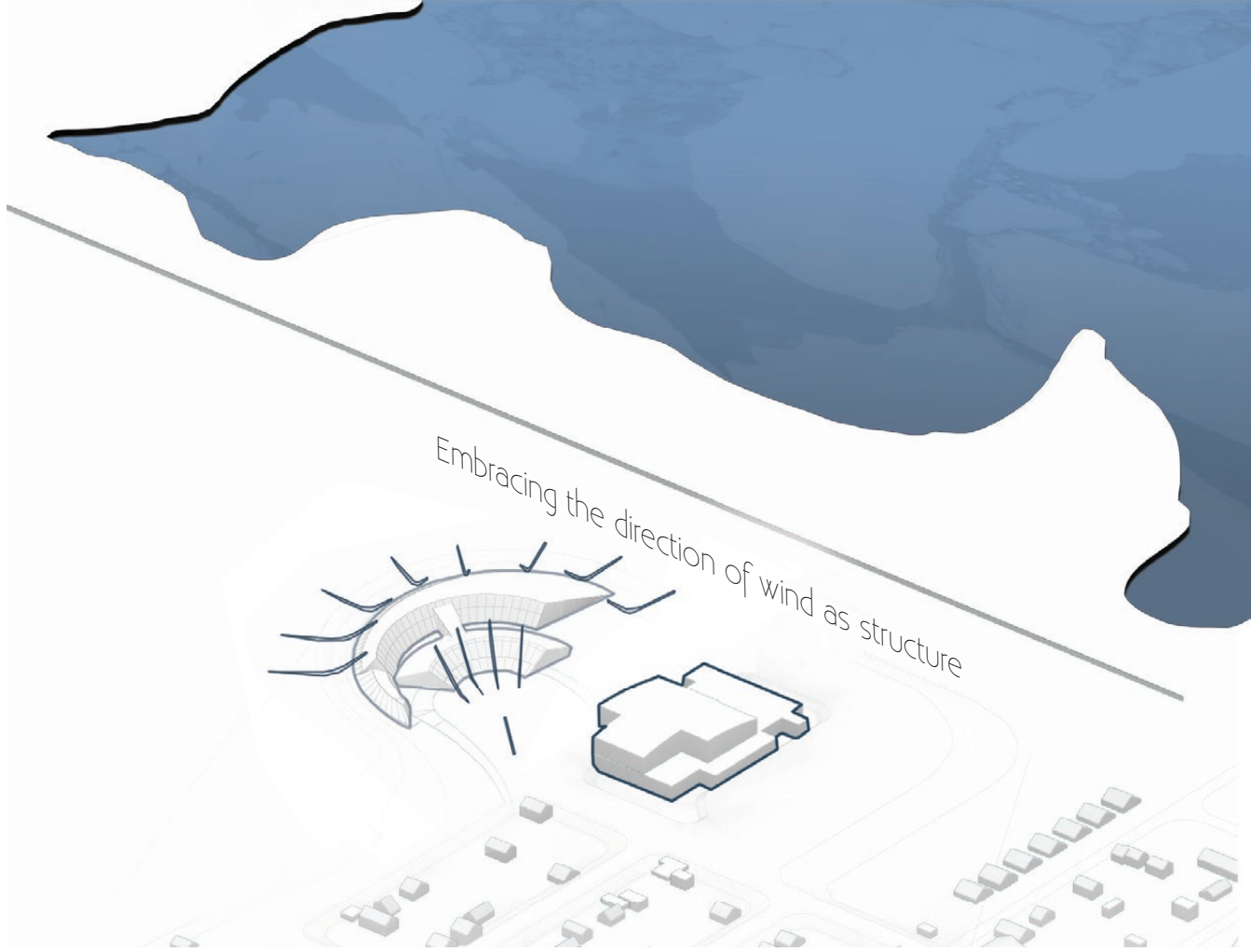
Since we are designing with programs in addition to the existing one, the spaces had to respond to the flow of the existing hospital as well as new flow. Overall the block was divided into three blocks. Front block would be the medicine block and the middle would be the central nave or the connection space and the next block would be the surgical block. This led to the placing of emergency close to the entrance and also near the emergency department next door.

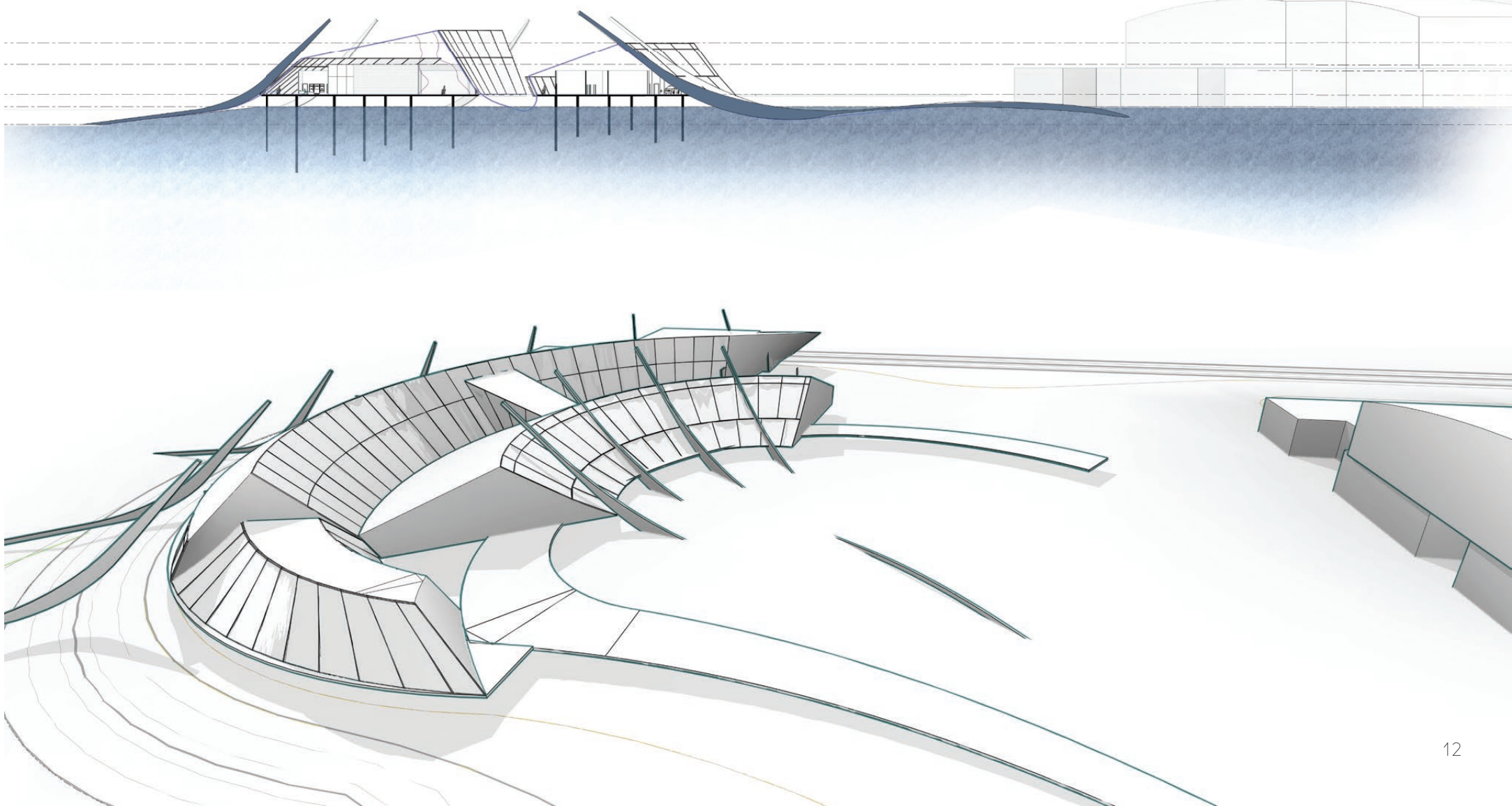


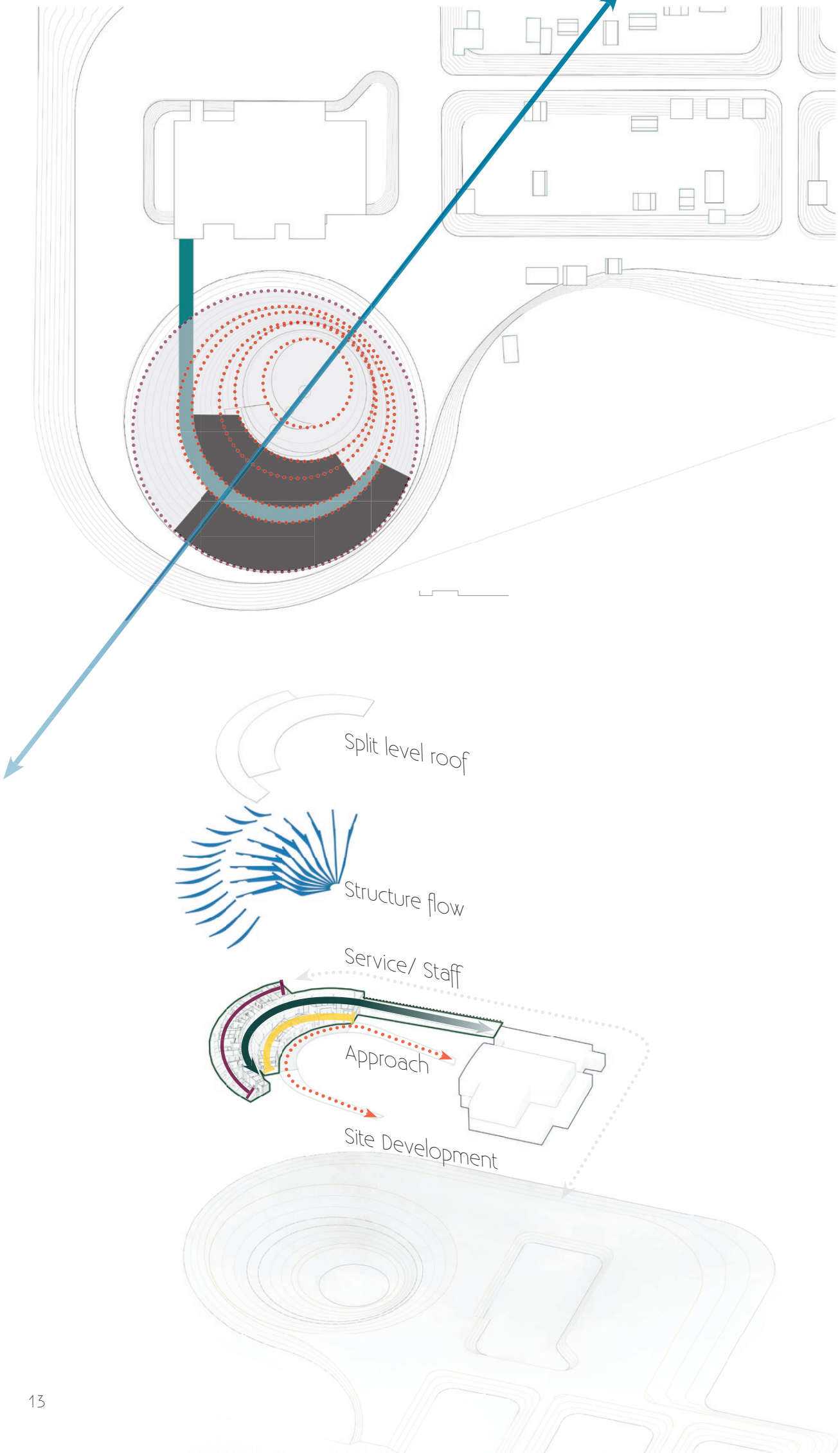
For people to feel the sense of belonging is when they see something familiar. In this site where everything is white and isolated, it was very difficult to think of something. But while studying the site I along with my professors we listed many things that could be a source of familiarity to them. We drew the thawed and broken permafrost lines seen on the ground or the shape of a lake nearby. But as we kept drawing, we came to realize that the settlement planning is affected by the direction of the wind which gave a strong axis.

After that, we came to decide that Dune would be a perfect familiar approach as the site is affected by the white dunes formation rather than actual snow falling. Dune became a strong guiding concept to the orientation of the building, flow of the circulation along with zoning as well as the overall form of the building.

During study of the existing hospital next to ours, we found that it is wise to raise the building on the ground rather than touch it as the permfrost would thaw and cause the building to fail. This led to filling out the overall site according to the shape of the dune and having split levels of blocks so that the building would allow the wind to flow smoothly underneath the building. This made us orient the shape of the facade as a curved dune shape in the orientation of the wind which in turn gave shape to the slope of the filled region of the fillings.







Refinement

Connection to the building

Decrease the surface area to be exposed to the outside

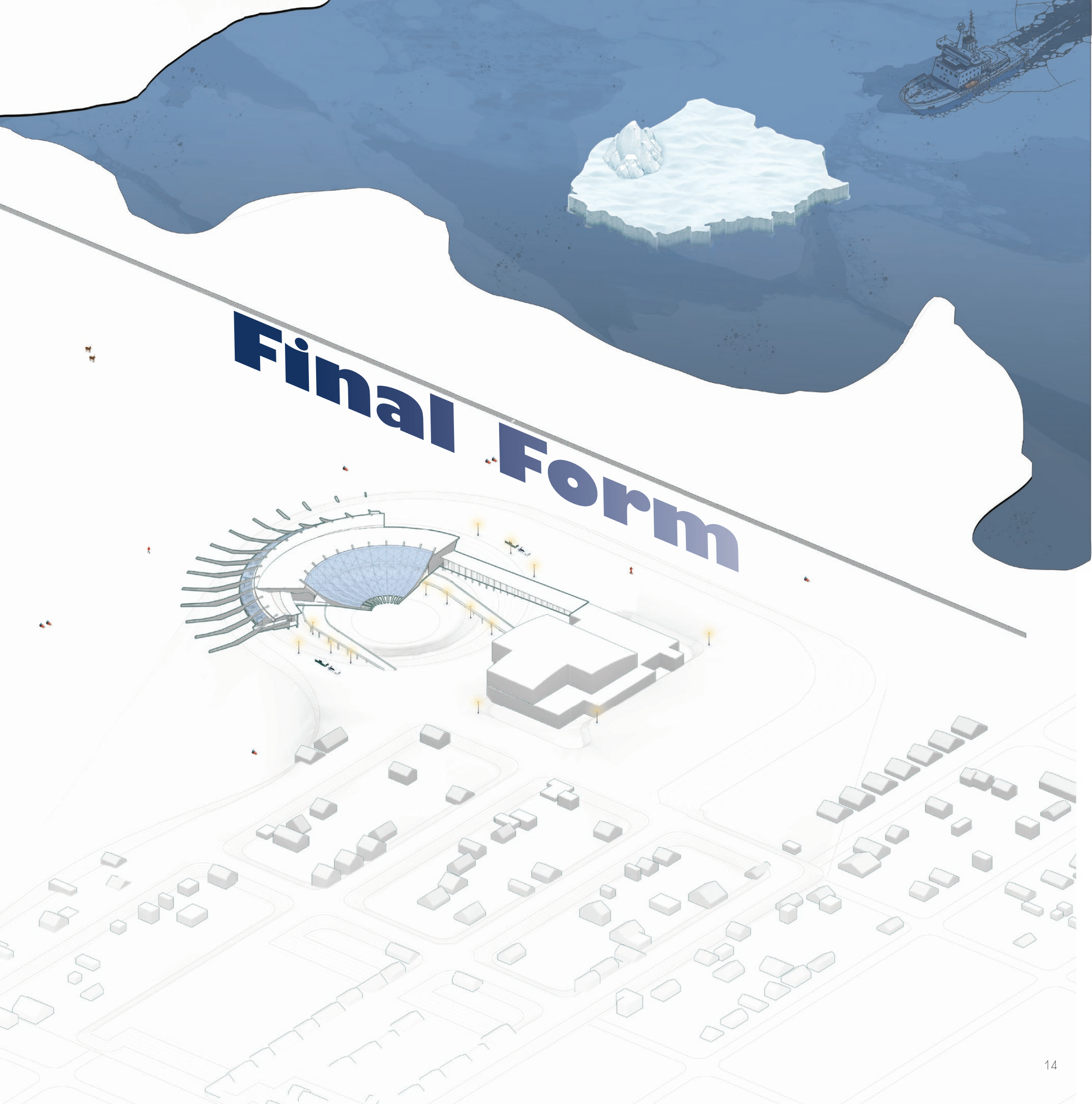
Public and patient flow must be unobstructed

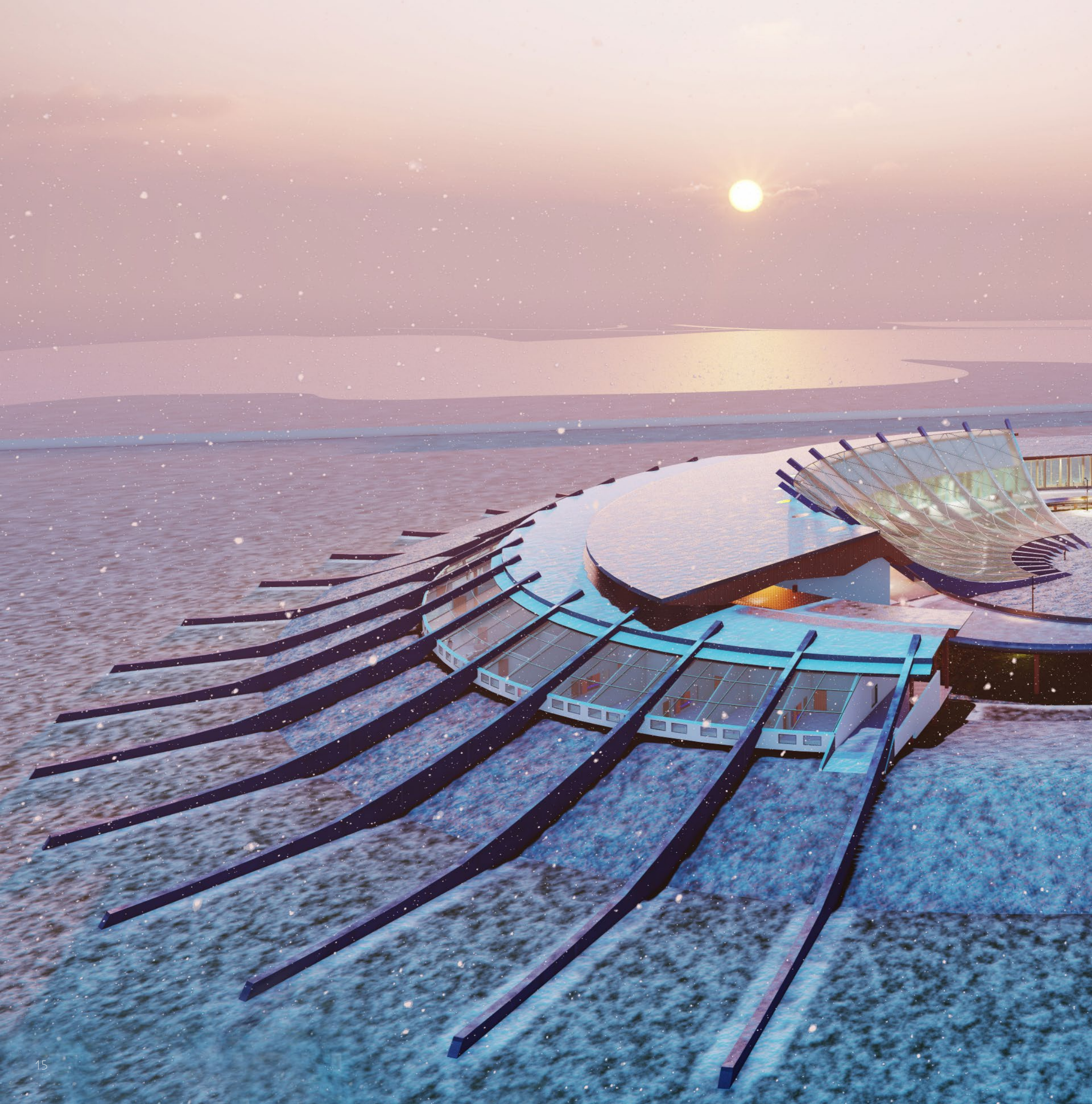
IV

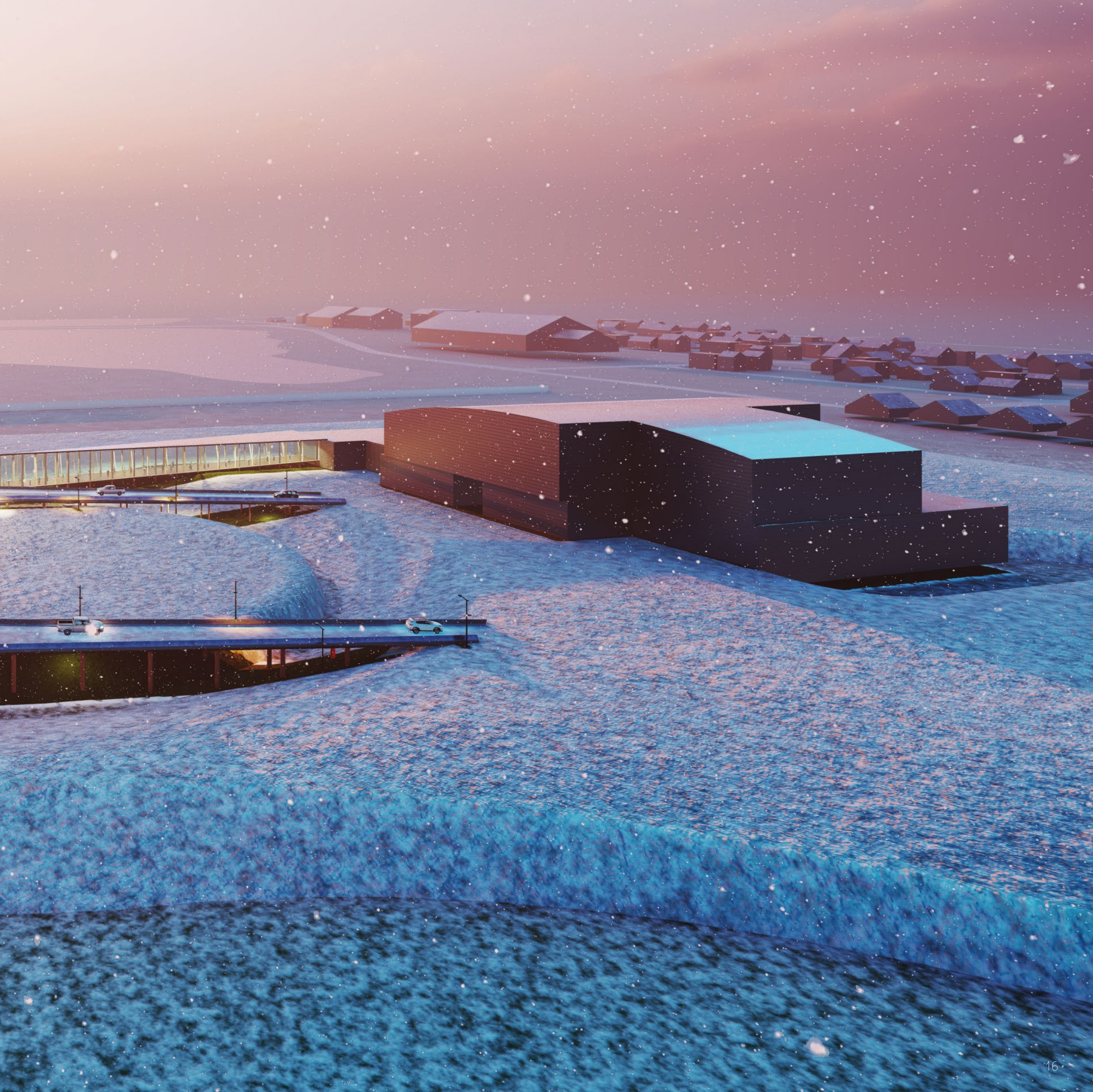
It became necessary to further develop the schematic design approach after weighing the pros and cons. We followed the strong central axis along the approach junction and in the wind's direction. Then, along the main axis, different circles with different centers were drawn. If we had used the same center, it would have become the focal point of the entire design, which was not the intention.

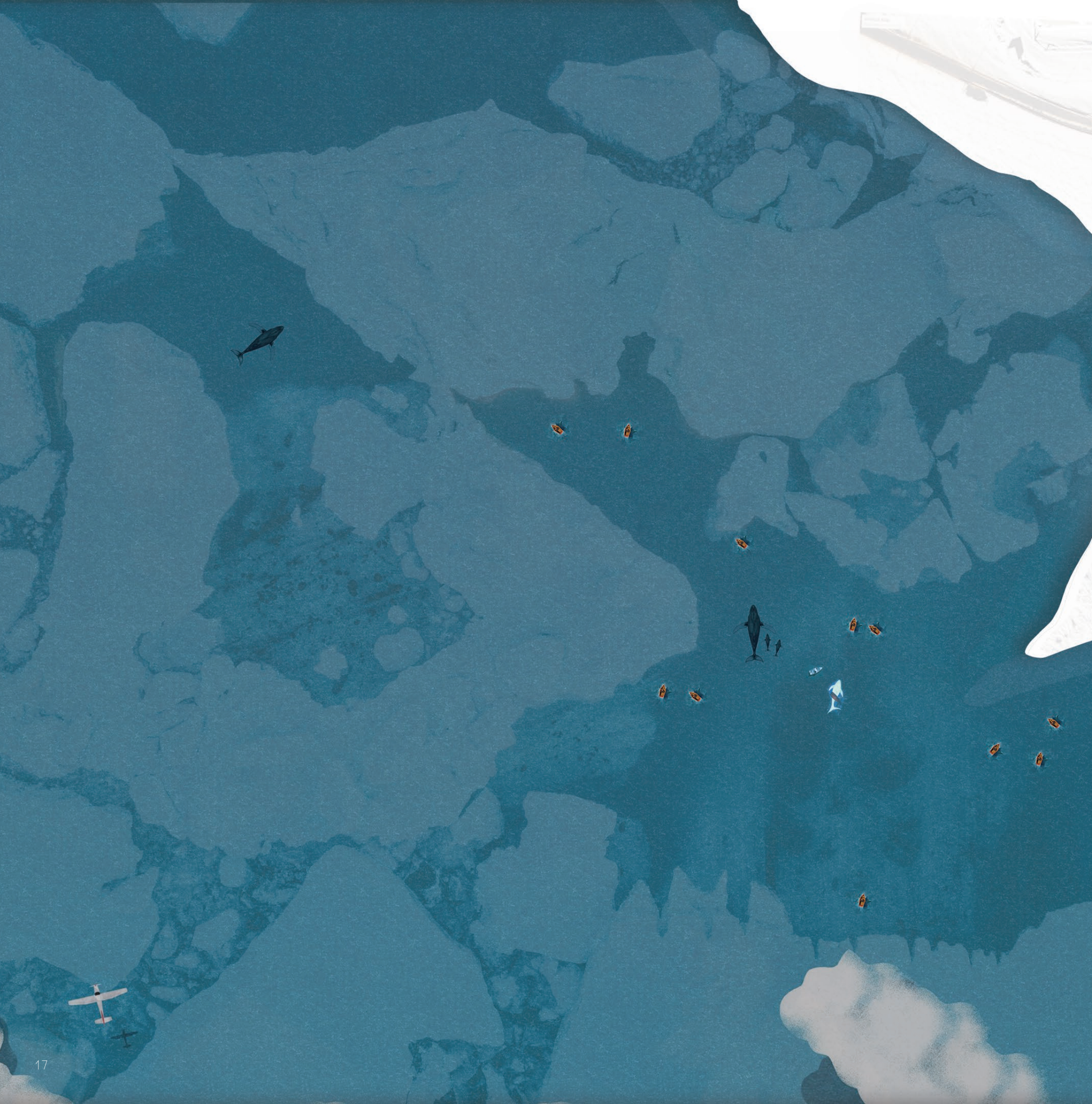
The goal was to demonstrate the dynamic formation of mass as the wind and climate do to the land here. Furthermore, the site filling was developed along the building's inside and outside circles. The DUNE shape of the building would complement the site slope, demonstrating how the dune forms naturally in the harshest climate.

Final Form









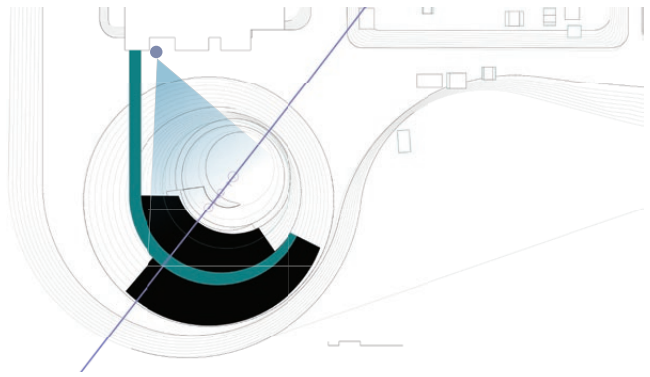
25' 50' 100'

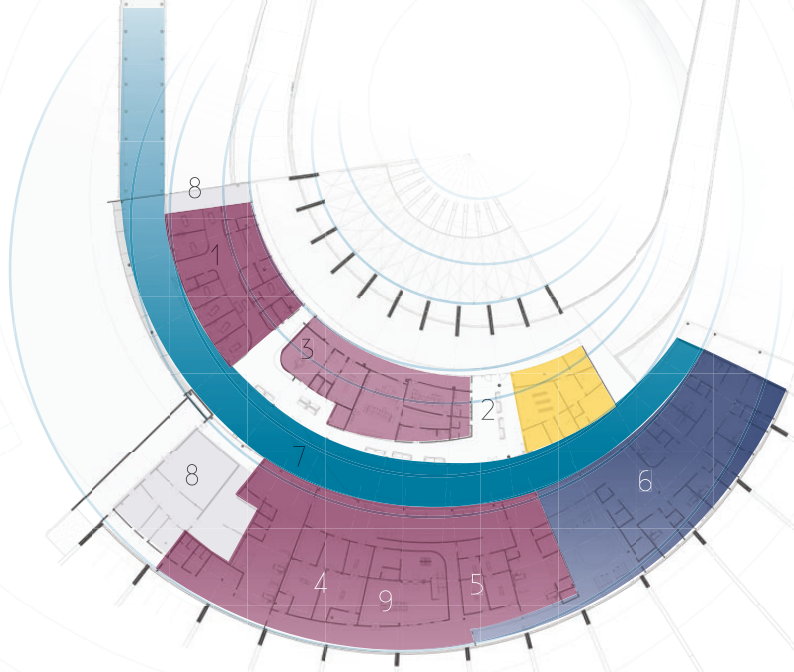
Site Plan

Sense of Arrival

It is critical to understand and anticipate where one is going. The approach from the vehicle through the bridge and under the front covered glass facade will give visitors the impression that they are entering something glacial, with light filtering through the glass into the entryway.

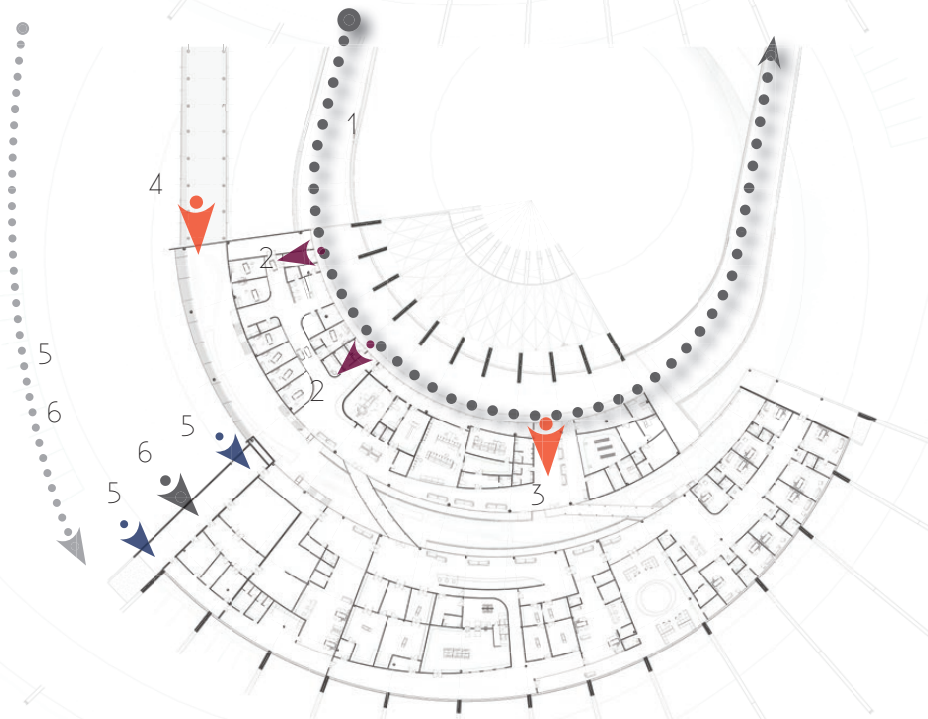
Even the block connecting to the existing hospital is designed in such a way that passing through it gives everyone a sense of approach, with one side overlooking the proposed hospital and the other overlooking the lagoon and city.





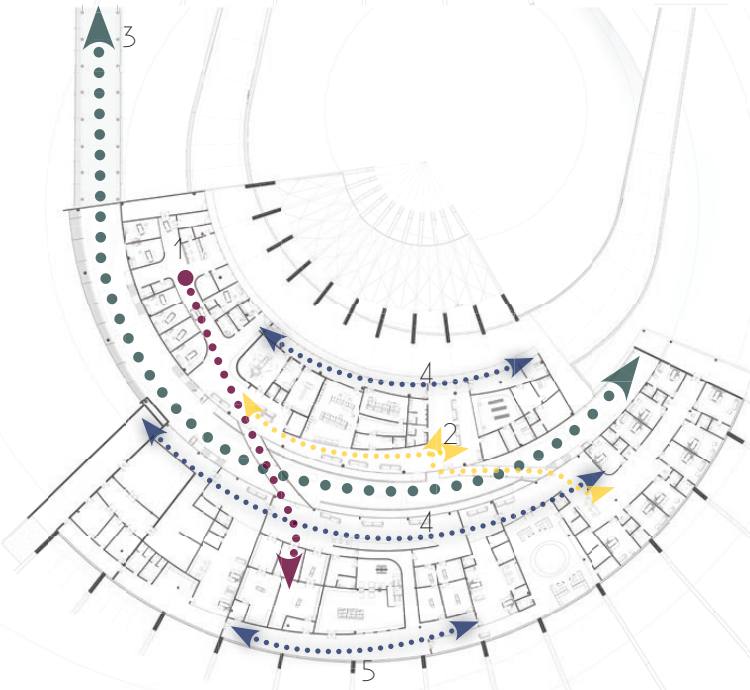
1. Emergency
2. Main lobby
3. Imaging and logistics
4. Surgery
5. Pulmonary
6. Inpatient
7. Central nave
8. mechanical
9. Sterilization

Zones



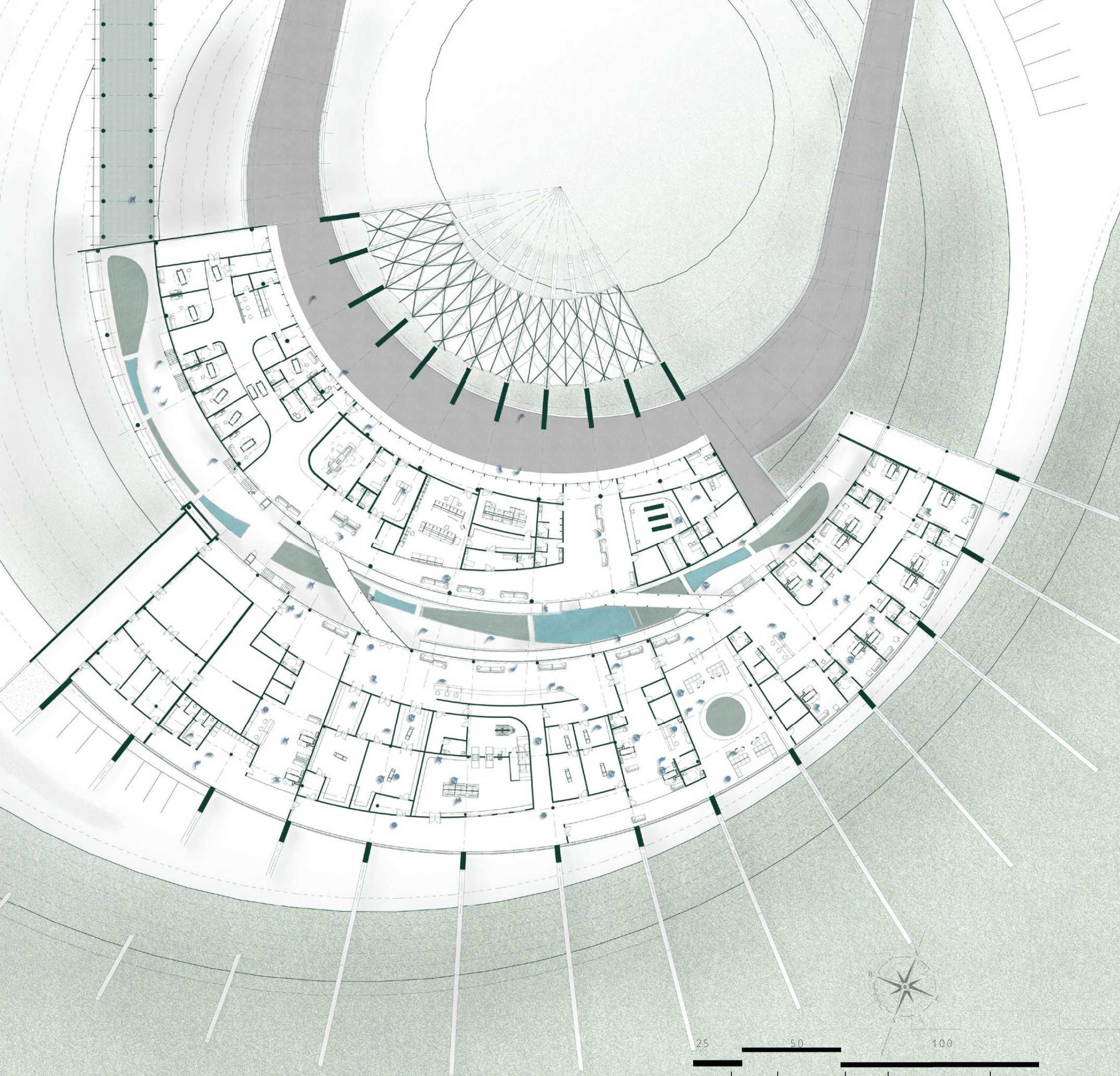
1. Vehicle access
2. Emergency
3. Main Entrance
4. Public entrance
5. Staff
6. Service

Access

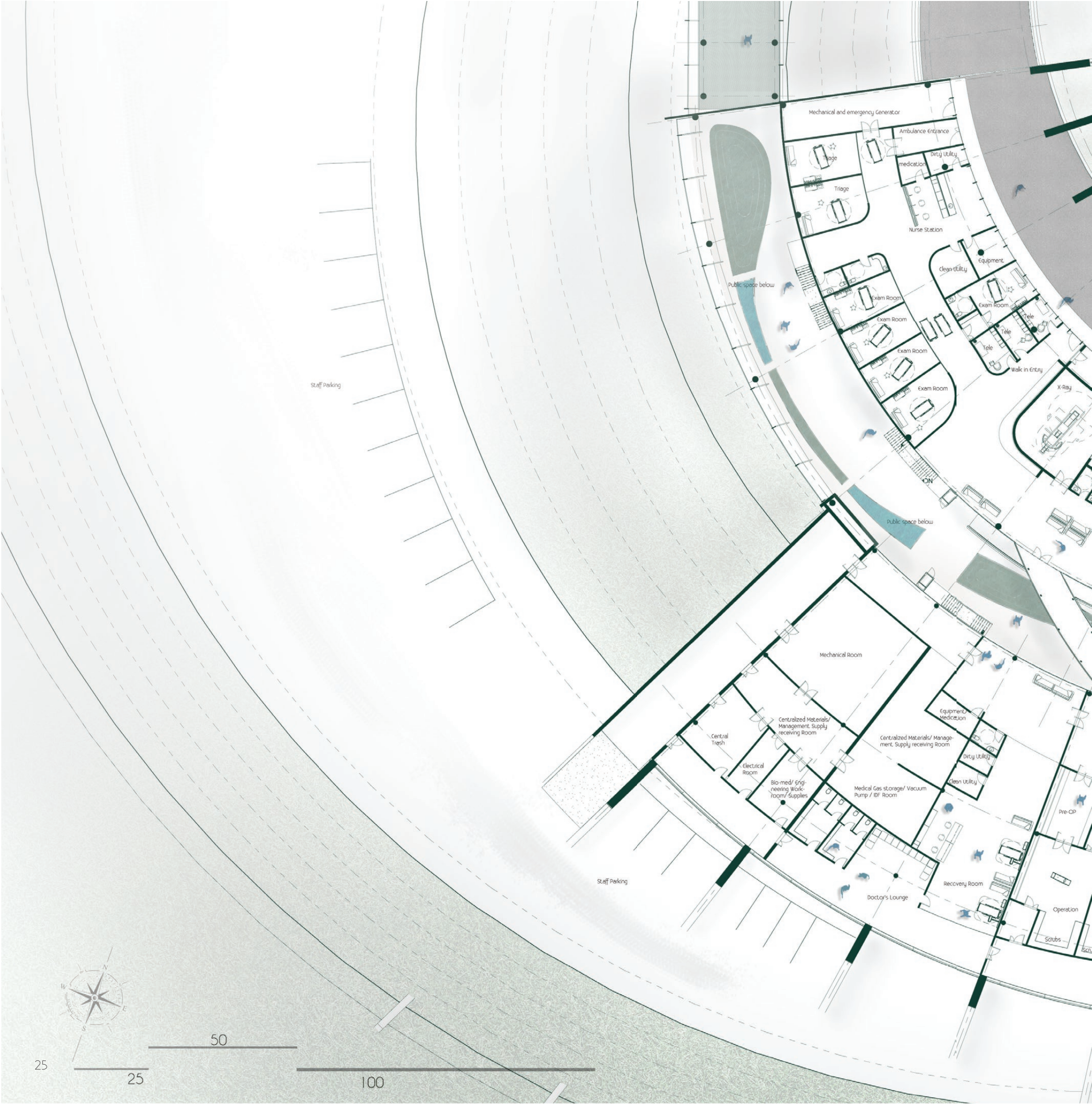


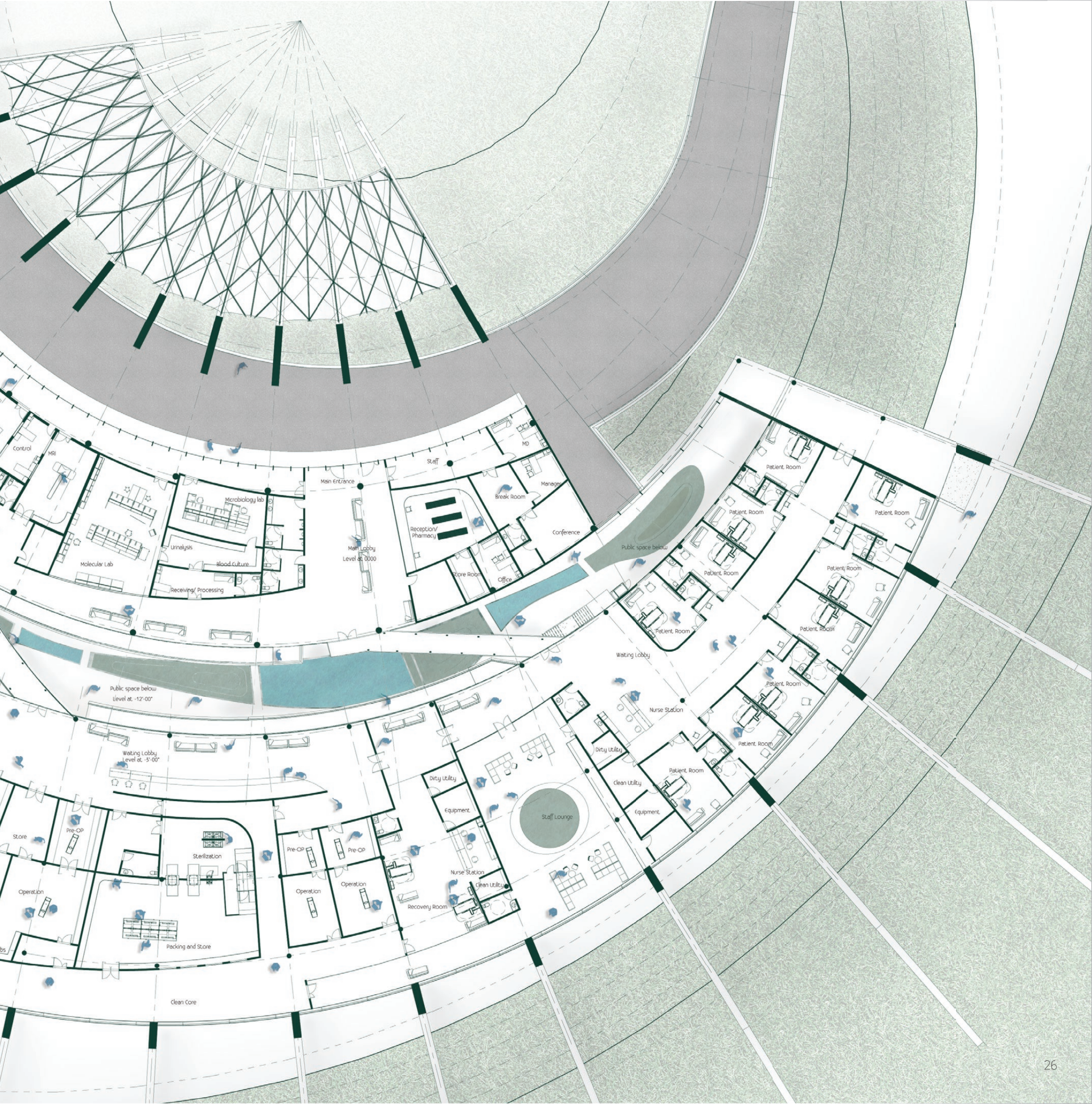
1. Emergency Flow
2. Semi Public flow
3. Communitiy flow
4. Staff flow
5. Clean Suite flow

Flows



Split level Floor Plan


Mechanical and emergency Generator
Ambulance Entrance
Triage
Triage
Dirty Utility
medication
Nurse Station
Public space below
Exam Room
Exam Room
Exam Room
Exam Room
Clean Utility
Equipment
Exam Room
Tele
Tele
Tele
Walk in Entry
X-Ray
Staff Parking
Public space below
Mechanical Room
Centralized Materials/ Management. Supply receiving Room
Central Trash
Electrical Room
Bio-med/ Engineering Work-room/ Supplies
Centralized Materials/ Management. Supply receiving Room
Equipment Medication
Dirty Utility
Clean Utility
Medical Gas storage/ Vacuum Pump / IDF Room
Pre-OP
Staff Parking
Doctor's Lounge
Recovery Room
Operation
Scrubs
50
25
100


Control
MRI
Molecular Lab
Microbiology lab
Urinalysis
Blood Culture
Receiving/ Processing
Main Entrance
Main Lobby
Level at: 0000
Staff
MD
Break Room
Manager
Reception/
Pharmacy
Conference
Store Room
Office
Public space below
Level at: -12'-00"
Waiting Lobby
Level at: -5'-00"
Store
Pre-OP
Sterilization
Operation
Packing and Store
Clean Core
Pre-OP
Operation
Pre-OP
Operation
Dirty Utility
Equipment
Nurse Station
Clean Utility
Recovery Room
Staff Lounge
Public space below
Waiting Lobby
Nurse Station
Dirty Utility
Clean Utility
Equipment
Patient Room
Patient Room
Patient Room
Patient Room
Patient Room
Patient Room
Patient Room
Patient Room
Patient Room

ZONES AND FLOWS

1. Emergency entrance
2. Triage
3. Imaging
4. Surgery/ Pulmonary
5. Sterilization
6. Post Operation
7. Inpatient
8. Main Entrance
9. Service

Emergency/ Procedure flow

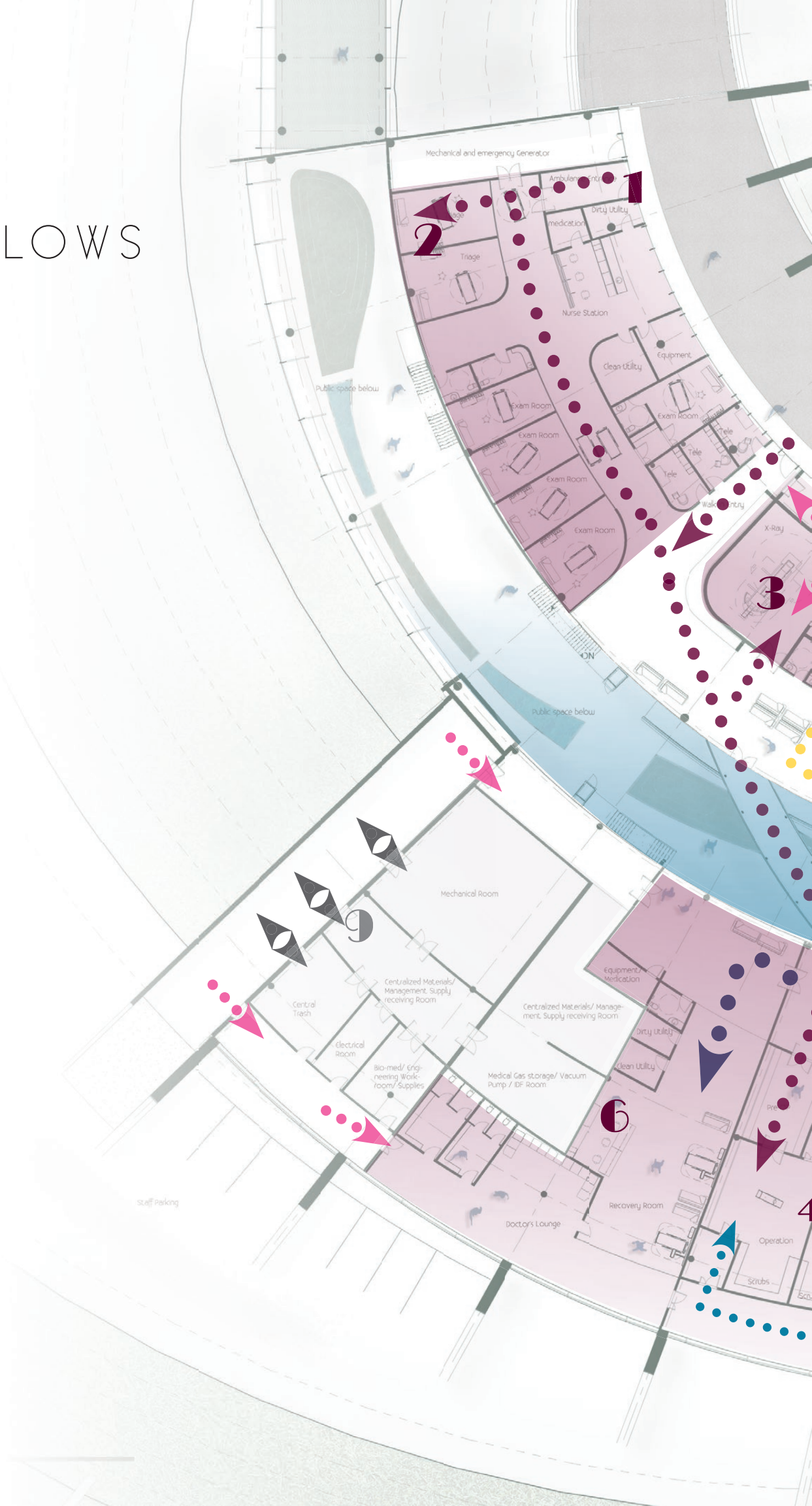
Sterilization flow

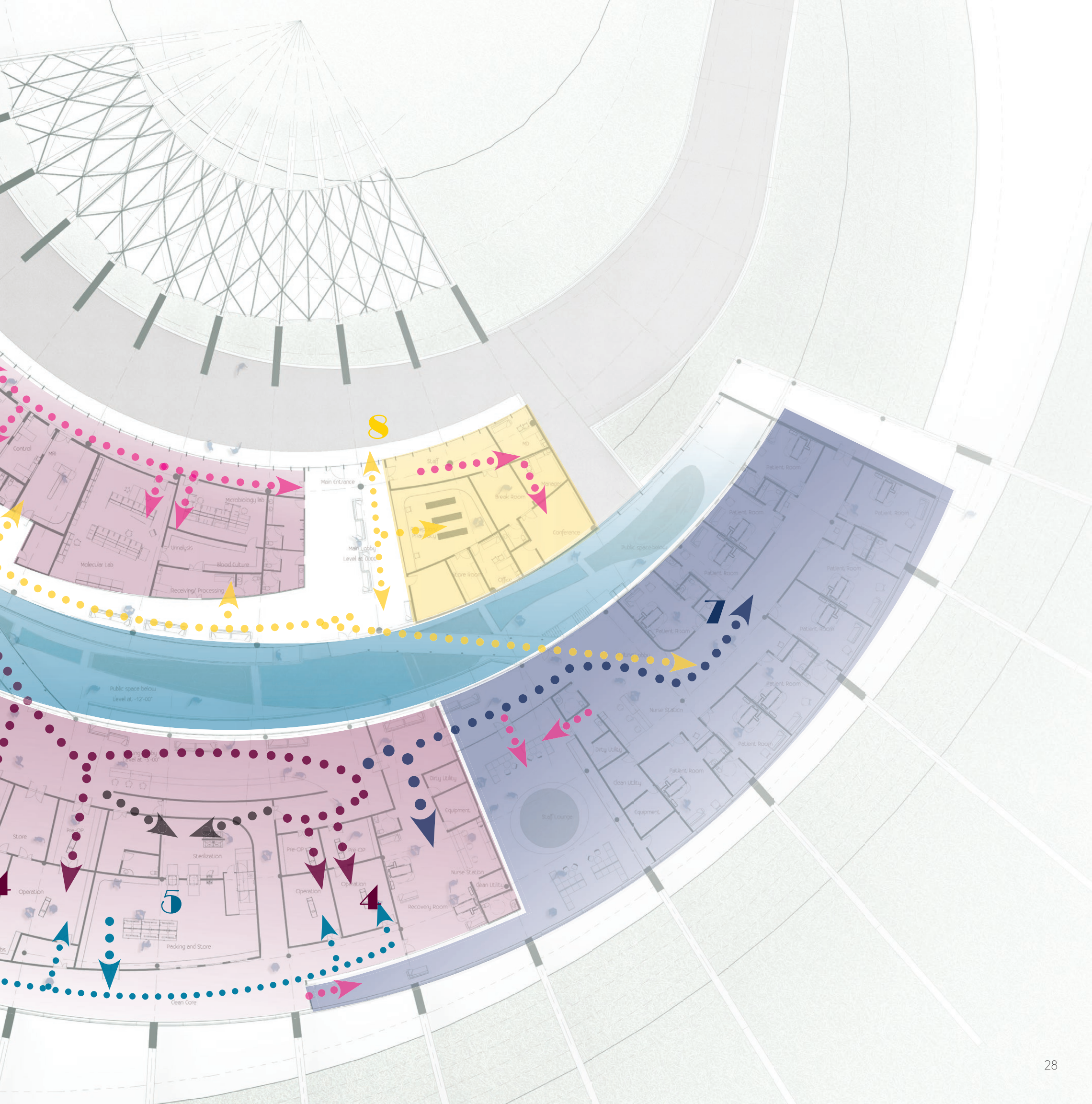
Staff flow

Inpatient flow

patient flow

Service




8
Main Entrance
Main Lobby
Level at: 0000
Staff
MD
Manager
Break Room
Conference
Core Room
Office
Control
MRI
Microbiology lab
Urinalysis
Molecular Lab
Blood Culture
Receiving/ Processing
Public space below
Level at: -12-00"
7
Patient Room
Nurse Station
Dirty Utility
Clean Utility
Equipment
Staff Lounge
Pre-OP
Store
Sterilization
Operation
5
4
Recovery Room
Packing and Store
Clean Core

Connection

Although we are trying to protect the users from harsh outdoor climate. It is crucial not to break the connection visually and physically. There has been consideration of connection to the outdoors in critical spaces such as patient rooms and recovery rooms which will impact the well being and fast recovery of patients. However, midnight sun and sunset glares cannot be ignored. Different lobby spaces have visual connection to the lower public space which will help them in wayfinding as well as act as positive distraction.

The idea here is to give them a choice to either stay in upper lobby space or go downstairs to have another separate space.

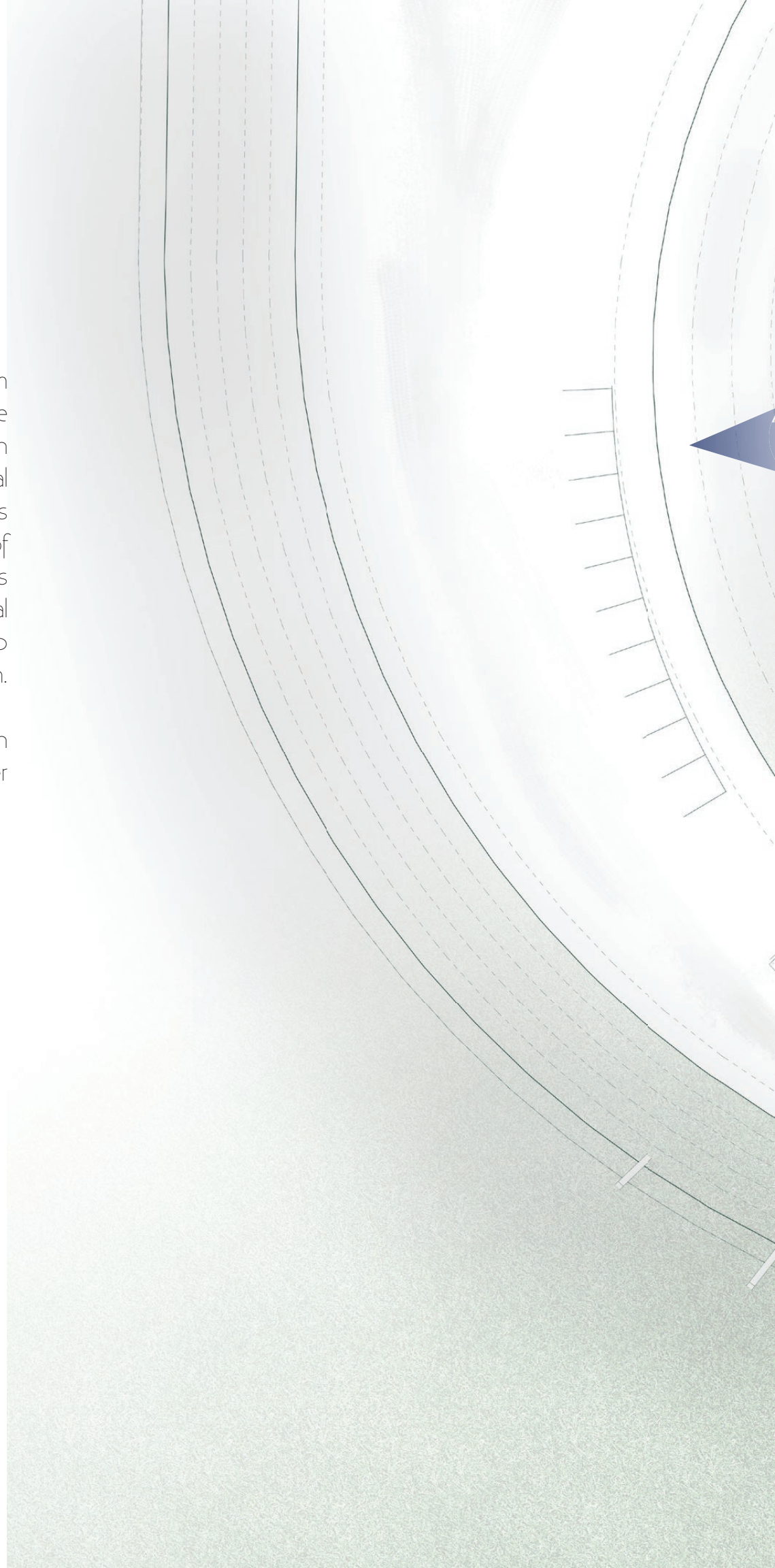
Visual access to the outside world

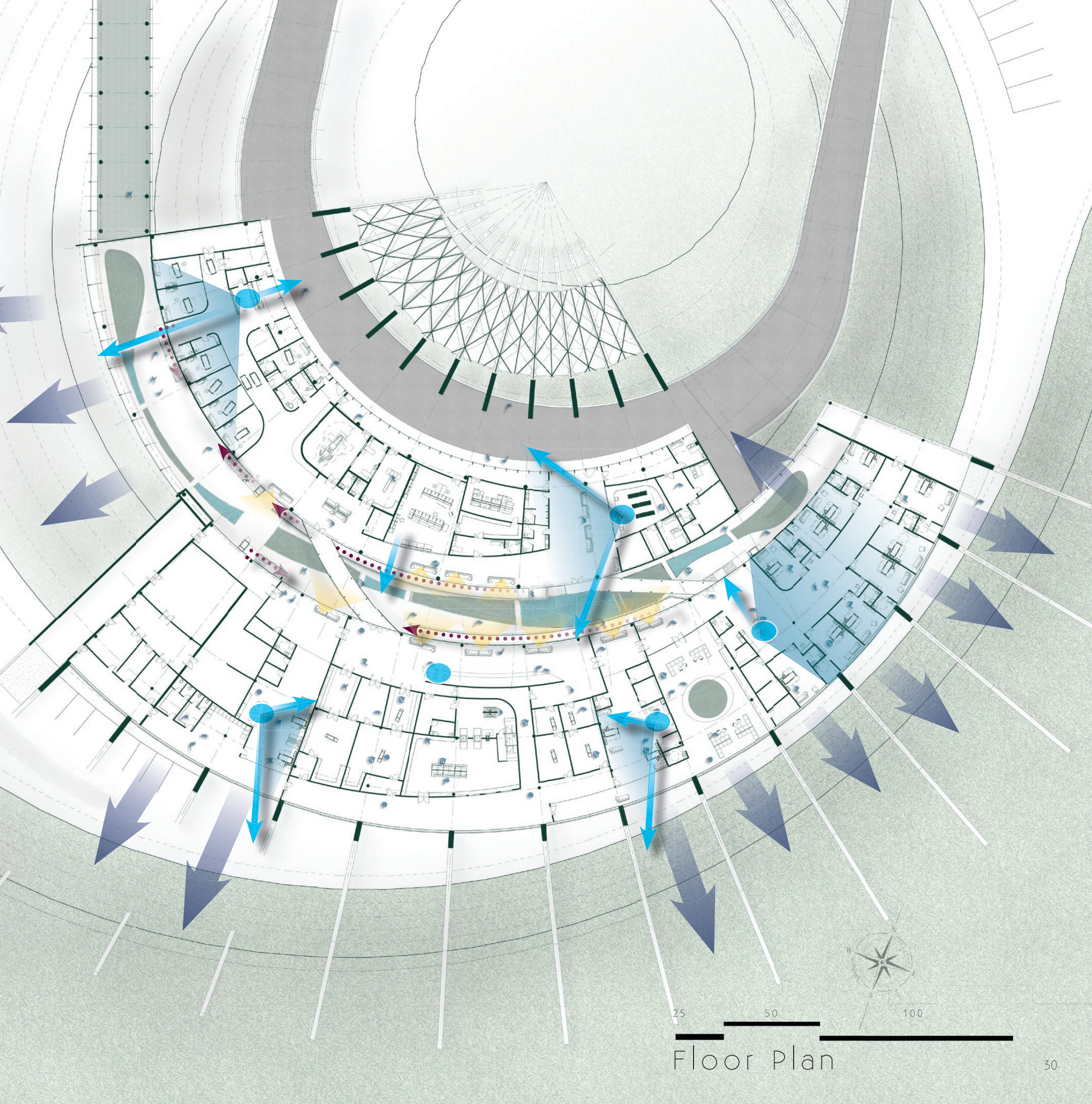
Visual proximity for staffs

Connection to the lower public space through ramps, stairs or wheelchair lifts

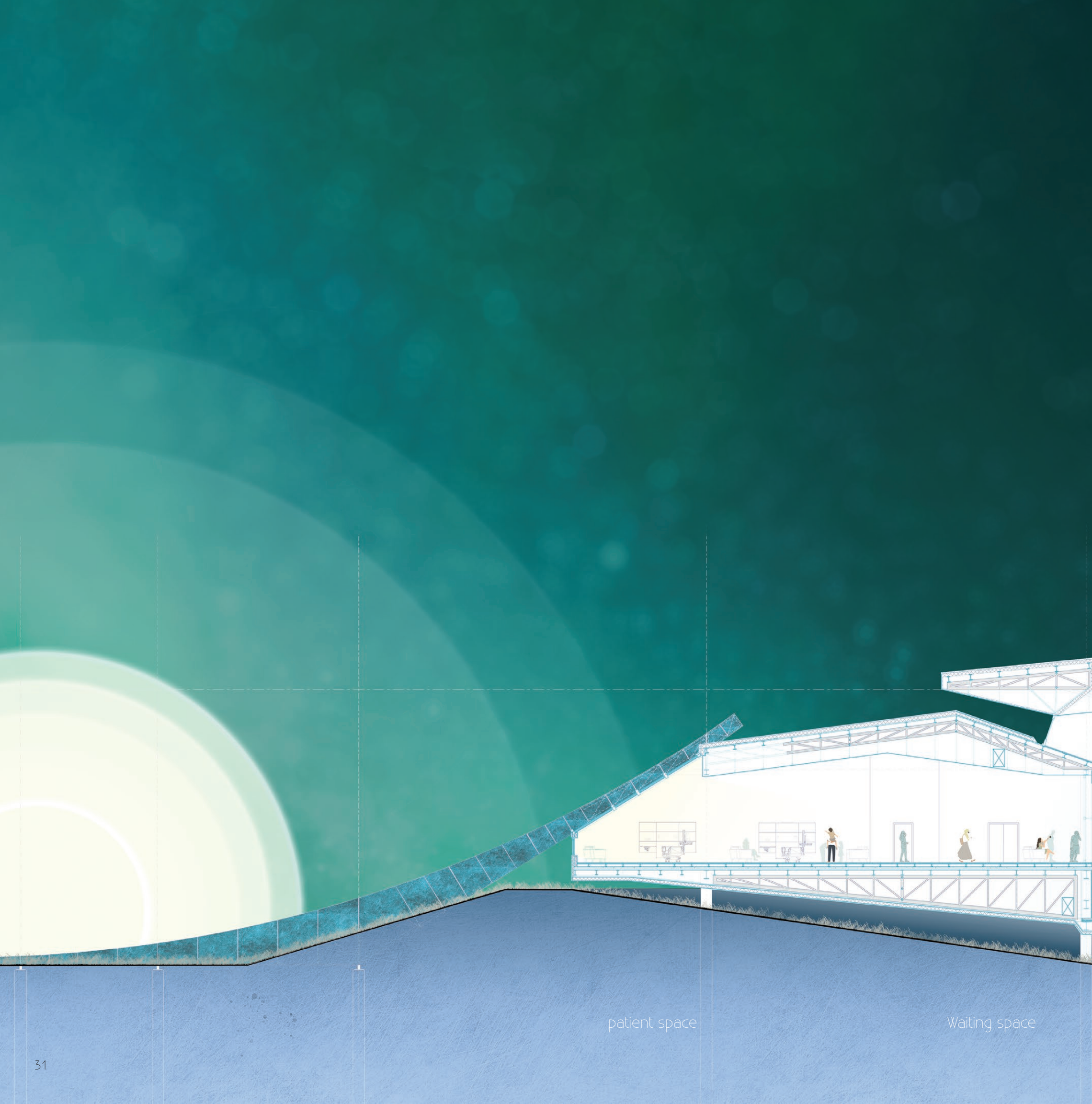
Nurse station

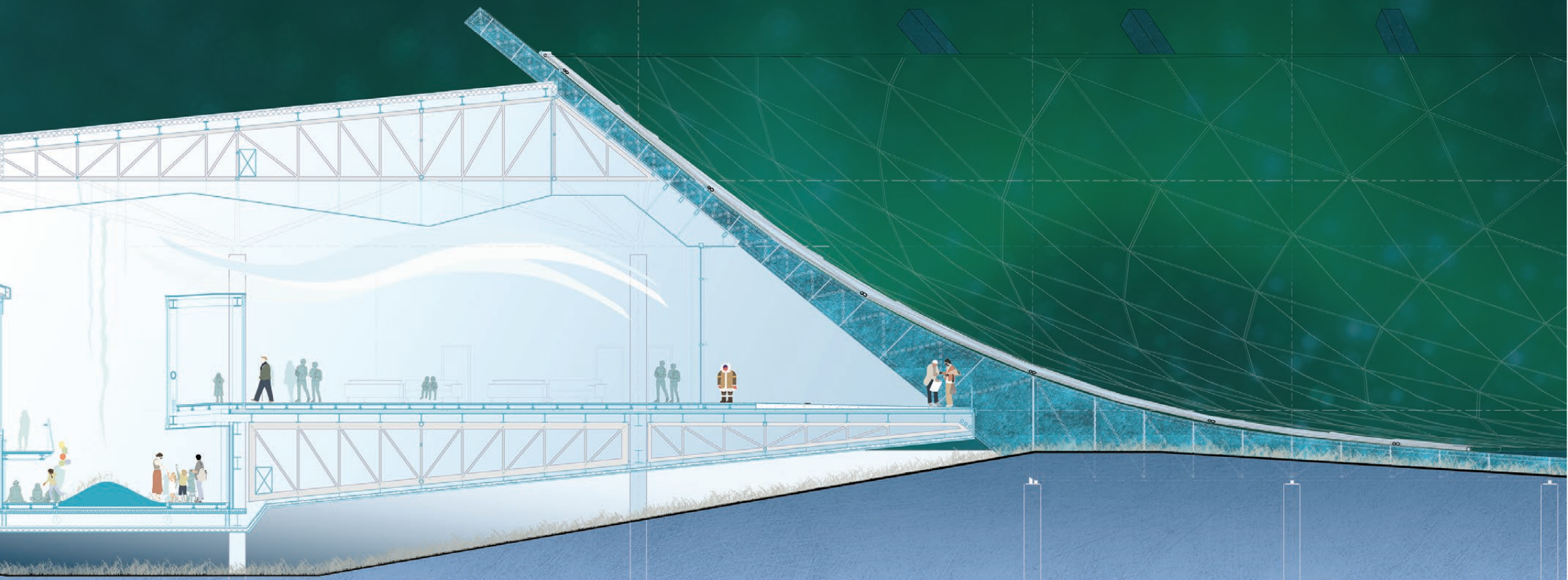
Visual proximity from the lobby space to lower public space





Floor Plan


patient space
Waiting space

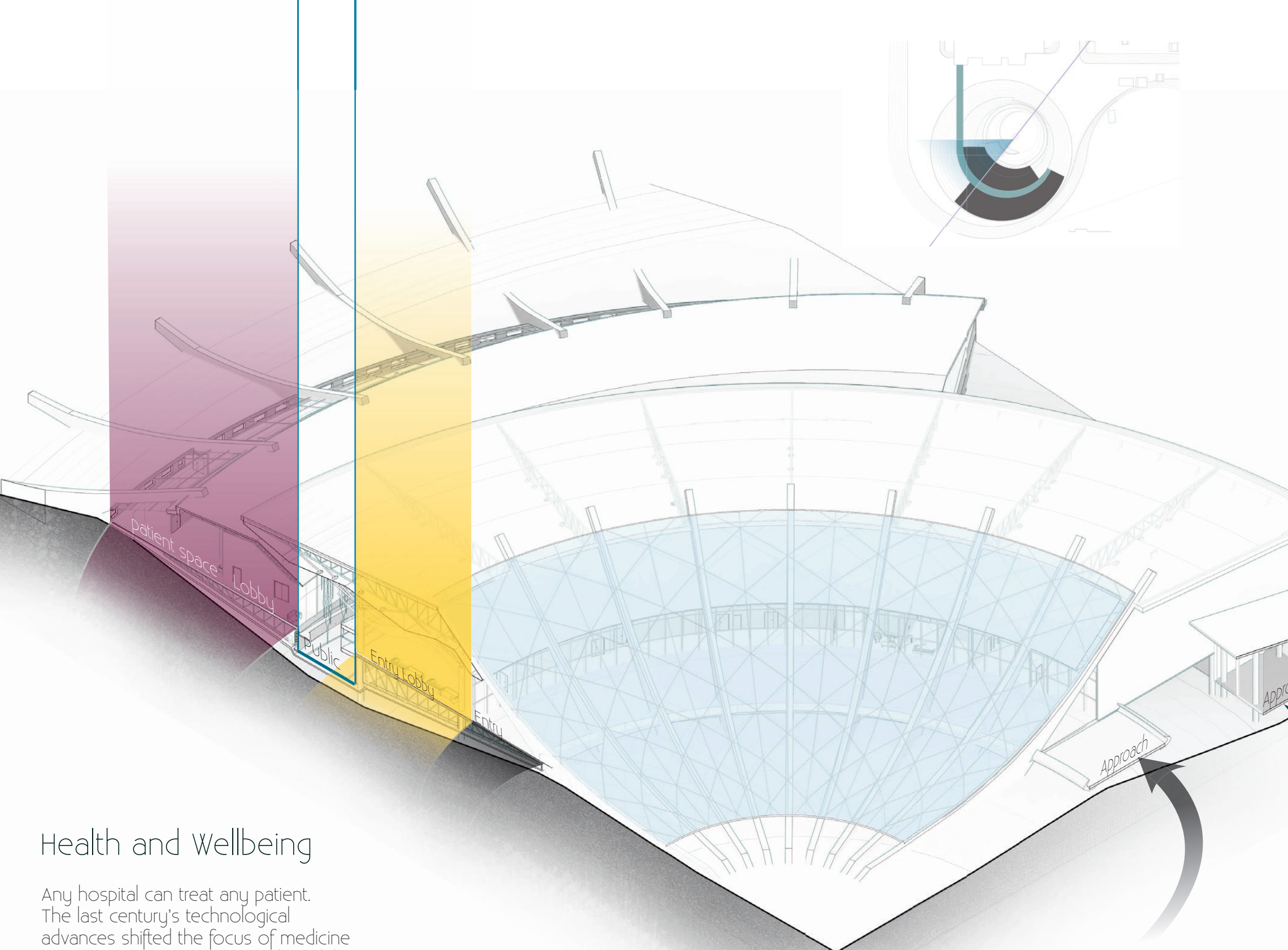


Central space

Lobby space

Entrance space

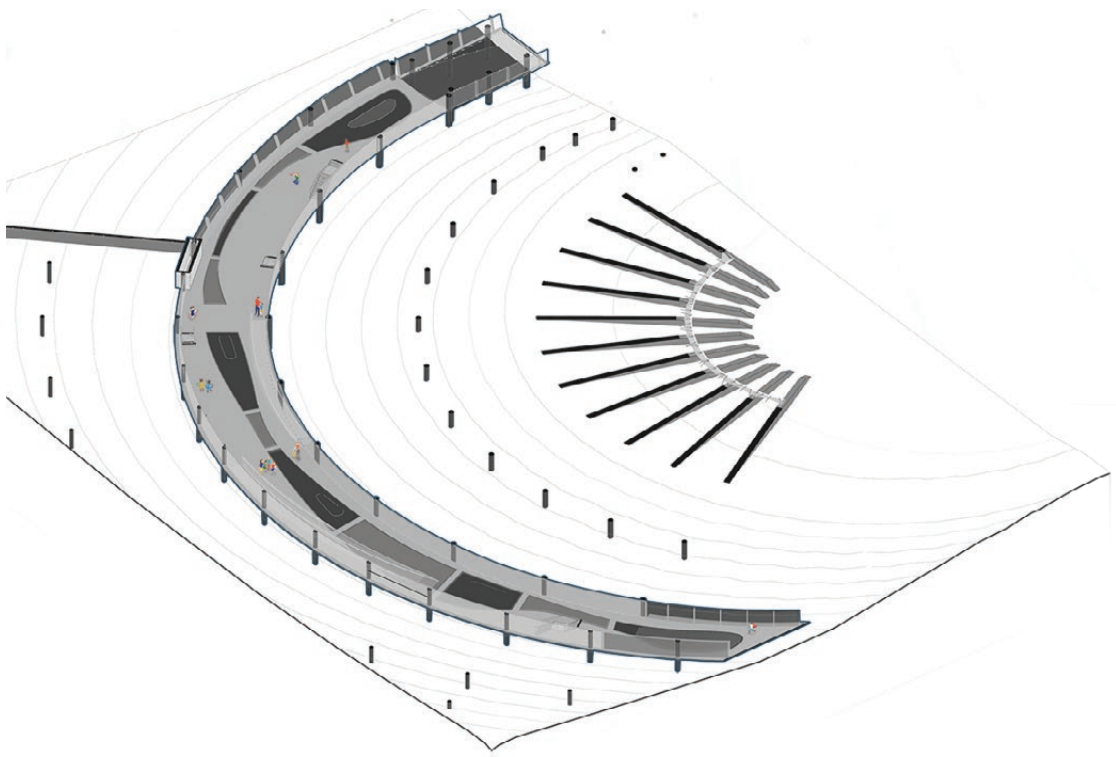
25 50 100



Health and Wellbeing

Any hospital can treat any patient. The last century's technological advances shifted the focus of medicine from a caring, service-oriented model to a technological, cure-oriented model. Technology has resulted in phenomenal advances in medicine and the ability to extend life.

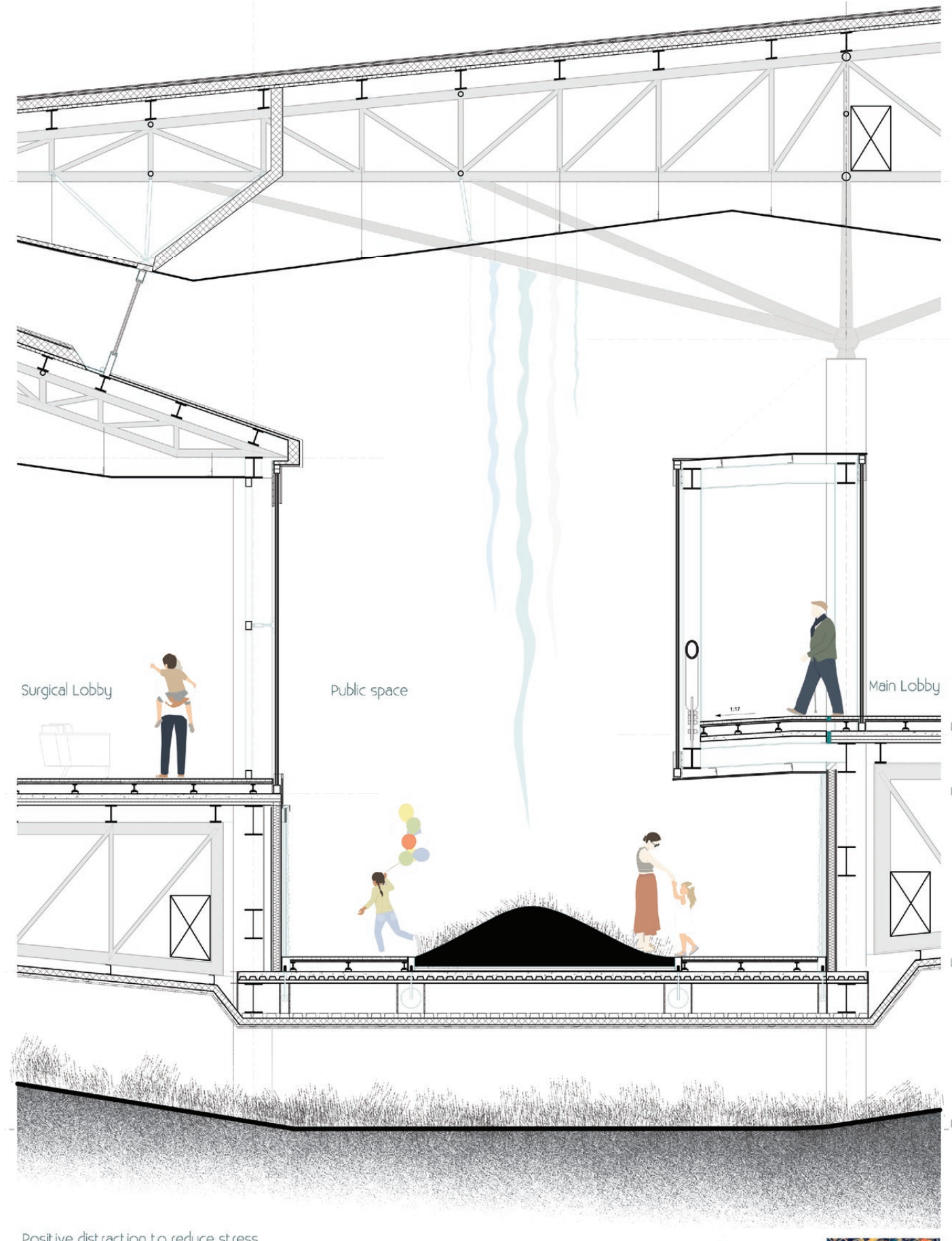
However, in recent decades, physicians have attempted to balance their care by reclaiming medicine's more spiritual roots, recognizing that spirituality was often associated with health care until modern times. Serving the whole person—physical, emotional, social, and spiritual—is what spiritual or compassionate care entails. Nature has an impact on more than just the mind. Roger S. Ulrich discovered that nature can also help the body heal.(Clay, 2001).



Wayfinding

Wayfinding refers to information systems that guide people through a physical environment and enhance their understanding and experience of the space. ("What Is Wayfinding? Part 1: It's All about Human Needs · RSM Design," n.d.).This is very important in any building. People have been reliant on other factors and elements to find their way.

One of the reasons to design a central open space here is to connect people as well as to other parts of the building visually and physically. The huge height of the roof will provide clearance to make users not feel enclosed and enjoy their stay in the space.



ROOF CONSTRUCTION:
400/70/2 MM ALUMINIUM SHEET TRAYS
2 THERMALLY SEPARATED ALUMIUM ANGLES, HEAIGHT VARIABLE
PVC MEMBRANE SEAL

HEB STEEL BEAM

TRUSS

SUSPENSION SYSTEM:
40/40 MM + 40/10 MM COUNTER BATTENS, BETWEEN THEM
45 MM MINERAL WOOL ACOUSTIC INSULATION ACOUSTIC FLEECE
40/40 MM FIRE-RETARDANT IMPOREGNATED PINE BATTENS, WHITE-PAINT

WINDOW:
LAMINATED SAFETY GLASS 2X10 MM +CAVITY+ LAMINATED SAFETY GLASS 2*8 MM AS STRUCTURAL GALZING

MOSS WALL: VISUAL AND ACOUSTIC BENEFIT

MOSS - REINDEER MOSS/ GREEN AND TORQUIOSE MOSS
PERFORATED STEEL PANEL
POLYESTER FIBER
WALL MOUNTING FIBERS
2X12.5 MM PLASTER BOARD PANEL CLADDING
110 MM TIMBER STUDS WITH THERMAL INSULATION IN BETWEEN
2X12.5 MM OSB

FLOOR CONSTRUCTION
4 MM LINOLEUM FLOORING
38 MM FIRE-RETARDANT IMPREGNATED TONGUE AND GROOVE PINE BOARDS
21 MM PLYWOOD
238 MM TIMBER I- JOISTS
33 MM LAMINATED VENEER TIMBER BLOCKS

COMPOSITE CEILING SLAB:
MAX 175 MM REINFORCED COMCRETE + 60 MM CORRUGATED STEEL SHEET
HEB STEEL BEAM -VARIES
(Should include Non-permeable insulation)

TRUSS:
Includes hollow truss and permeable insulation

85/0.75 MM CORRUGATED STEEL SHEET

SUBSTRUCTURE:
175 MM METAL CHANNEL, THERMALLY SEPARATED, BETWEEN MINERAL WOOL THERMAL INSULATION; 20 MM HAT PROFILE
400/70/2 MM ALUMINIUM SHEET TRAYS

Positive distraction to reduce stress

Curved asymetrical indoor greeneries
water bodies
Different access points
Reindeer moss in walls to increase green and also to absorb noise

Common grass - Water Sedge
Cotton grass
Tundra grass

Kinnikinnick

Arctic Poppy

GREEN FLOOR:

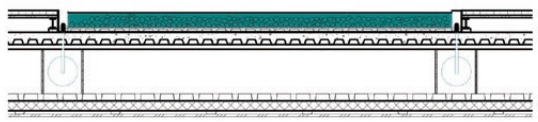
CULTIVATION LAYER
FILTER LAYER
MOISTURE RETENTION LAYER
AERATION LAYER
THERMAL INSULATION LAYER
DRAINAGE LAYER
ROOT BARRIER
MEMBRANE PROTECTION
WATER PROOFING MEMBRANE
STRUCTURAL SUPPORT

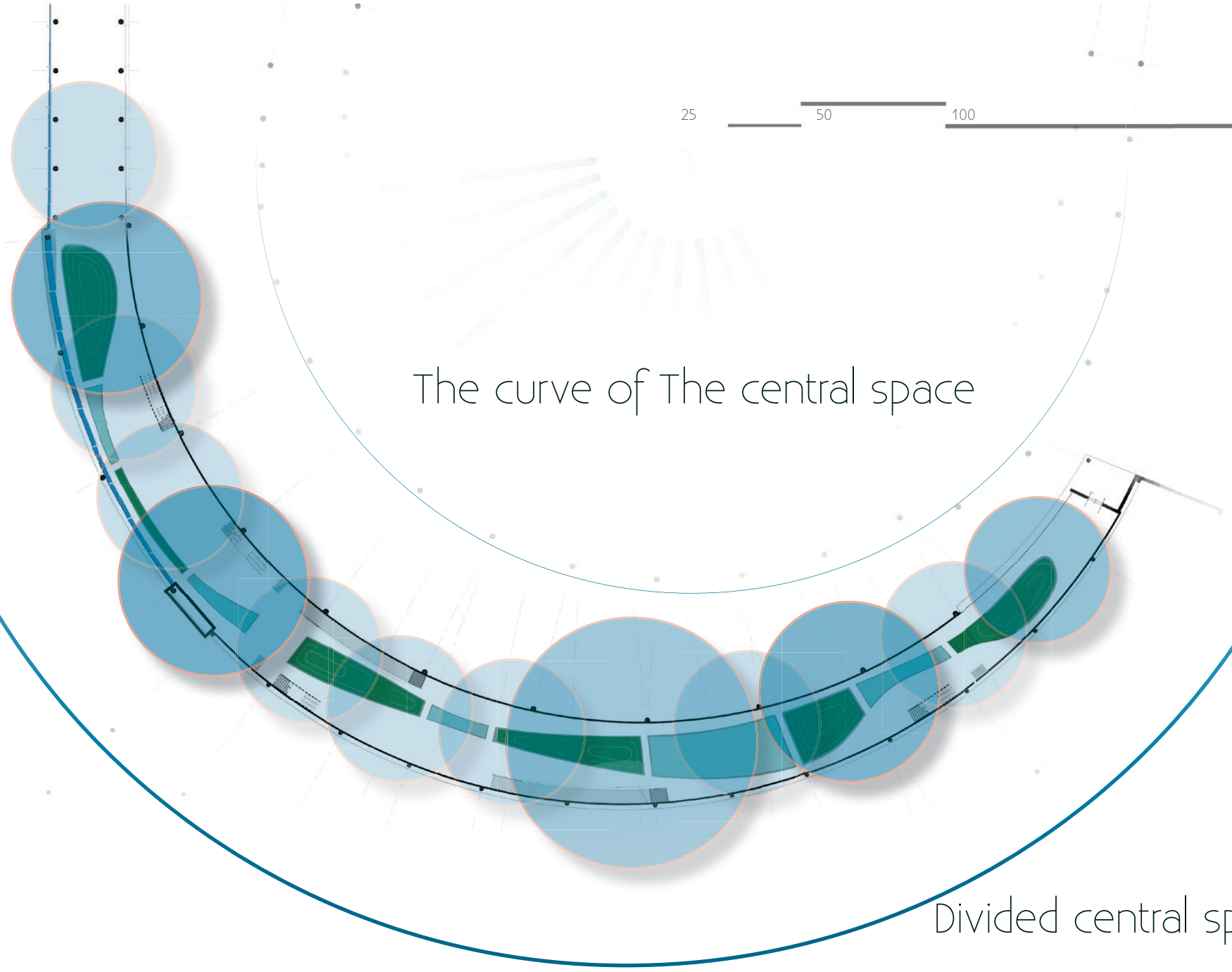
'WATER BODY:

'WATER
GRAVEL
MOISTURE RETENTION LAYER
AERATION LAYER
THERMAL INSULATION LAYER
DRAINAGE LAYER
MEMBRANE PROTECTION
WATER PROOFING MEMBRANE
STRUCTURAL SUPPORT

DRAINAGE:
STEEL PLATE
RUBBLE
CORE SAND

Central space section





The curve of The central space

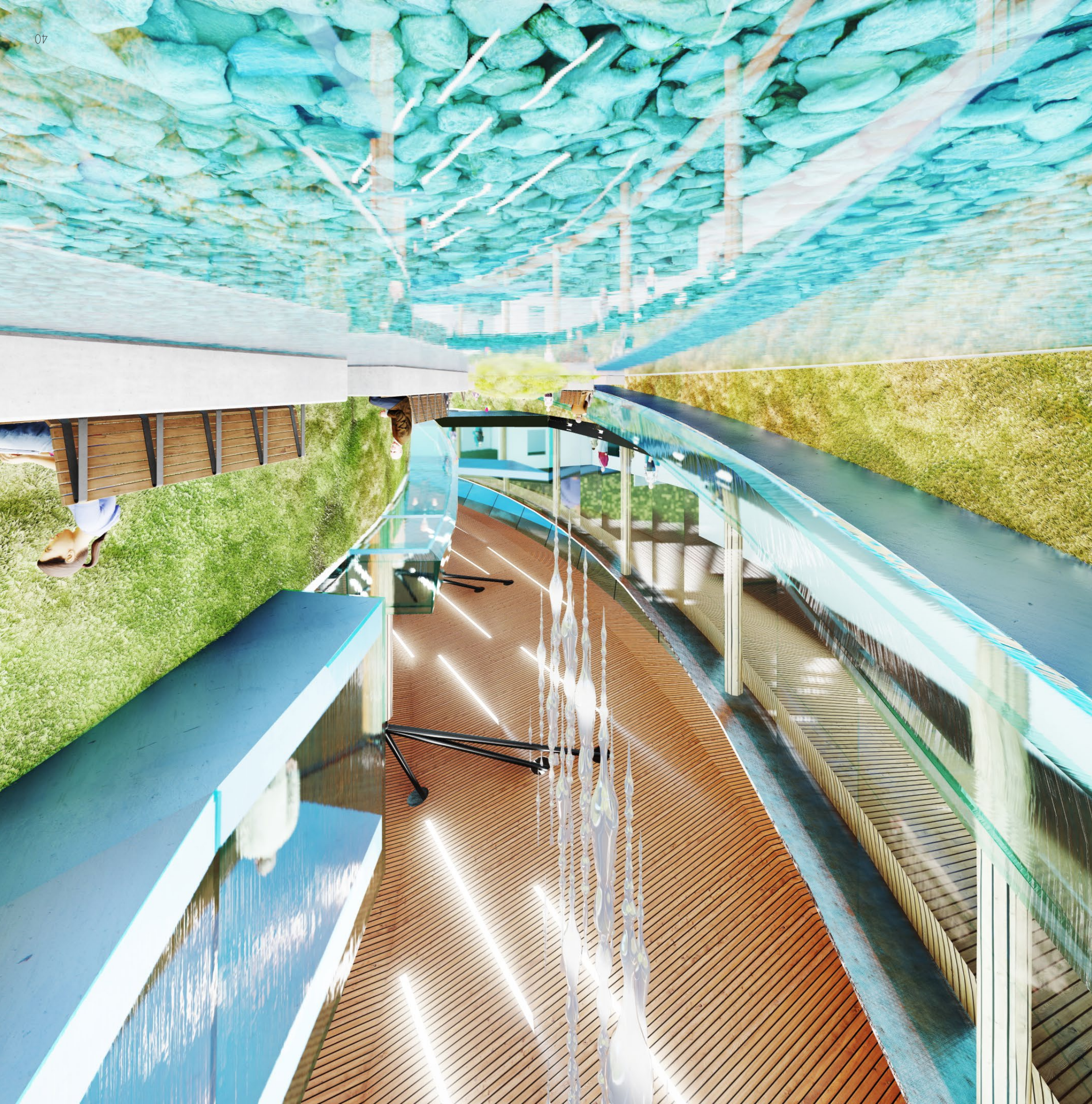
Community

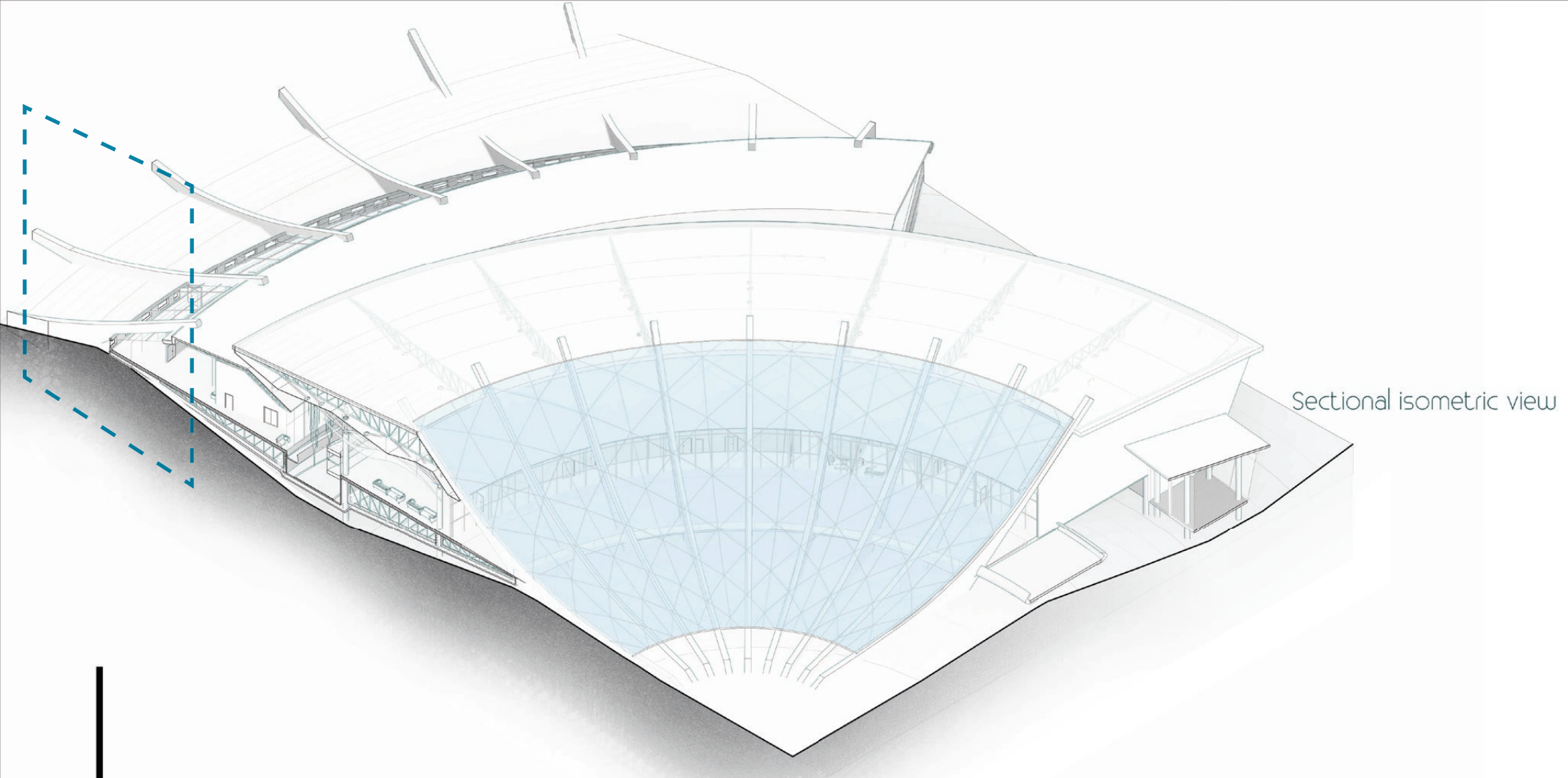
This is a small community where most people will know each other. Their activities are more communal so the scale should be according to the activity. Central space can be used for people to share and communicate while waiting or during harsh climate outside without affecting the patient flow within medicine and surgical block. This is the reason, the zoning has been divided into three blocks and at different levels

Divided central space

The central space's curve is long, with the landscape and waterbody spread out asymmetrically. The reason for not making it geometrical is that we don't want anything to be focused in the center. The activity must be separated, and everyone must have their own space. People who must wait and do not wish to be bothered can use their own space as a positive distraction.

We've discovered that when people get lost, they remember the lobby area and try to find their way back there. They will have a sense of presence if the central space is connected to both public spaces on either side and its height is high enough for people to see far ahead. They will have the option of finding their own way. In addition, the indoor activity will not be overly condensed. They will be aware of their surroundings. This was necessary for the local community.





Sectional isometric view

WINDOW:
LAMINATED SAFETY GLASS 2X10 MM +CAVITY CONTROLLABLE BLINDS+ LAMINATED SAFETY GLASS 2*8 MM AS STRUCTURAL GALZING

FLOOR CONSTRUCTION
4 MM LINOLEUM FLOORING
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HEB STEEL BEAM -VARIES
(Should include Non-permeable insulation)

TRUSS:
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85/0.75 MM CORRUGATED STEEL SHEET

SUBSTRUCTURE:
175 MM METAL CHANNEL, THERMALLY SEPARATED, BETWEEN MINERAL WOOL THERMAL INSULATION; 20 MM HAT PROFILE
400/70/2 MM ALUMINIUM SHEET TRAYS

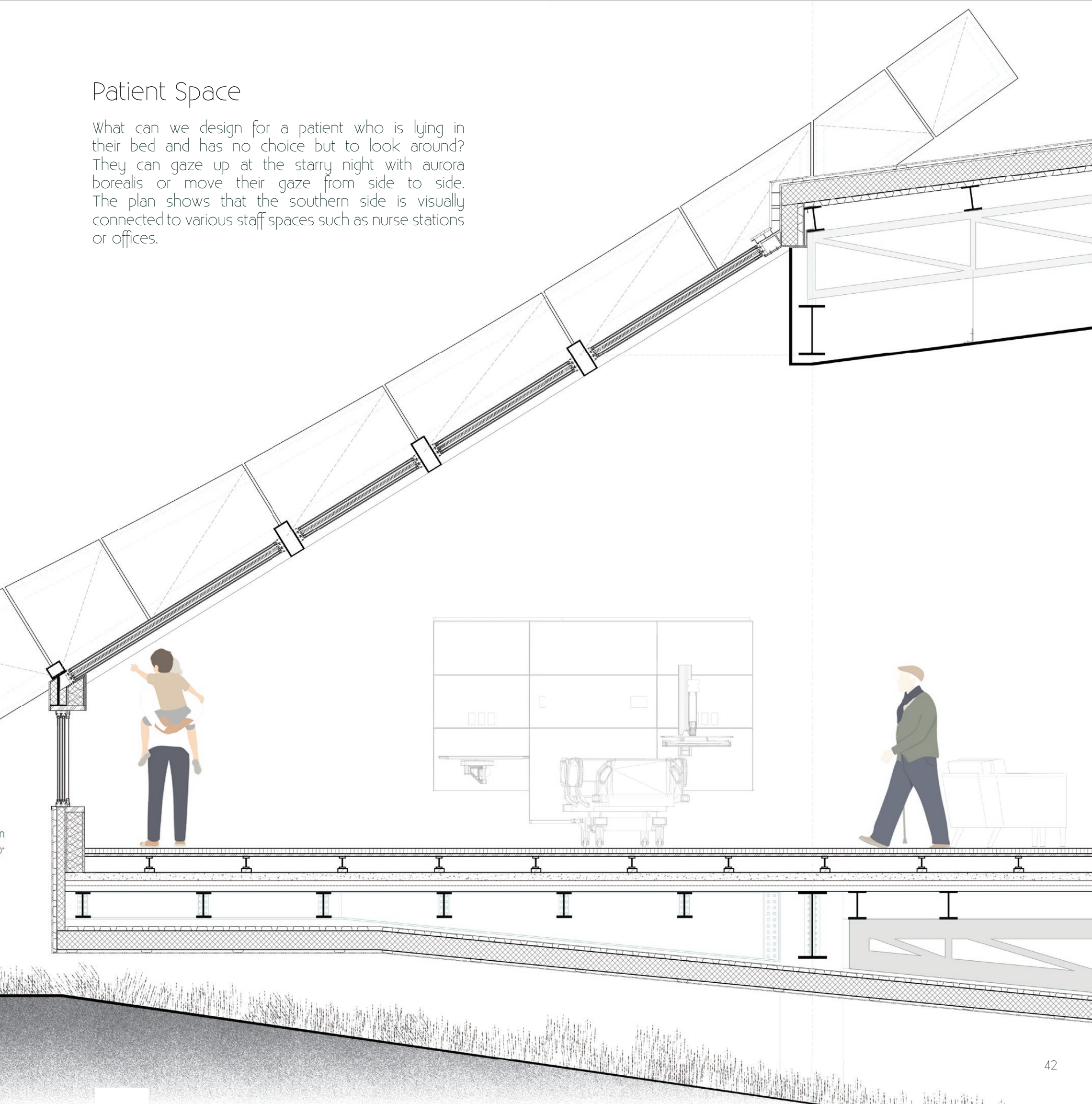
10'
4'
2'
1'

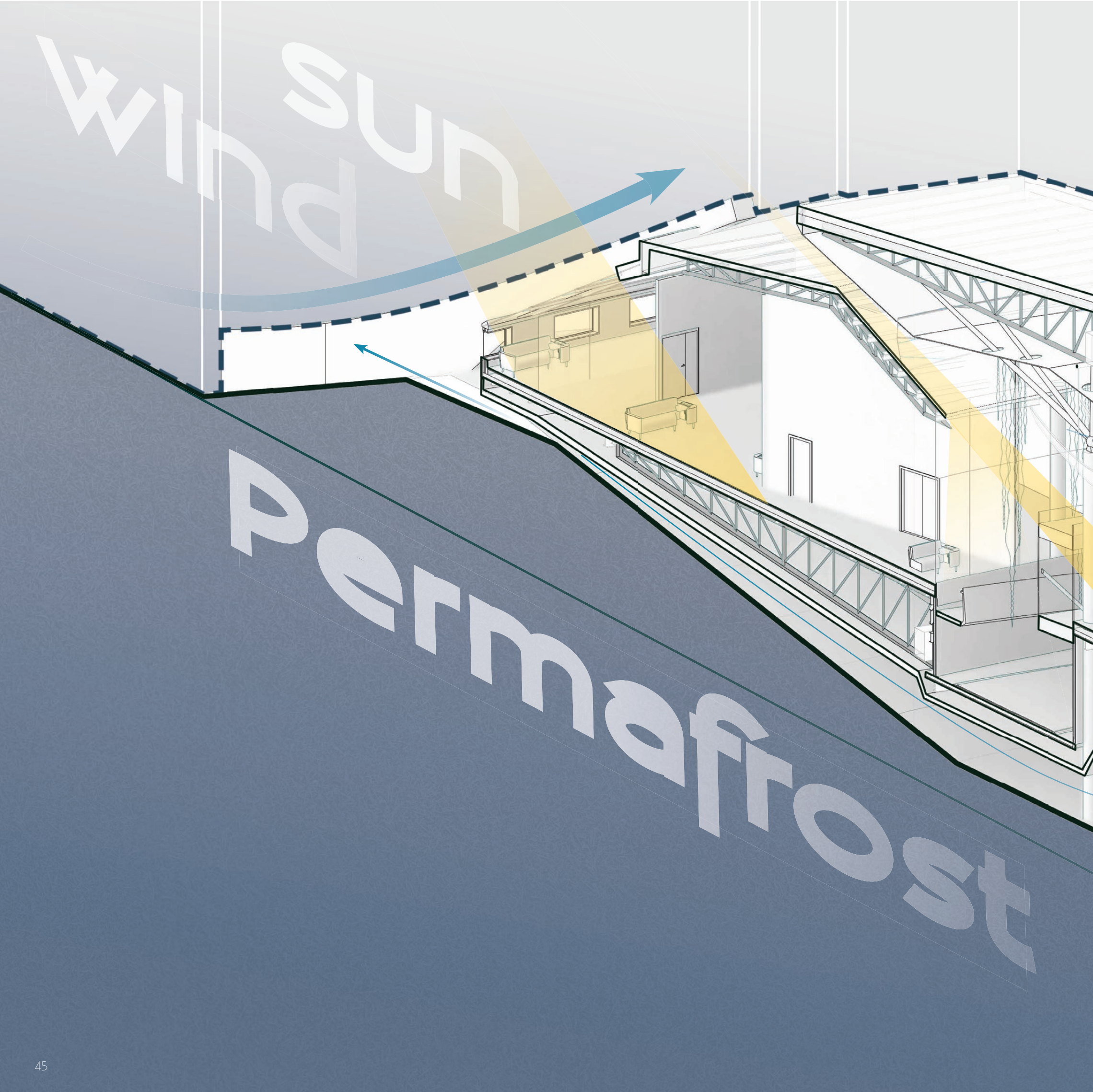
Patient Roor
Level at 17'- (

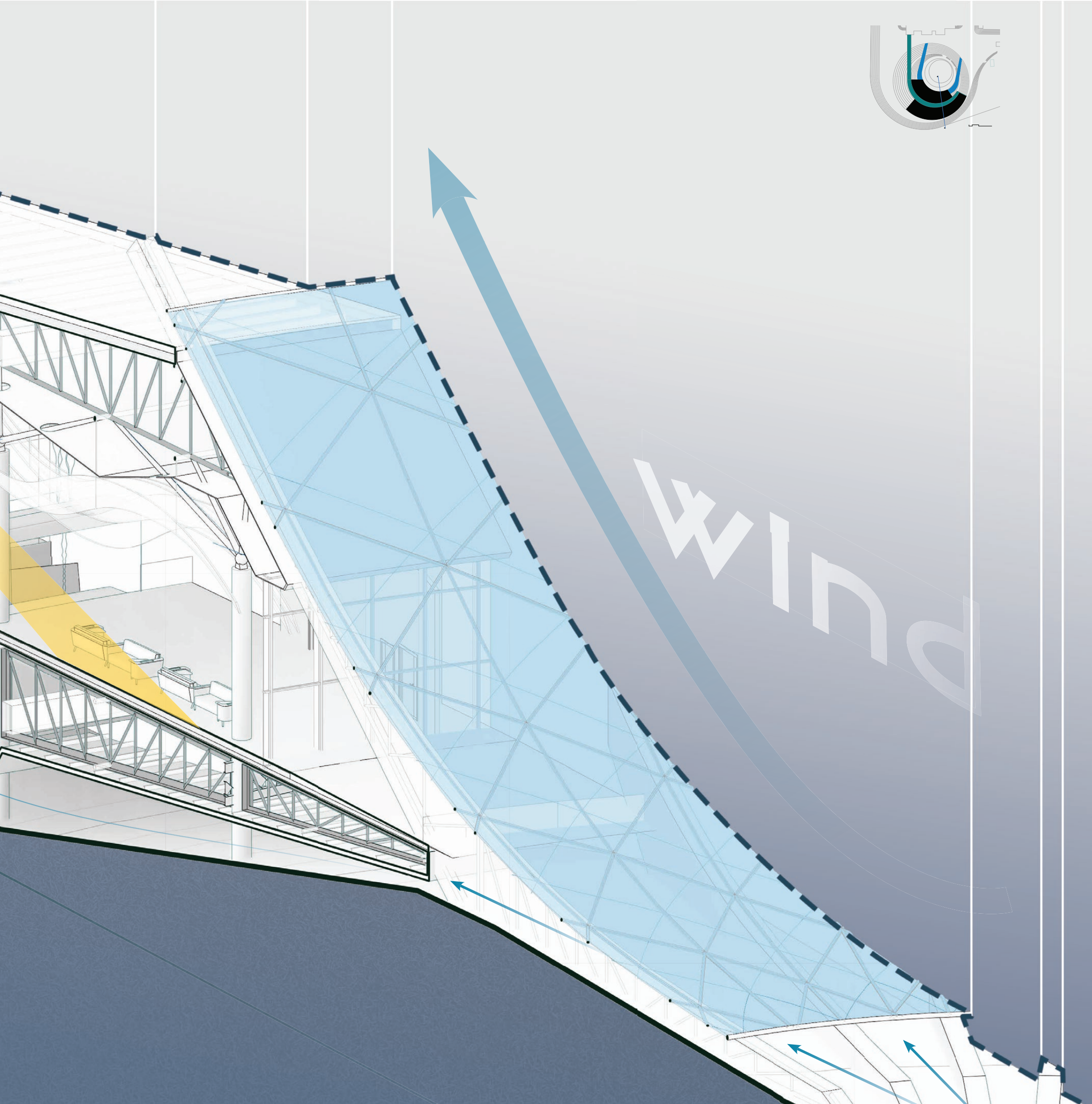
Southern Side section

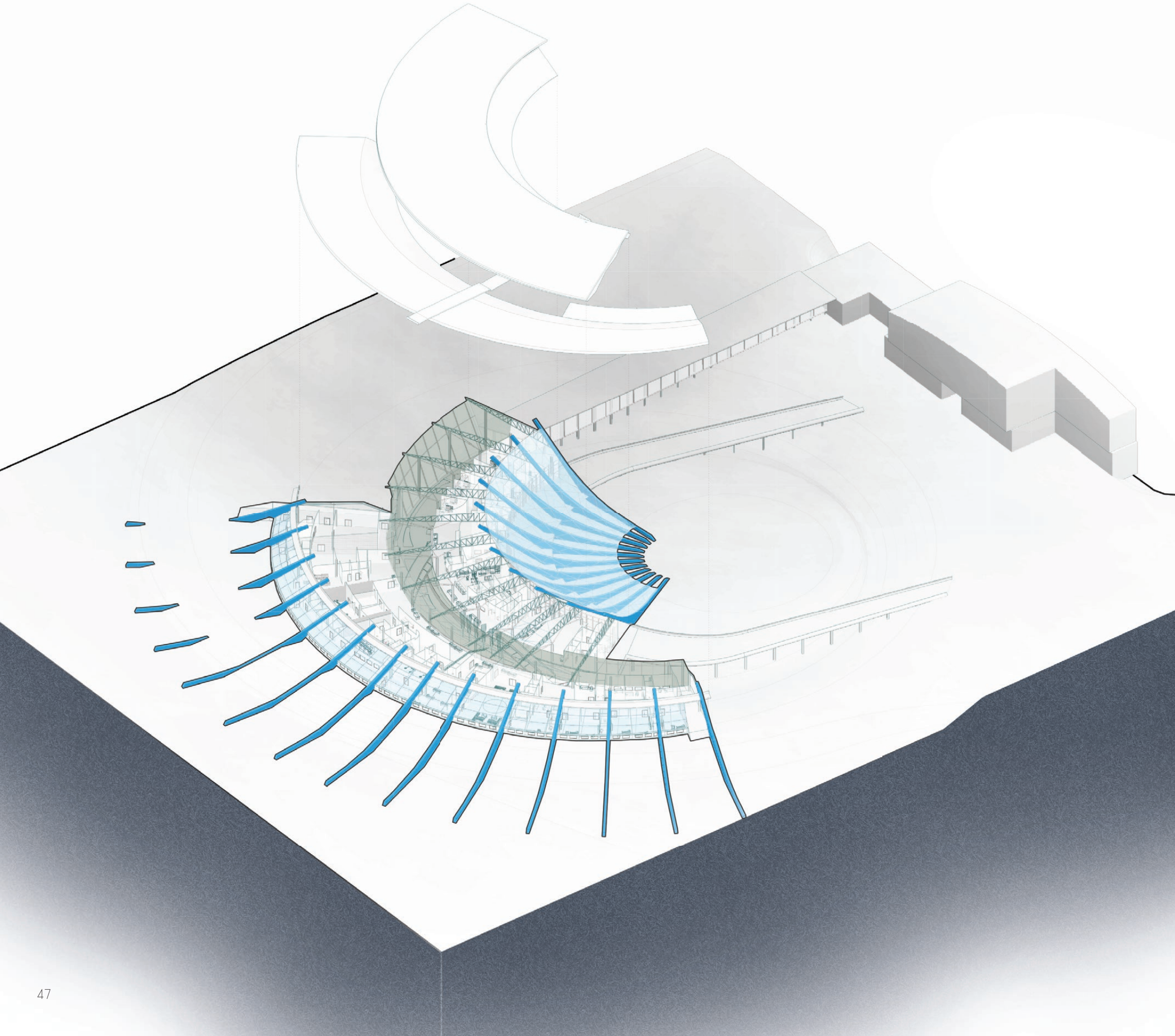
Patient Space

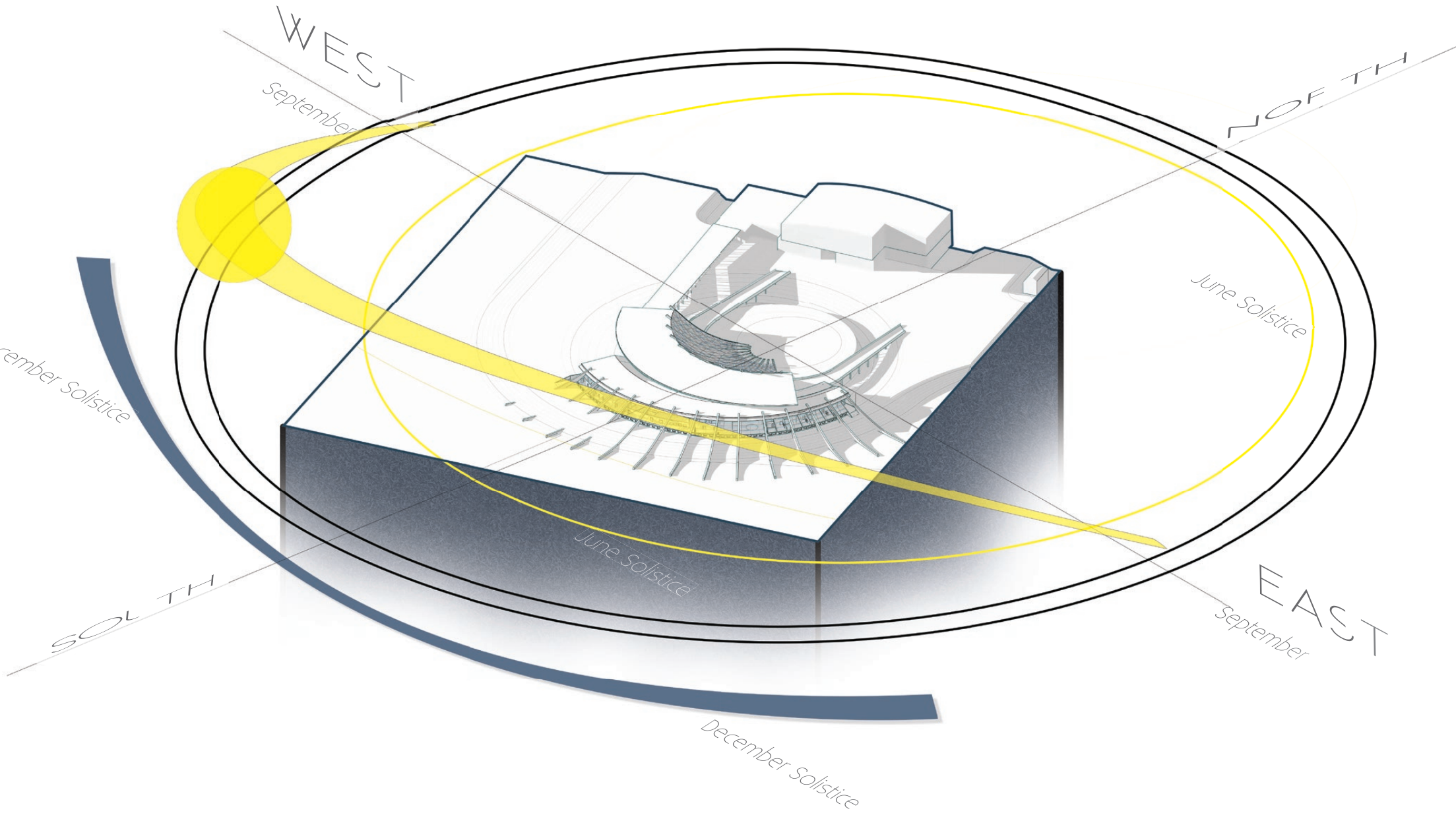
What can we design for a patient who is lying in their bed and has no choice but to look around? They can gaze up at the starry night with aurora borealis or move their gaze from side to side. The plan shows that the southern side is visually connected to various staff spaces such as nurse stations or offices.




wind
sun
permafrost



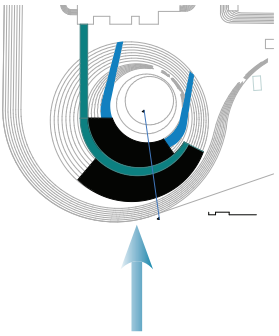




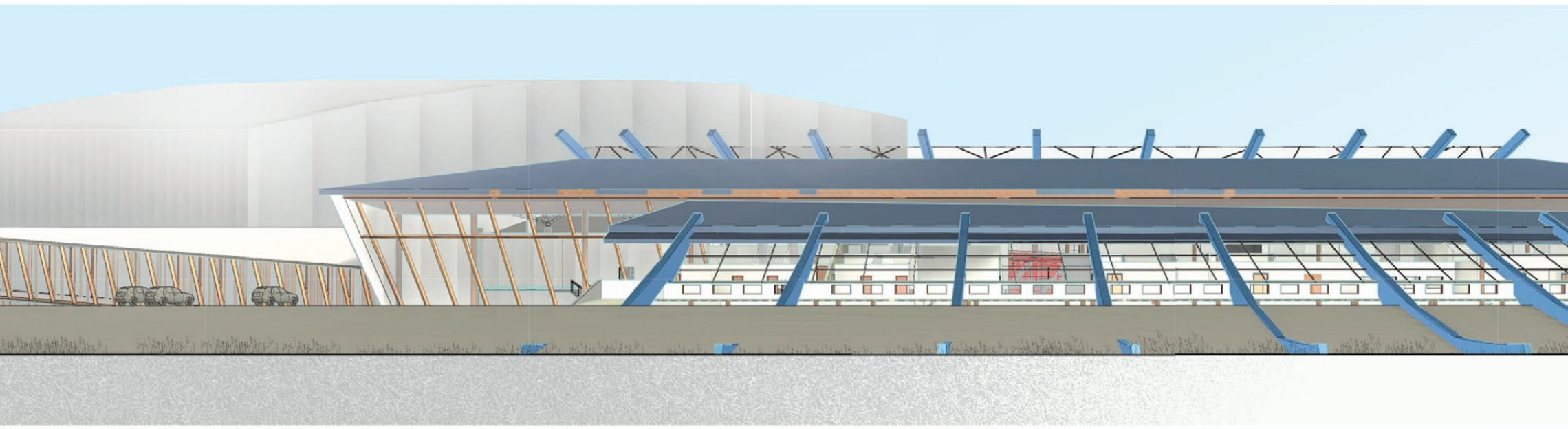
Material and structure

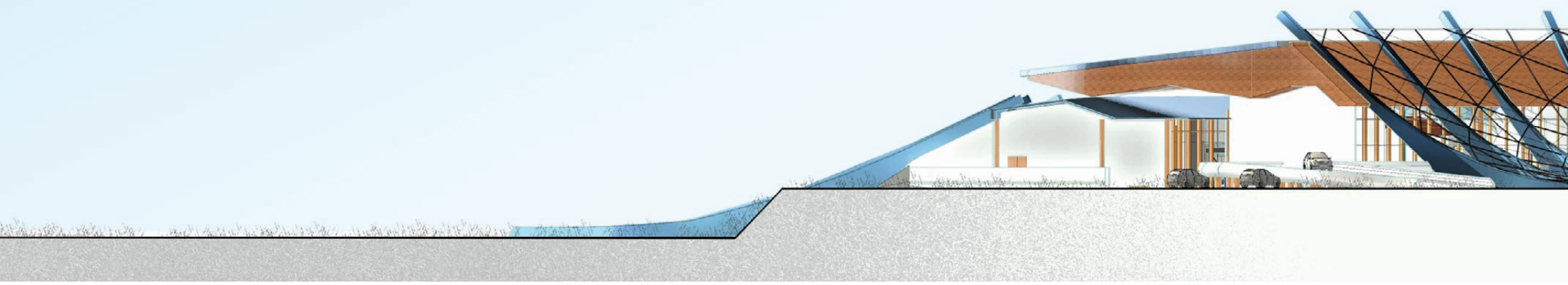
The extreme climate has a time frame and material selection issue. We have designed the whole structure to be steel truss so that the elements can be pre assembled and brought to the site just for connection. We had learned that there is only a limited amount of time work and we would lose a few minutes of daylight to work everyday.

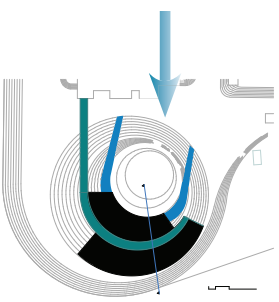
One of the key things to consider in this site is the thermal comfort of the building. The challenge is to design an envelope. The envelope should not entirely enclose the indoor space. It was crucial to open the facade in a way that connects outdoor with indoor space. We decided to use a truss system that can support as well as provide envelopes to the indoor environment. The use of truss would also provide space for ducts and cables to go through the building.



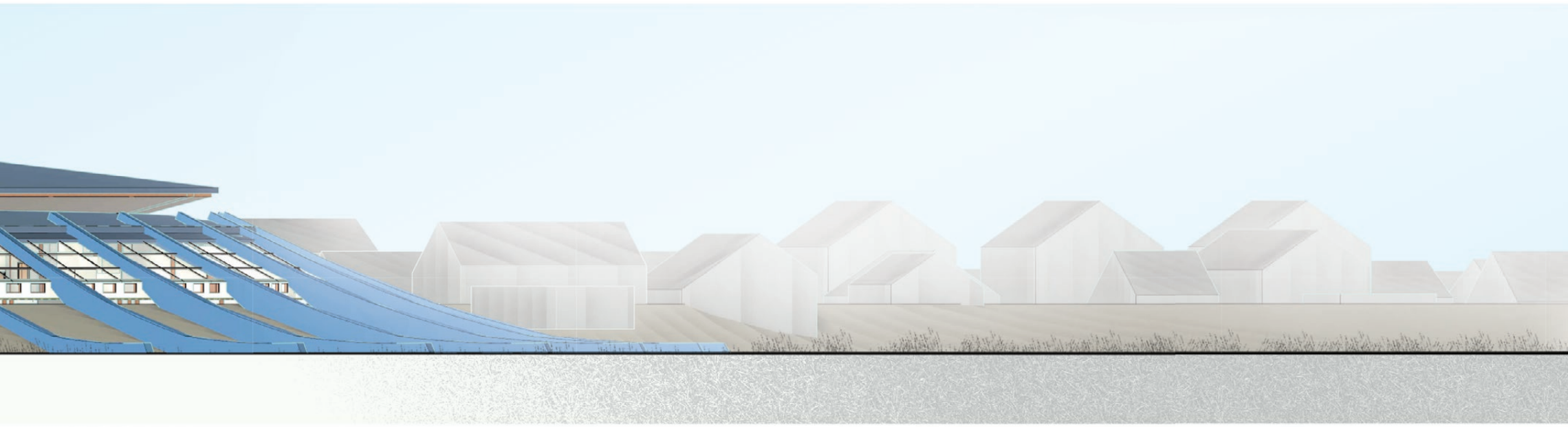
South

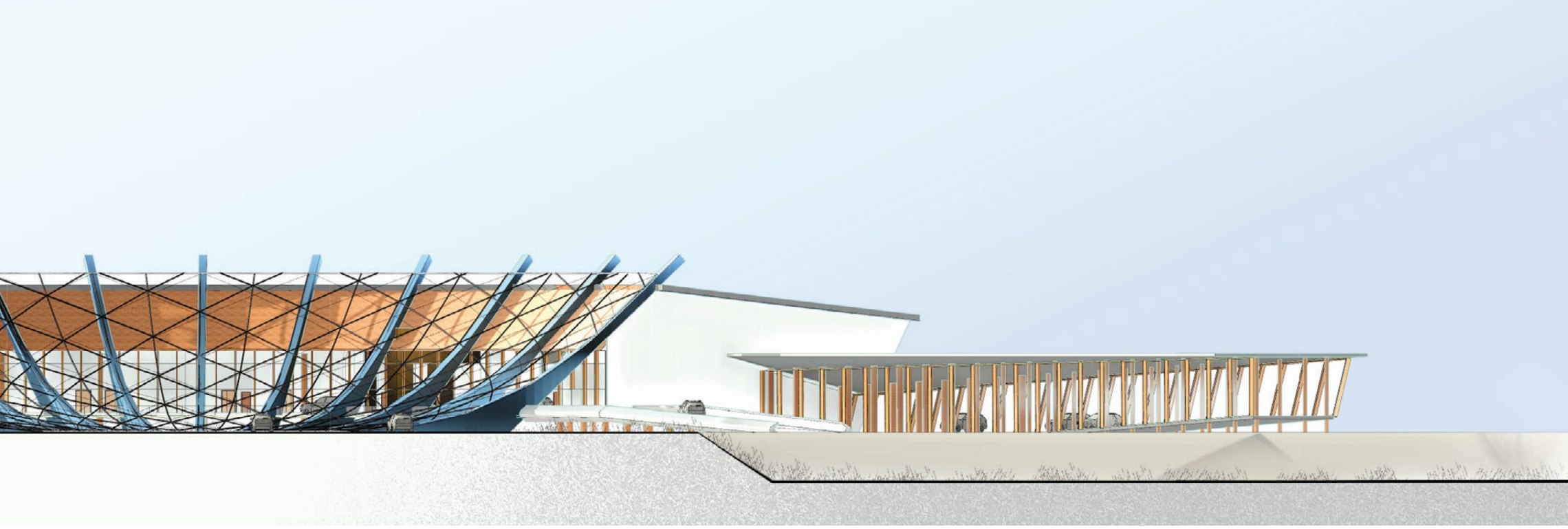


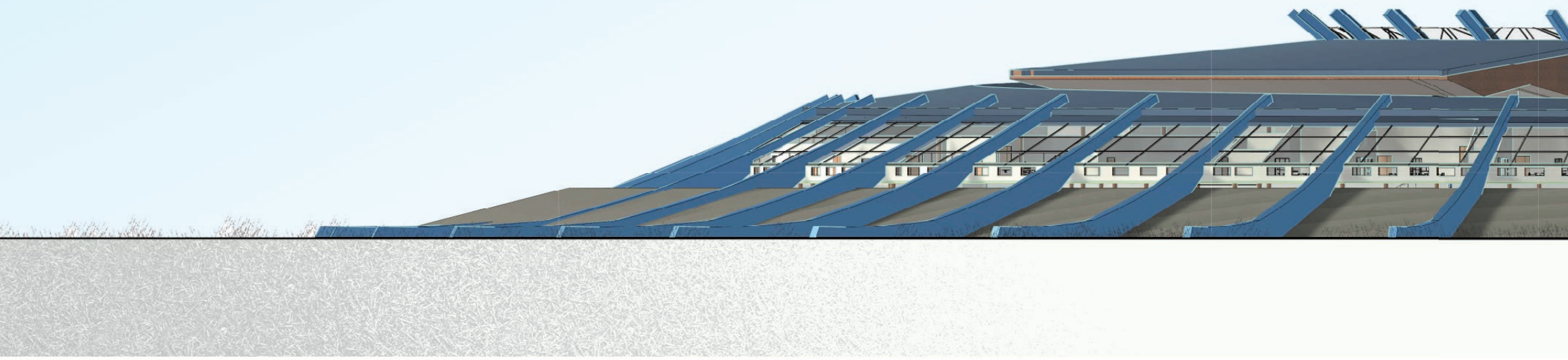




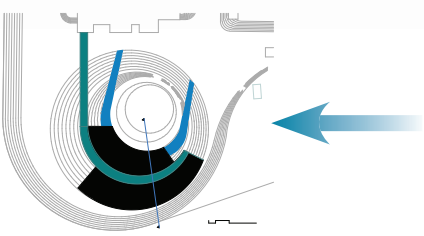
North

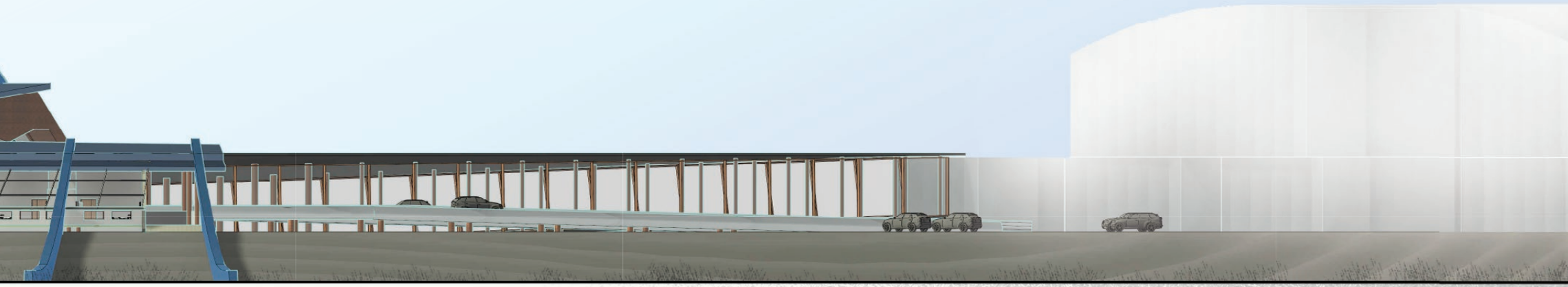


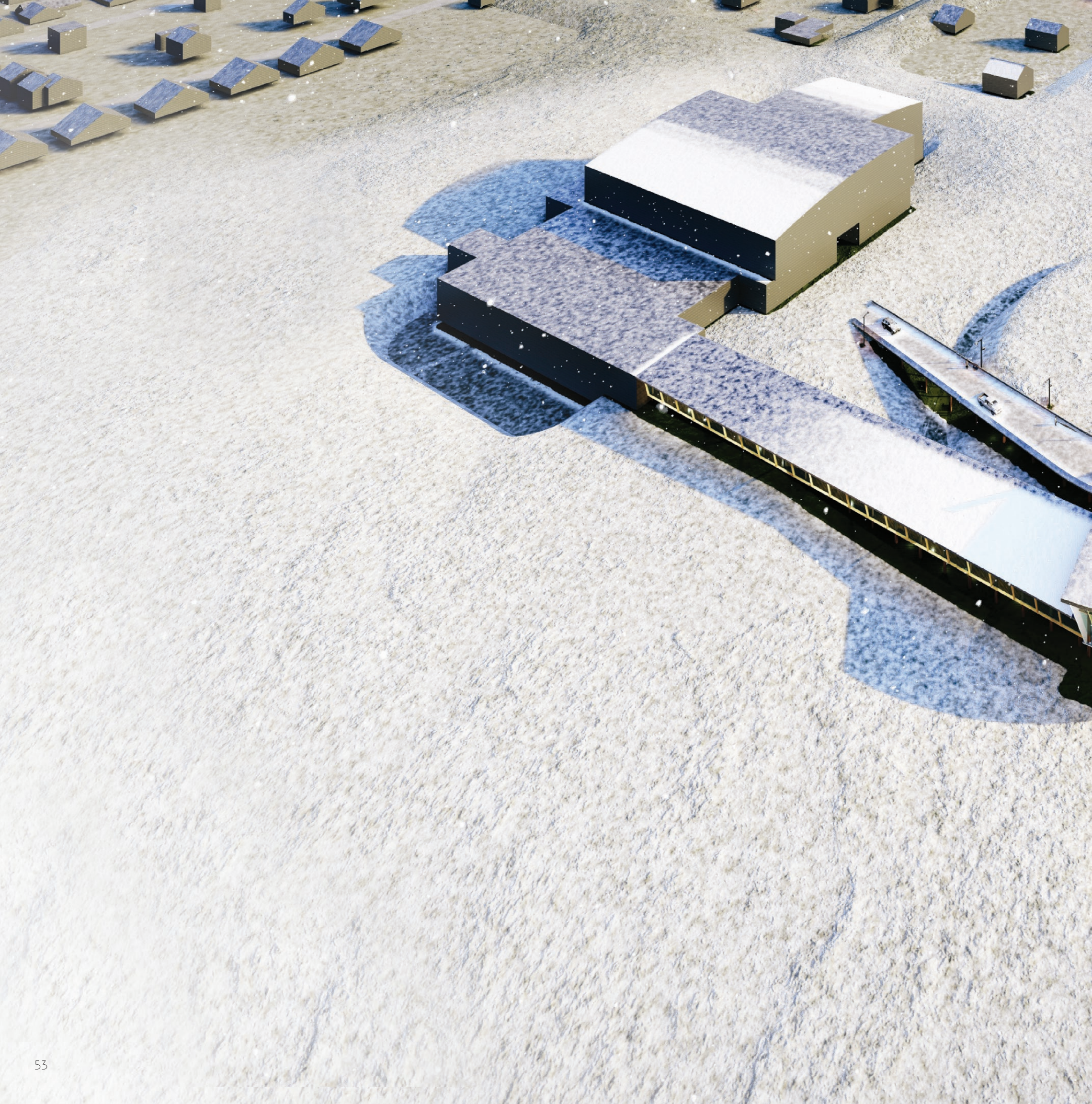


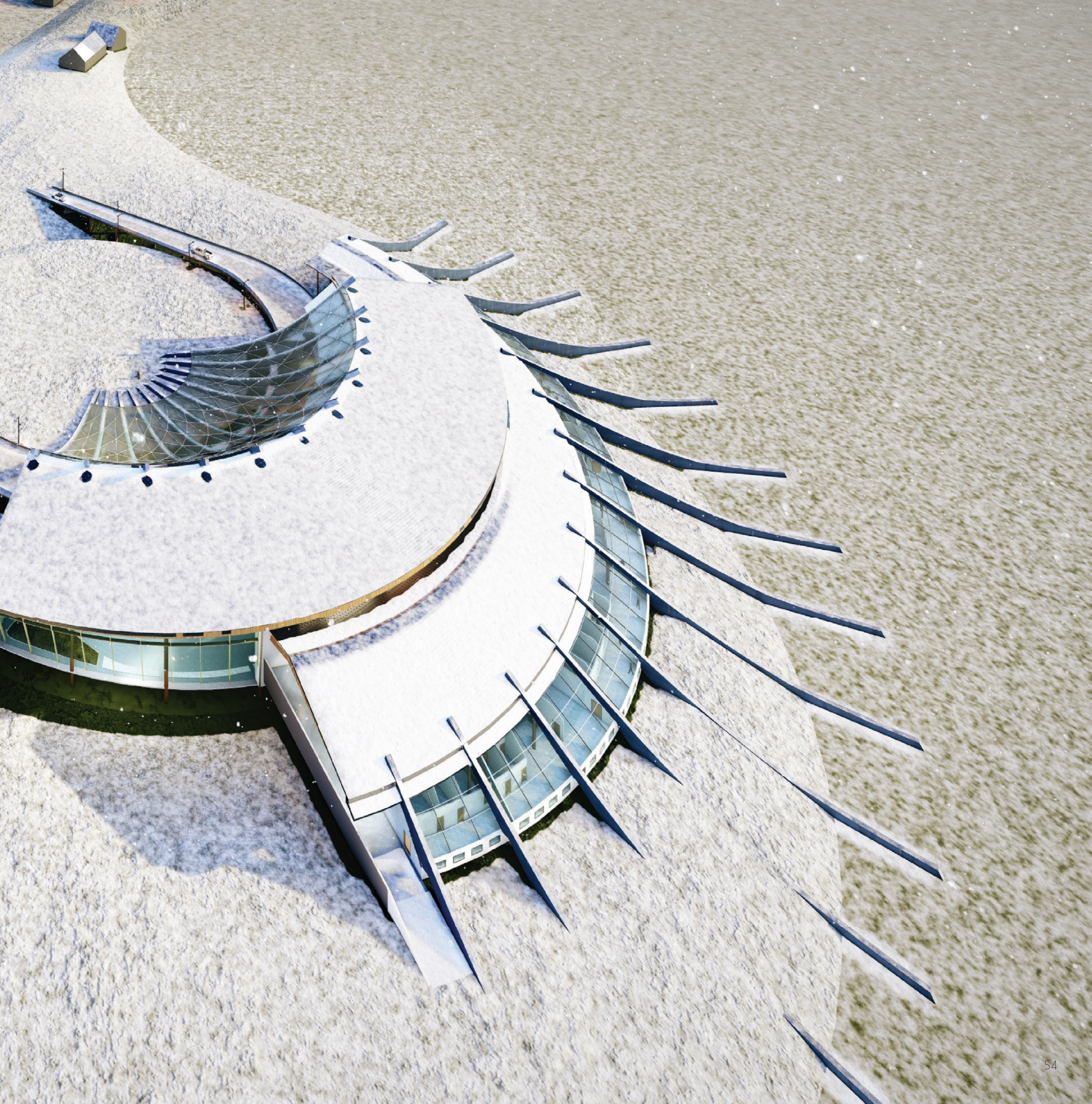


East









DUNE

K A L U T O Q A N I Q

People have been able to call Utqiagvik home even in the harshest climatic conditions. It's because they've adapted to their surroundings. They are familiar with it. In every way possible, Dune has been inspired by the quality of being familiar to the community there. From the approach, materials, and structure to the user experience, everything is considered. One of the factors that contribute to dune formation is a sense of presence.

I think therefore I am...As I am WHERE *I do and think*

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