THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

SCHOOL OF ARCHITECTURE AND LANDSCAPE ARCHITECTURE

URBAN WELLNESS:
TOWARDS RESTORATIVE ENVIRONMENTS IN HOSPITALS

CATHERINE BARTELS
Spring 2010

A thesis
submitted in partial fulfillment
of the requirements
for a baccalaureate degree
in Architecture
with honors in Architecture

Reviewed and approved* by the following:

Jawaid Haider
Professor of Architecture
Thesis Supervisor

Christine Gorby
Associate Professor of Architecture
Honors Adviser

** Signatures are on file in the Schreyer Honors College.*

environment
Neuroscience
Architecture
wellness
wayfinding
Brain
architectural
architects
knowledge
research
better
evidence
settings
buildings
studies
understanding
health
patients
design
human
urban
experience
illuminate
emotional
hospital
Institute
church
aging
serve
experiences
users
visual
Salk
neuroscientific
community
President
Base
cortex
first
mental
book
Academy
Coexistence
Fellow
Landscape
good
hippocampus
laboratory
founding
intellectual
Inversely
cerebellum
decisions
changes
able
behalf
facilities
groundbreaking
change
auditory
hypotheses
compelling
classroom
functions
color
living
insight
cerebral
artfully
anyone
bear
just
issues
enrich
facility
located
Christian
churches
intuitions
increased
introduction
devoted
lead
criteria
funding
cathedrals
describing
beyond
enlightenment
interface
cytokines
Hypothesis
findings
general
back
eventual
Mall
Eberhard
century
created
light
asks
bridge
clear
make
exploring
learning
fruit
concept
argues
clients
exploratory
considers
fundamental
construction
effects
ence
example
interaction
figure
Fallingwater
amygdala
convince
envisage
lobe
architect
cells
important
accessible
also
drawing
delivered
images
evokes
harmony
explores
easily
behavior
based
client
ability
inform
interested
consciousness
activity
building
contemplated
Entasis
laboratories

Abstract

The average American spends 90% of their life inside a building. Whether or not we are conscious of it, buildings affect our bodies and our emotions. Anyone who has ever felt awe in a cathedral or has been depressed by a drab office understands the importance of the built environment. While people may know this intrinsically, numerous studies have established the link between the built environment and mood, productivity, and human error. Reduced hospital stay and faster patient recovery ultimately translate into a higher standard of patient care and reduced costs for patients and hospitals. Patient recovery is primarily affected by four different design factors:

- Quality of day lighting
- Access to landscape and nature
- Opportunities for social interaction and
- Ability for patients to personalize their space.

Urban Wellness

Towards Restorative Environments in Hospitals

Catherine Bartels_The Pennsylvania State University_Department of Architecture_Schreyer Honors College_May 2010

Table of Contents

1. Abstract
2. Thesis Statement
3. Research and Documentation for Area of Focus
    - 3.1. Area of Focus Summary
    - 3.2. Discussion of Findings from Literature Review
    - 3.3. Questions/Theoretical Issues Raised
    - 3.4. Architectural Issues
    - 3.5 Architectural Precedents
4. Site and Context Information
    - 4.1. Aerial photos or maps of site
    - 4.2. Site Documentation
    - 4.3. Site Analysis
    - 4.4. Site Parameters
5. Program
    - 5.1. Program Type and Description
    - 5.2. Programmatic Elements
    - 5.3 Graphic Representation of Program
6. Final Design Project
    - 6.1. Project Parameters
        - 6.1.1 Accessibility and other ADA Requirements
        - 6.1.2 Sustainable Design Features Assessment
        - 6.1.3 Code Analysis
    - 6.2 Studies or Devices Revealing Architectectonic Ideas
    - 6.3 Site
        - 6.3.1 Site Plan
        - 6.3.2 Site Section(s)
        - 6.3.3 Site Model
    - 6.4 Building Plans
    - 6.5 Elevations and Facade Studies
    - 6.6 Building Sections
    - 6.7 Wall Sections
    - 6.8 Representation of Structural System
    - 6.9 Other Project Images
7. Consclusions
    - 7.1. Reflections
    - 7.2 Attached CD
8. Bibliography
    - 8.1 Written Sources
    - 8.2 Project References

"We shape our buildings; thereafter

they shape us."

-Winston Churchill

Thesis Statement

A spatial environment can have a therapeutic influence on the psyche of the individual. Whether or not we are conscious of it, buildings affect our bodies and our emotions. Numerous studies have proven the link between the built environment, mood, and productivity.

In hospitals, design that manifests certain qualities can reduce hospital stay, contribute to stabilizing mental disorders, and speed patient recovery.

Research

3.1. Area of Focus Summary
3.2. Discussion of Findings from Literature Review
3.3. Questions/Theoretical Issues Raised
3.4. Architectural Issues
3.5. Architectural Precedents

3.1 Area of Focus

The Area of Focus of my research is primarily centered on scientific studies that link environment to human behavior. Such studies primarily fell into three categories of environment: lighting, landscape, and atmosphere. The first question that we must ask is, can design affect human behavior? The overwhelming answer appears to be YES. A study on hospitals in 2002 found that 'improved environment' reduced treatment times by 21 percent and reduced usages of analgesics by 59 percent.[1]

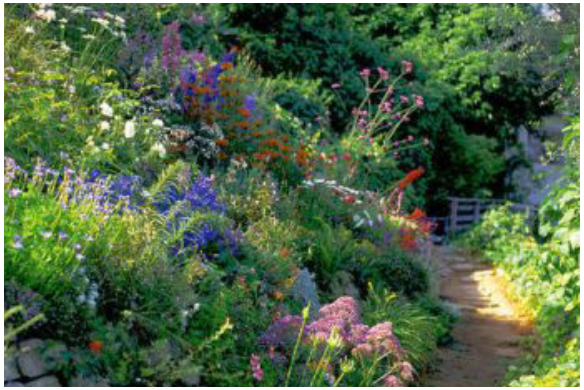
So what constitutes 'improved environment?' what is the baseline that we should use to discover the positive or negative impact of a building? While we may claim that we know that one building makes us feel better than another, how can be use science to quantify these claims?

1 Lawson, B. (2002) Healing Architecture. *Architectural Review*, May.
2 Eberhard, John P. Brain Landscape: The Coexistance of Neuroscience and Architecture. New York: Oxford University Press, 2009. Page 82.
3 IBID, 132.
4 IBID, 146.
5 IBID, 151.
6 IBID, 146.
7 IBID, 168.
8 Zeisel, John. Inquiry by Design: Environmental/Behavior/Neuroscience in Architecture, Interiors, Landscape, and Planning. New York: W.W. Norton, 2006. Page 357.
9 IBID, 357.
10 Eberhard, 131.
11 IBID, 127.
12 IBID, 127.

Lighting

Lighting is incredibly significant in affecting human behavior. First, lighting can affect recovery times. Light is used to orient patients and help them restore a sense of normalcy[2]. Lighting can also increase appetite and encourage eating in healthy portions.[3] Increased natural sunlight can also be used to lower depression, which increases patient recovery times.[4]

Second, lighting can impact behavior during treatment. Proper natural and artificial lighting can reduce errors by doctors and hospital staff. A 2006 study showed that depriving lab technicians of daylight and the ability to stay "visually oriented" with the outside world had a drastically negative effect on their performance, accuracy, and efficiency.[5] Part of this phenomenon is connected to the increase of cognitive ability for workers who have a connection to the outdoors.[6]



Landscape

Access to nature can have a positive impact on a patient's recovery, even if the patient can only see nature from afar. In 1984, Roger Ulrich published the first groundbreaking research on the connection between hospital patient recovery and nature. Ulrich conducted a study of patients who had had a gallbladder removal surgery between 1972-1981 in one hospital. Ulrich paired the patients based on age, gender, fitness, and medical history, among other factors. Then, one patient in each pair was given a hospital room with the view of a garden, while the other patient recieved a view of a brick building. Patients who recieved the "natural" view spent a shorter time in the hospital (7.96 vs. 8.70 days), had fewer negative notes made about them on their charts (1.13 vs. 3.96 per patient), and requested "significantly fewer" analgesis (pain medication) during their stay.[7]

Sense of Place

A sense of place, while important to all human beings that use space, is especially important to hospital patients who are uprooted from familiar surroundings. Personalization is the act that we engage in to make a place our own. It makes a place reflect our personalities, our past, and our aspirations.[8] Neuroscience research suggests that we engage in personalization of spaces because "memories of our past largely define ourselves- who we believe that we are."[9]

This concept of achieving a sense of place is especially important for elderly or disoriented patients. A study of an elderly care home found that allowing residents to furnish rooms with their own furniture was comforting and relaxing to patients. It also reduced depression and stress in residents who brought in their own furniture.[10]

Social Interaction

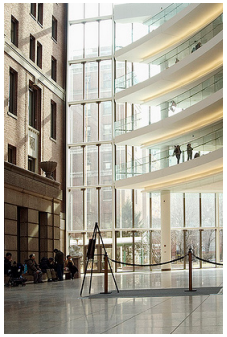
While environment can have a tremendous affect on hospital patients, architecture cannot ignore other means and mechanisms that can aid a patient on the way to recovery. Instead, buildings must work encourage other aspects, such as social considerations.

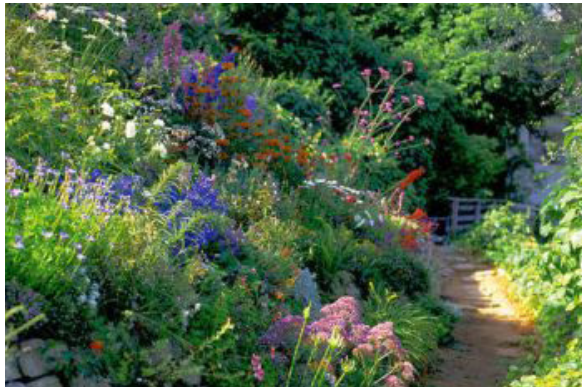
Neuroscience research has reinforced an intuitive feeling- that social stimulation is an important factor in maintaining elements of cognitive awareness, such as memory.[11] Research has also shown that feelings of self-worth are directly connected to how connected people feel to other in their family and how much they tink that they can influence what happens to them.[12] Patients who have higher levels of self-worth are thus less susceptible to depression and therefore more likely to make a quick and successful recovery. These feelings are therefore directly connected to social interaction.

3.1.1 Precedents in each Area of Focus

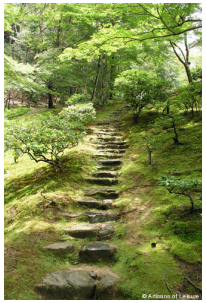
These photos are designed to give an idea of how architecture can represent each of the four areas of focus in the context of a building design.

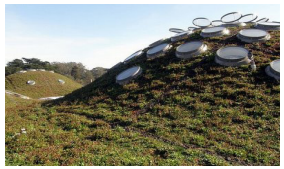
Lighting





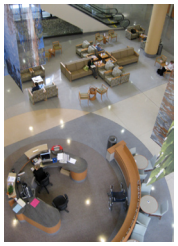
Landscape

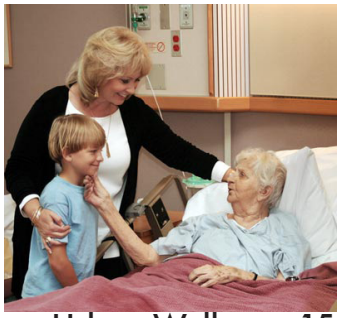




Personalization

Social Considerations





3.2 Literature Review

John Zeisel's book on Environment and Neuroscience is a comprehensive introduction to the relationship between environments and behavior. The book discusses how to observe environmental behavior as well as how to conduct research about environmental behavior. This book also contains concrete examples of case studies as well as the results from those studies.

Brain Landscape discusses how buildings can cultivate different feelings and emotions. The book has specific chapters on the impact of different types of architecture, from sacred spaces to facilities for the aging.

Richard Restak, a neurologist, provides a technical overview into the inner-workings of the brain in his book *Brainscapes*. The book describes each region of the brain takes impulses and puts them into feelings and emotions. It also describes how injury in different parts of the brain manifest themselves in different ways.

Healing Spaces specifically focuses on how the right type of space can be "healing" for patients recovering from mental and physical distress. The book specifically mentions "healing" locations around the world that have been thought to have a positive healing impact on patients.

Places of the Soul talks about architecture that has been specifically designed to heal; the book discusses how the belief in the connection between places and healing has evolved thoroughout time and the architectural manifestations that have occured as a result.

Inquiry by Design: Environmental/Behavior/Neuroscience in Architecture, Interiors, Landscape, and Planning

by John Zeisel

Brain Landscape: The Coexistance of Neuroscience and Architecture

by John Eberhard

Brainscapes:
An Introduction to What Neuroscience has Learned about the Structure, Function, and Abilities of the Brain

by Richard Restak

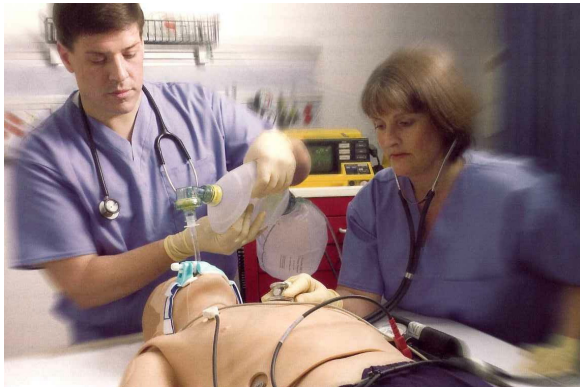
Healing Spaces: The Science and Place of Well-Being

by Esther M. Sternberg, M.D.

Places of the Soul: Architecture and Environmental Design as a Healing Art
by Christopher Day

3.3 Theoretical Issues

Studies have proven that the brain is significantly more active when viewing complex scenes, such as rooms, landscapes, and city streets, than when viewing photographs of objects or faces.[1] Architects may be quick to embrace this statement, but they have been slow to embrace the ability of science to aid and guide design, even when the evidence is irrefutable. Why is this so? Architect John Eberhard suggests that this is because the architectural community can not "recognize problems that can be met in no other way."[2] Thus, one of the great challenges of my thesis involves an exploration of the relationships between design and Environment/Behavior research. How can architectural design still meet occupants' needs in a creative way while still incorporating the conclusions of environment/behavior research?



What is the relationship between design and science?

Traditionally, architecture and science have had very little to do with each other. Architecture is often grouped as a combination of art, business and technical knowledge, none of which are fields that interact with science. In addition, neuroscience is an extremely new field, and so architecture hasn't had a lot of time yet to respond to the field. However, many architects and neuroscientists believe that the future of architectural design will be hand in hand with science. Architect John Eberhard notes, "In the future, architects will need an understanding of how to integrate knowledge of neural networks and their organization into the practice of architecture."[3]

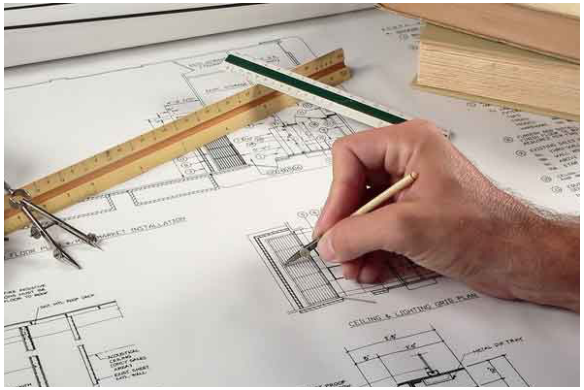
1 Eberhard, John P. Brain Landscape: The Coexistance of Neuroscience and Architecture. New York: Oxford University Press, 2009. Page 74.
2 IBID, 7.
3 IBID, 9.
4 IBID, 78.
5 IBID, 9.

What part of environment can affect us the most?

The question of whether or not environment can impact human behavior appears to be proven irrefutably by the previously mentioned research. Environment affects all of our senses- touch, smell, hearing, taste, and vision. However, one can argue that vision is the most important element that affects how we interpret and experience our surroundings. After all, nearly half of the brain's cerebal cortex is used to process visual signals. This is more area than is devoted to any other sensory system.[4] While we use vision to orient us, we must be aware of we use all of our senses to experience and interpret an environment. It is these interpretations which determine how our enviornment affects us.

How can design incorporate creative elements while still using the knowledge of science?

The findings of neuroscience as they relate to design offer very specific guidelines on the 'correct' way the spaces should be designed to either affect human behavior in either a positive or negative way. For a scientist, a building environment either has a negative or a positive impact- there is no grey areas. This has led some architects to dismiss the combination of neuroscience and architecture as one that crushes creativity. However, neuroscience offers only snippets of how design should work. Designers and architects must step in to combine these ideas into a cohesive whole that fits the needs of the client, the future occupants, the site, and the community. These elements leave a large amount of room for creativity in design.



How do neuroscience studies of environment affect the architecture profession?

Currently, architecture schools do not teach about the link between architecture and neuroscience. Architecture today is largely focused on a process of aesthetics- not on human behavioral studies. Very few buildings even participate in post-occupancy studies, and so the focus is on the design rather than the occupants. Architect John Eberhard writes that architecture must shift how it understands human requirements "away from an exclusive emphasis on solving the puzzle of designing a building- its structural, mechanical, lighting and spatial components- to studying how to accomodate human activities correlated with responses of the brain and the mind."[5] In short, architecture has an obligation to use whatever field that it can that will enable architects to create better design.

3.4 Architectural Issues

Hospital and healthcare design creates many significant architectural issues in an of itself. Modern hospitals must incorporate so much technical knowledge of how a building comes together that design and patient welfare are often pushed to the side. These issues are compounded even further in an urban environment, where space is extremely limited. My thesis must strive to not only meet the techical requirements of a modern hospital and modern hospital equipment, but will also address how to create a hospital that practices good design in an urban environment.

What are the challenges of healthcare design?

Designing a hospital raises a number of significant architectural issues that might not otherwise exist. Some examples of additional challenges include challenges of circulation (considering space required to move equipment and patients), sterilization (to prevent and lower risk of infection and aid recovery), and coordination of units. A hospital operates as a small village- it must serves as a place for care, cleaning, food, support, and work. Meeting so many needs can cause the different functions of the hospital to clash. Each unit of the hospital must be able to function independently while still supporting the ultimate goal of patient wellness.

What are the unique challenges of healthcare design in the urban context?

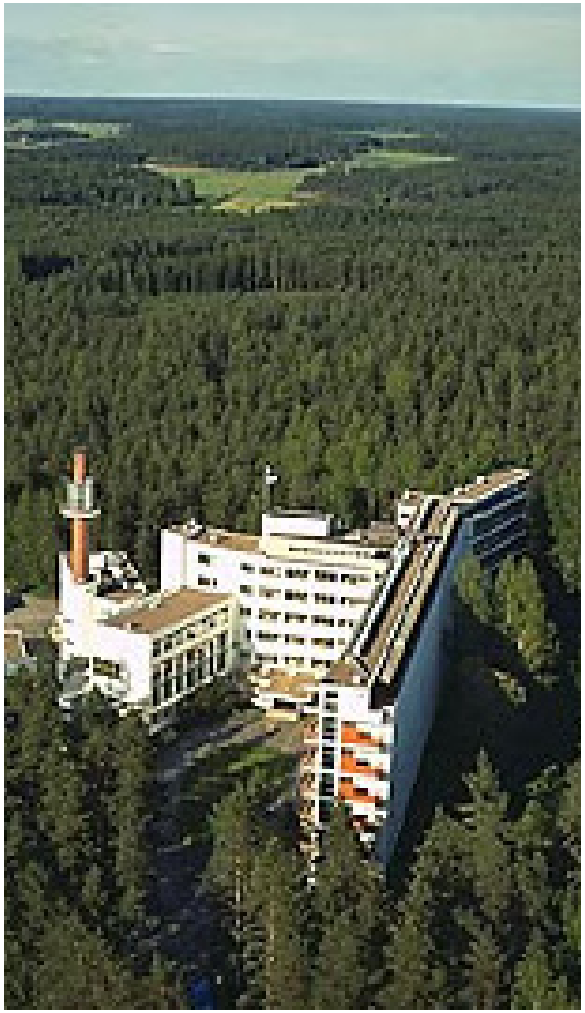
The aforementioned research on health and healing (see section 3.1) focuses a lot on the healing effects of both sunlight and nature, neither of which are readily available in an urban context. These are the unique challenges of all urban contexts. My particular site is also in a highly impoverished neighborhood. This situation also creates a highly charged architectural issue as to how architecture can and should respond to a very poor environment.

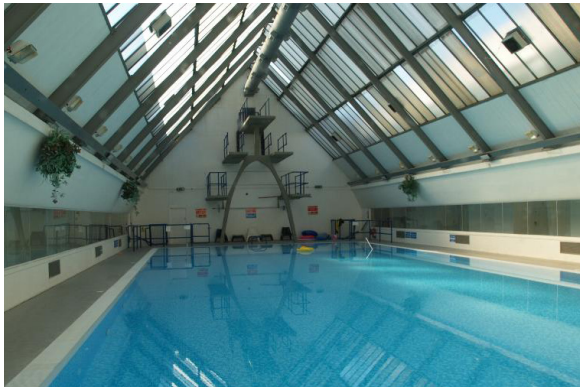
How can a building addition create a new identity while still connecting to an old one?

My thesis site will be an addition to an existing hospital, which will require a lot of coordination and planning with the existing building to create an addition that feels cohesive with the old building, yet also retains its identity as a new position.

3.5 Architectural Precedents

My architectural precedents focused on buildings that have been designed around the concept that the building environment can impact health. Two such buildings are the Paimio Sanatorium and the Peckham Health Centre.





Alvar Aalto's tuberculosis sanatorium... is informally planned, each department occupying a separate wing and the wings radiating from the centre at different angles, determined by the direction of sunlight and view. The reinforced concrete frame construction is fully exposed and fully exploited aesthetically: taut and muscular yet gracefully modulated."
–J.M. Richards. *800 Years of Finnish Architecture*. Vancouver: David and Charles, 1978. p144-5.

Designed in 1929 by Alvar Aalto, the Paimio Sanatorium (photos above, above left, and left) was designed specifically to house patients with Tuberculosis. Aalto designed the sanatorium with the idea that TB could be cured by adequate air, sunlight, clean design, and beautiful vistas. The location of the sanatorium in the Finnish mountains was believed to be integral to its success as a building.

The Peckham Health Centre (above, above left, and left), designed by Sir Owen Williams in 1935. Run and managed by two doctors, it was deliberately designed as an experiment to measure the affect of environment on health. It was a radical departure from previous ideas about how to achieve and maintain health. The Health Centre contained a large amount of athletic facilities, such as the above swimming pool, designed to promote a healthy lifestyle. The Peckham Health Centre was also one of the first buildings that applied the principal that high levels of natural lighting can positively impact health.

Site Analysis: St. Joseph's Hospital

Site and Context

My thesis site is adjacent to an existing hospital, St. Joseph's Hospital, in Northern Philadelphia. As a city of 1.4 million people, Philadelphia is a large urban center. Philadelphia is a unique, historied city, yet it is also representative of a city that faces many of the same issues in modern healthcare design that all cities face.

As a local hospital, St. Joseph's is closely connected to the complexity of the North Central neighborhood of Philadelphia. North Central is one of the poorest areas of Philadelphia and the vast majority of St. Joseph's patients are from the area. As a result, the hospital struggles everyday to meet the needs of patients who are uninsured or underinsured. In fact, 69.68% of the neighborhood population is more than 200% below the poverty line. This hospital addition uses design to improve patient care while reducing costs. This benefits patients, the surrounding community and the hospital's financial situation.

Percent Vacant Properties: **42.99%**

Percent Vacant Land: 28.08%
Percent Vacant Structures: 17.08%

Percent of families 200% below the poverty line: **69.68%**

Percent of population over 25 with a High School Degree or higher: **36.26%**

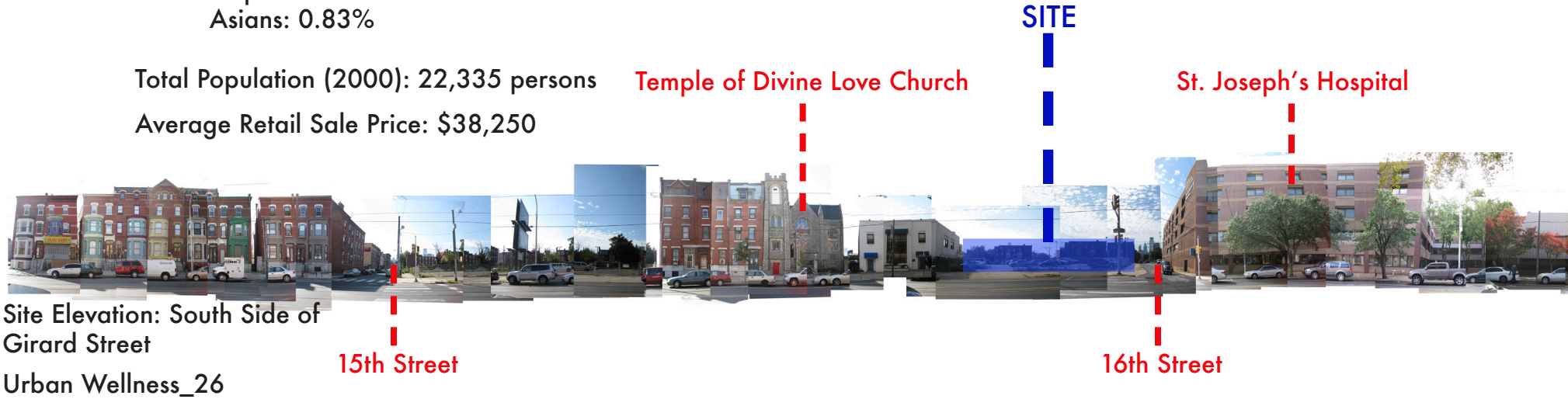
Racial Make-up:

African-American: **93.80%**

White: 3.08%
Hispanics: 2.07%
Asians: 0.83%

Total Population (2000): 22,335 persons

Average Retail Sale Price: $38,250



Site Elevation: South Side of Girard Street

Site Analysis: Large Aerial View of Philadelphia

Proposed Site of Addition =
C-2 Commercial Site

Maximum Height:
35 feet or 3 stories; one additional foot of height can be added for each foot of set back for a maximum of 60 feet

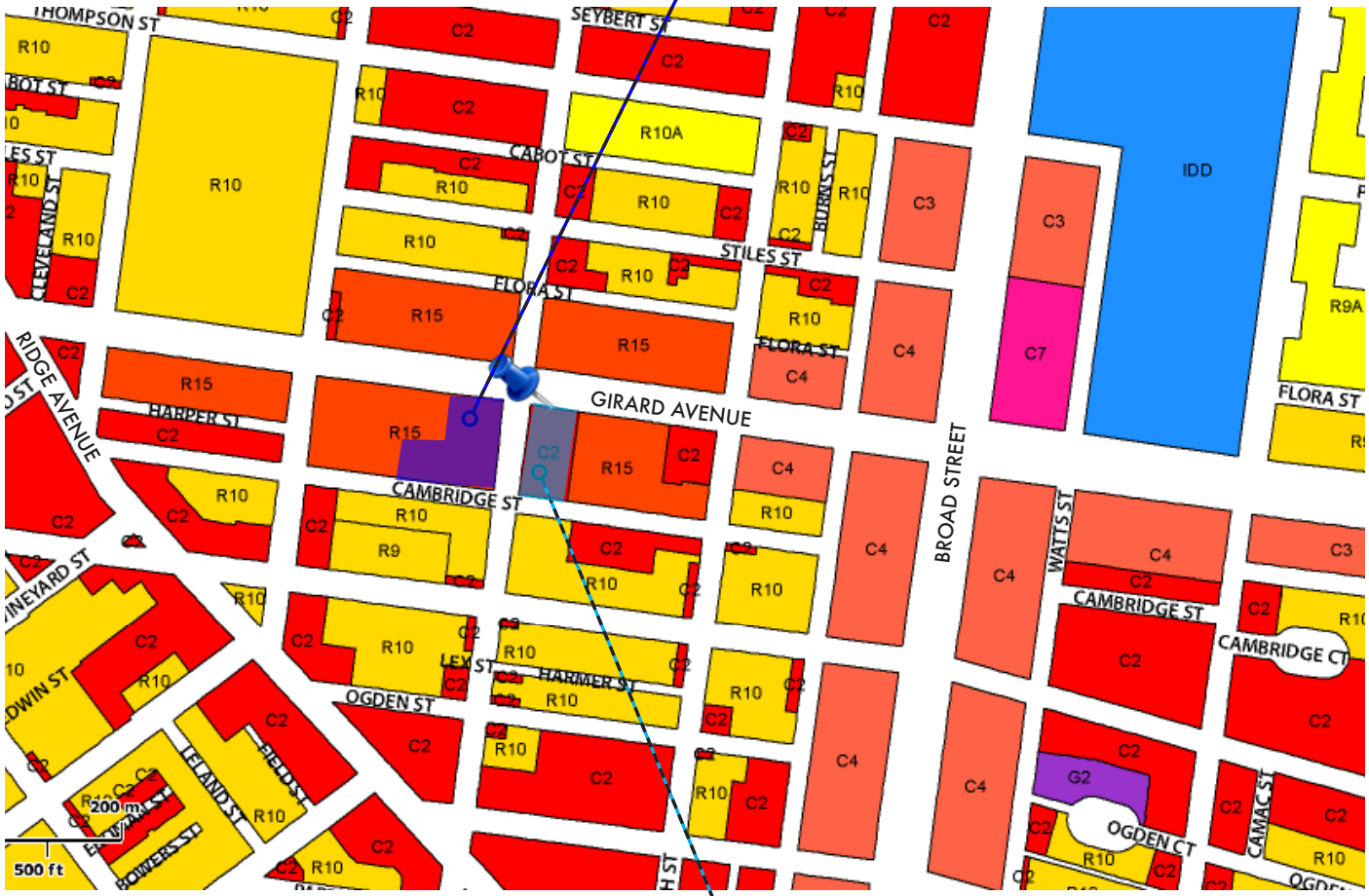
Setback:
No setback required

Occupied Lot area:
No more than 80% of the lot should be occupied by buildings

Other Zoning Provisions:
Inner courtyards should be no smaller than 100 ft sq.

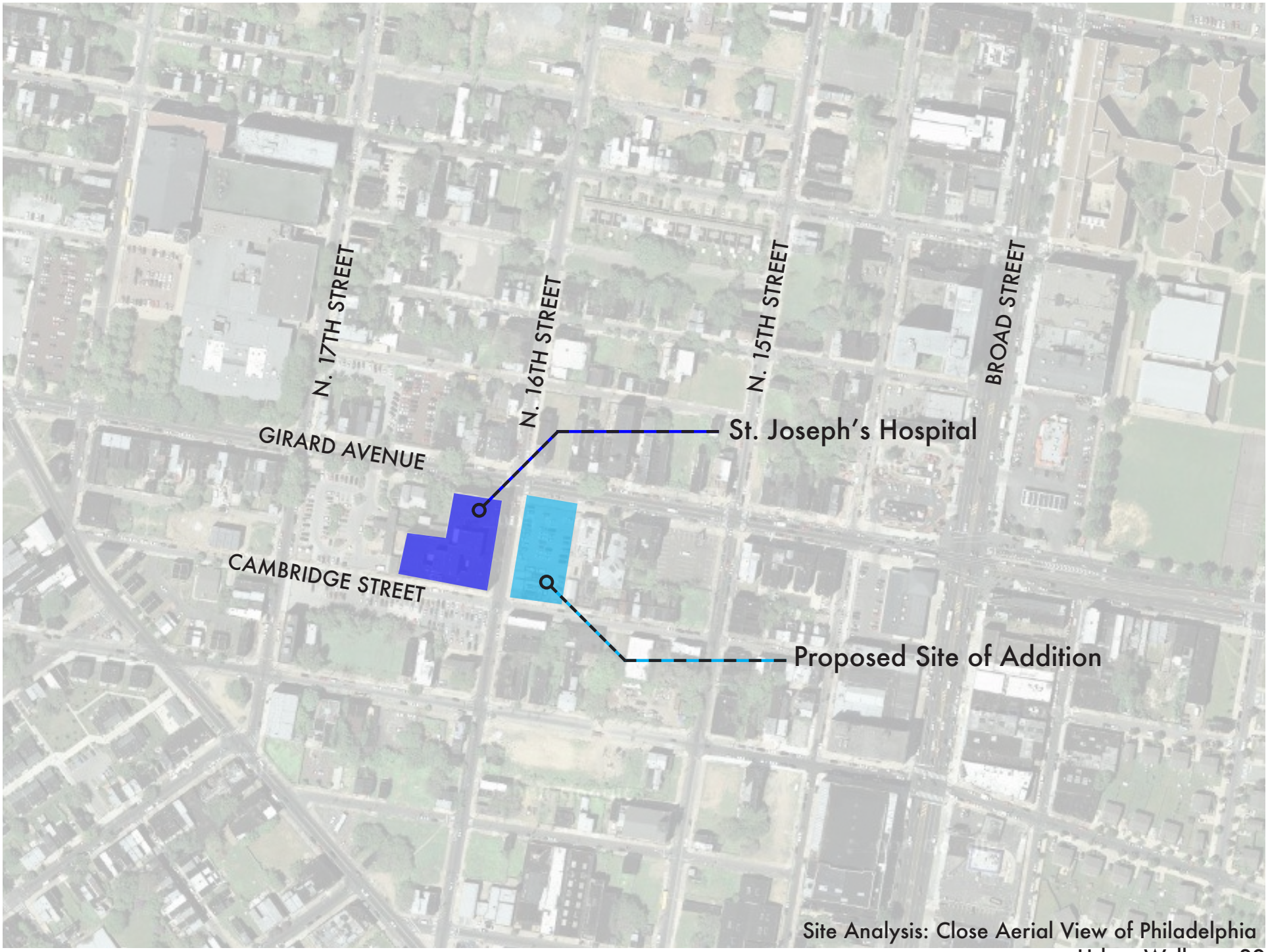
Hospitals are not allowed on C-2 properties; they are, how ever, allowed on R-15 properties.

St. Joseph's Hospital

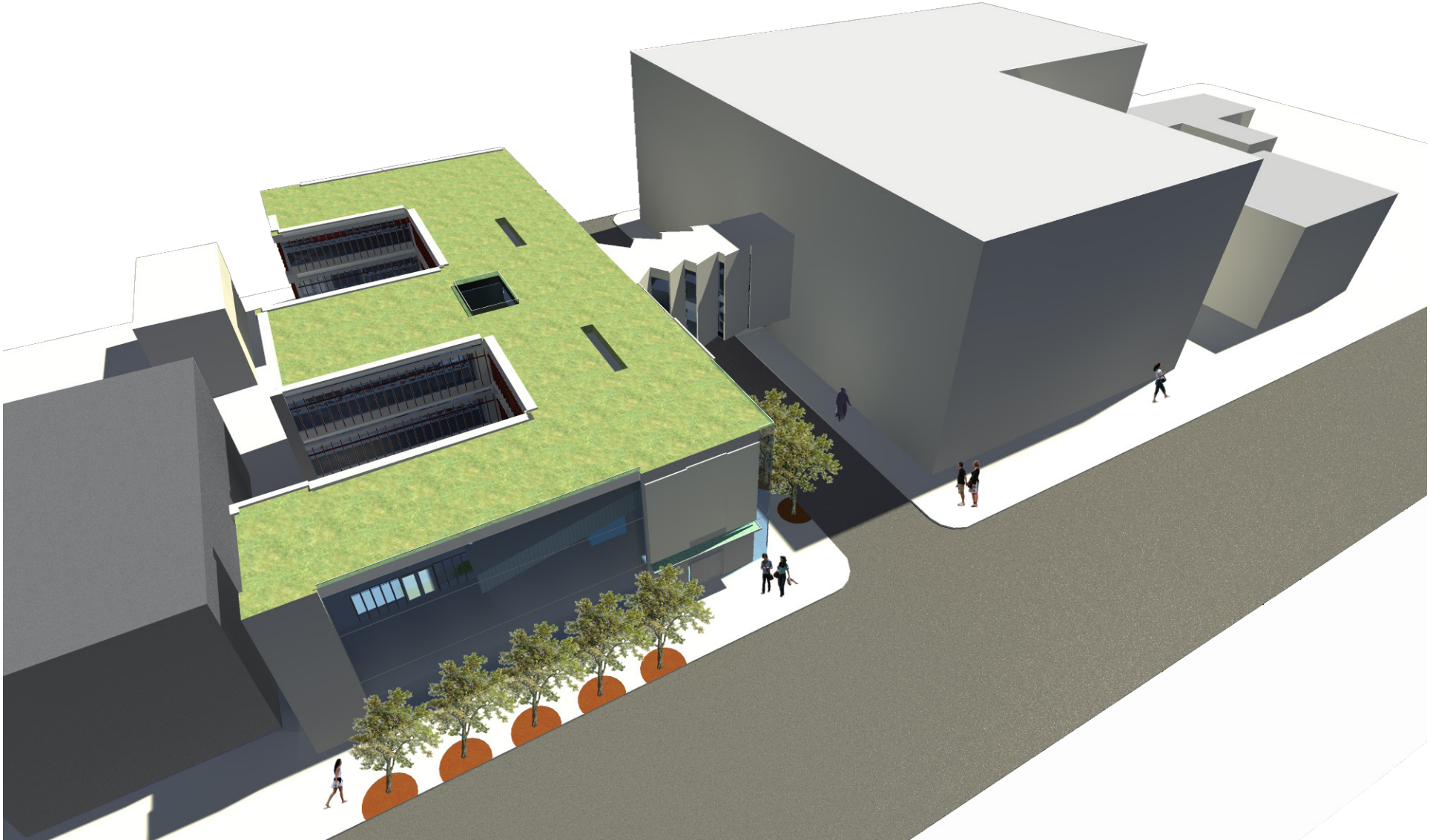


Proposed Site of Addition

Site Analysis: Zoning



Site Analysis: Close Aerial View of Philadelphia



Program

5.1 Program Type and Description
5.2 Programmatic Elements
5.3 Graphic Representation of Program

5.1 Program Type

The program of the addition contains areas that address the diagnosis, treatment, and recovery of the patient. The building program consists of 22 Progressive Care Unit (PCU) rooms. PCU or “step-down” rooms are for patients that have recovered enough to leave the ICU. These patients would typically stay in the PCU for 3-5 days. The program also includes spaces for education of the local community on proper health and nutrition, an operating room, discharge consulting spaces, and physical therapy recovery.The approximate square footage is 45,000 square feet. Program spaces for preventative care would also extend the service of the building to healthy and at-risk residents, not just sick residents. This program augments a design that could produce perceptible results based on neuroscience principles of design (e.g., shorter patient recovery times). A hospital program will allow patients to travel along a wide arc of change in physiology from illness to wellness. No other program would allow its inhabitants to experience the effects of a neuroarchitecture design to such a great degree.

5.2 Programmatic Elements

TOTAL HOSPITAL PROGRAM:

22,792 sq. ft. program
\+ 2,500 circulation

25,292 sq. ft. Total

N

TREATMENT (2,745 sq. ft.)
_Operating Room (475 sq. ft.)
_Sub-sterile & Scrub Rooms (1000 sq. ft.)
_Pharmacy (1035 sq. ft.)
_Physical Therapy (1270 sq. ft.)

PREVENTION (4,983 sq. ft.) (40%)
_Educational Classrooms (1,114 sq. ft. @557 sf ea.)
_Educational Kitchen (844 sq. ft.)
_Outpatient Offices (900 sq. ft.)
_Catwalk (1,130 sq. ft.)
_Offices (995 sq. ft.)

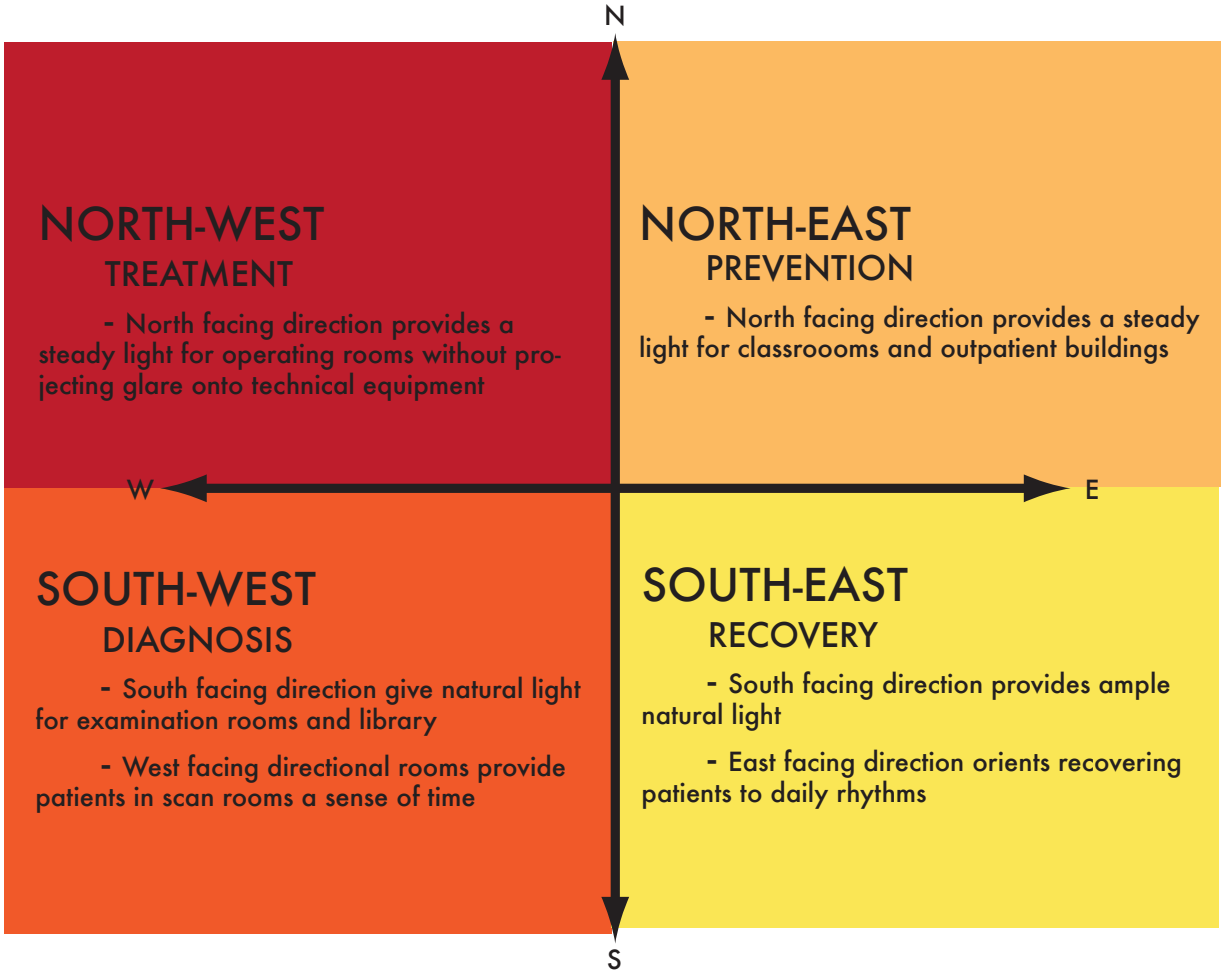
W E

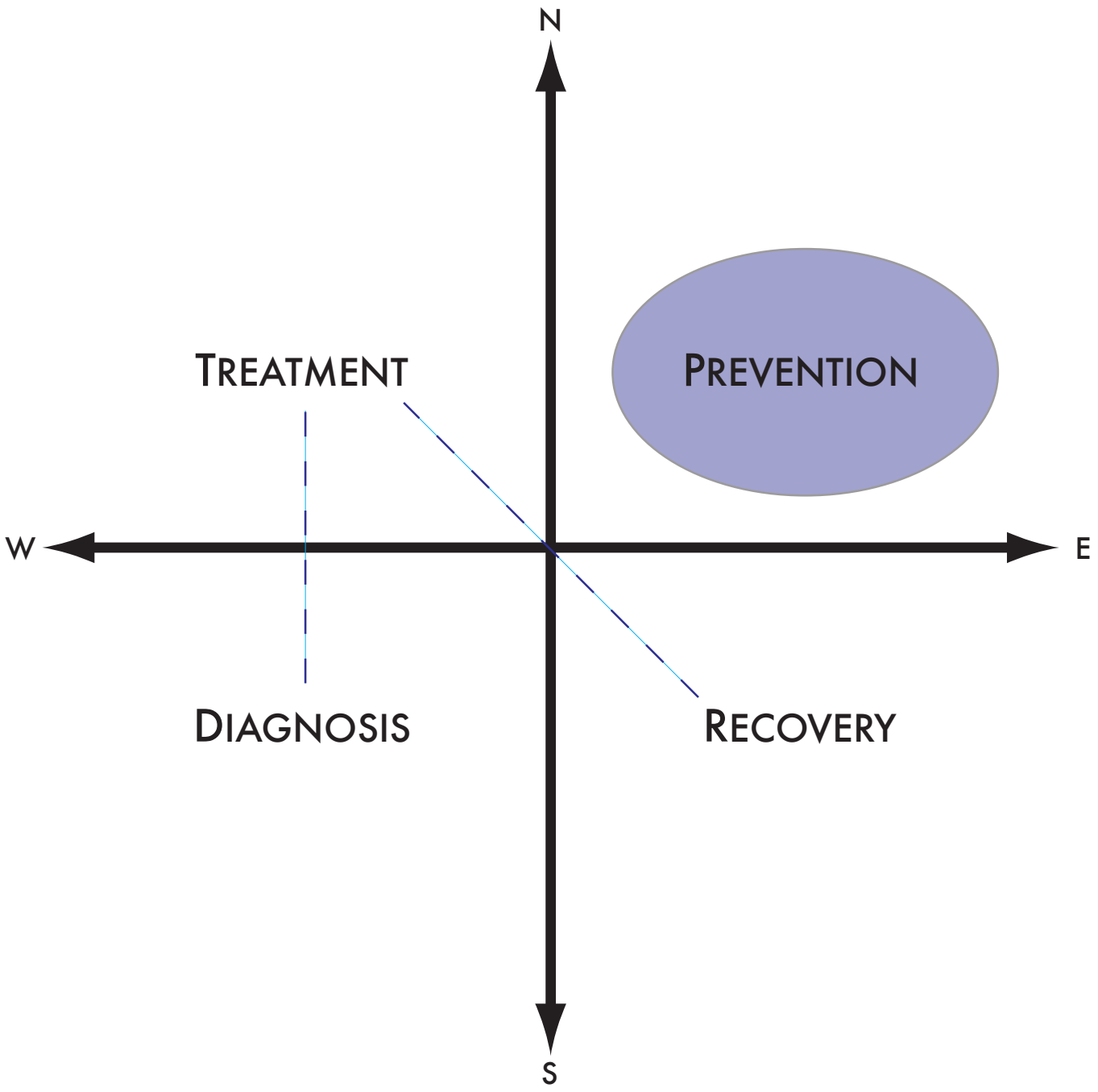
DIAGNOSIS (734 sq. ft.) (12%)
_Doctor's Lounge (530 sq. ft.)
_Diagnosis consulting (204 sq. ft. @68 sf ea.)

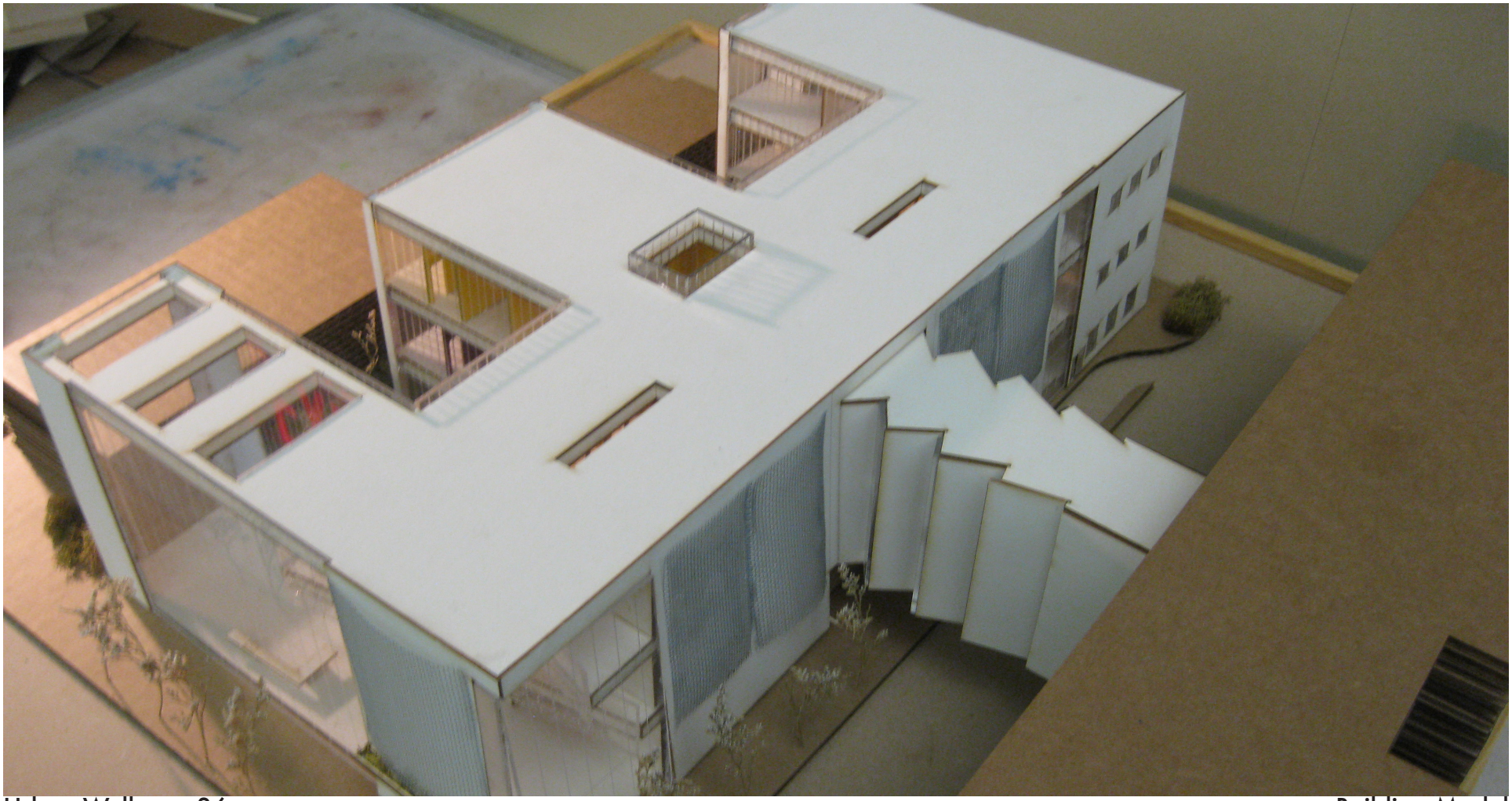
RECOVERY (14,330 sq. ft.) (36%)
_Hospital Rooms (5,160 sq. ft. @ 215 sf ea.)
_Waiting Areas (5,500 sq. ft.)
_Nurses' Stations (1,400 sq. ft.)
_Gift Shop (500 sq. ft.)
_Cafe (1,400 sq. ft.)
_Family Kitchens (370 sq. ft. @ 185 sf ea.)

S

5.3 Graphic Representation




N
PREVENTION
TREATMENT
W
E
DIAGNOSIS
RECOVERY
S



Building Model

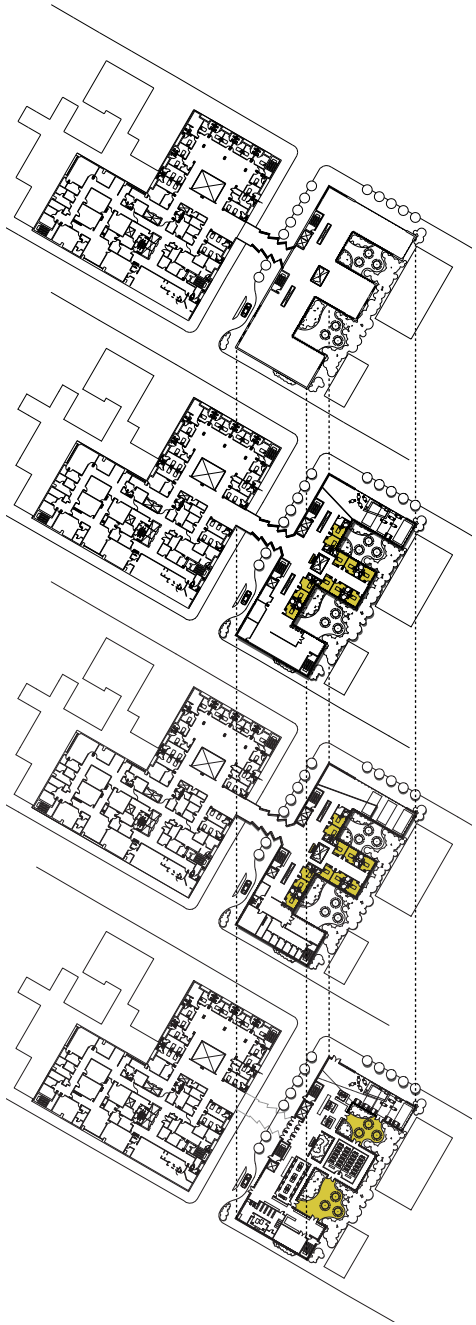
Final Design Project

6.1 Project Parameters
6.2 Studies or Devices Revealing Architectonic Ideas
6.3 Site
6.4 Building Plans
6.5 Elevations and Facade Studies
6.6 Building Sections
6.7 Wall Sections
6.8 Representation of Structural Systems

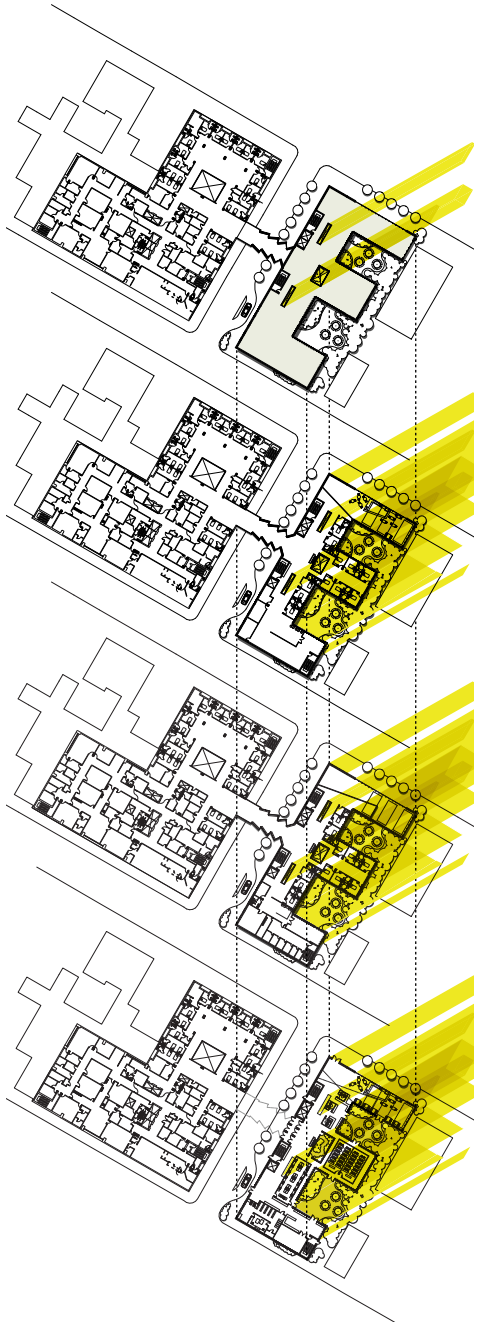
6.1 Project Parameters

6.1.1 Accessibility and other ADA Requirements
6.1.2 Sustainable Design Features Assessment
6.1.3 Code Analysis

Building Model



Sense of Place



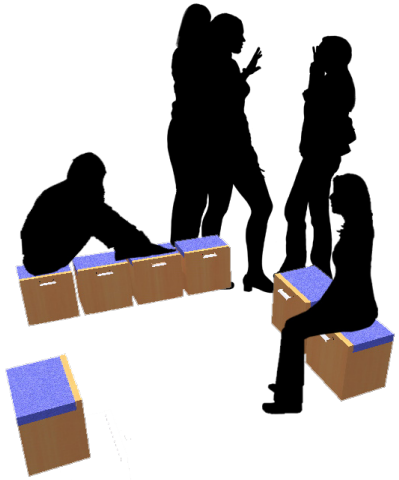
Lighting

Landscape

Social Interaction

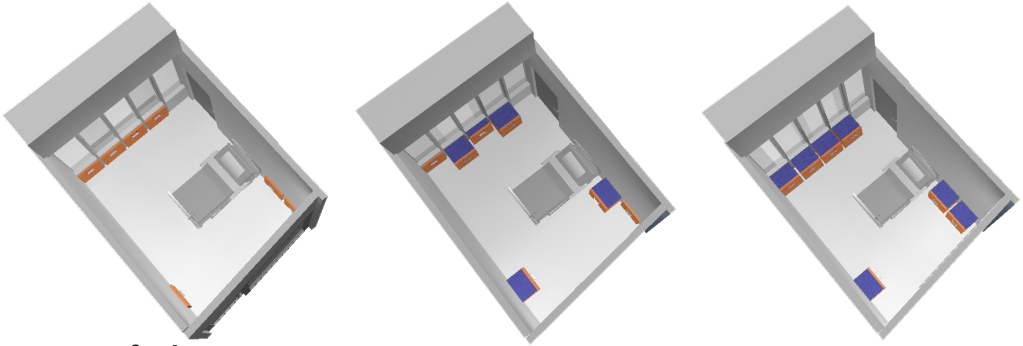
6.2 Architectonic Ideas

The diagrams present over the next two pages show how the areas of focus are present in the architecture of the hospital design. These diagrams further show how the thesis idea is embodied through the hospital design.



Social Interaction

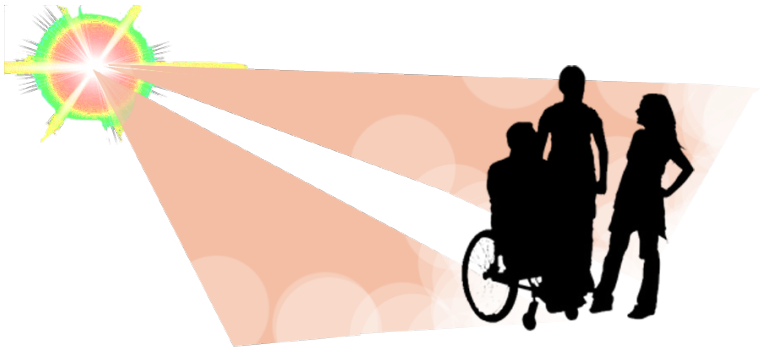
The hospital design provides many opportunities for social interaction. The center of the building functions as a node between the catwalk to the rest of the building. A large atrium, a cafe, and educational classroom spaces provide social interaction with the community, while a moveable bench system in patients rooms allows for flexible levels of social interaction at the patient's comfort level.



Sense of Place

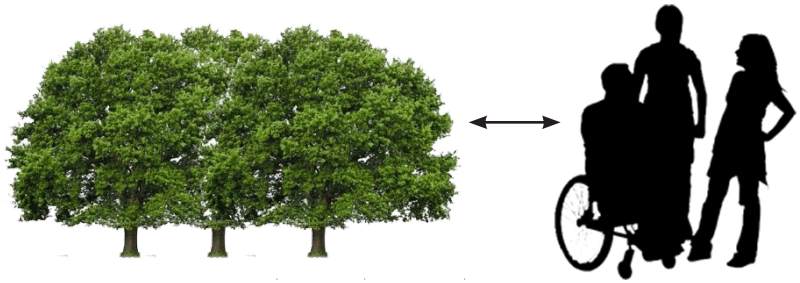
Good wayfinding is the first step towards establishing a sense of place in the hospital. The addition uses color as a primary means of creating place and standardizing care. Patients are also able to create their own sense of place within their own rooms through a moveable bench system and smart glass, which allows patients to determine their desired level of privacy through transparency or opacity..

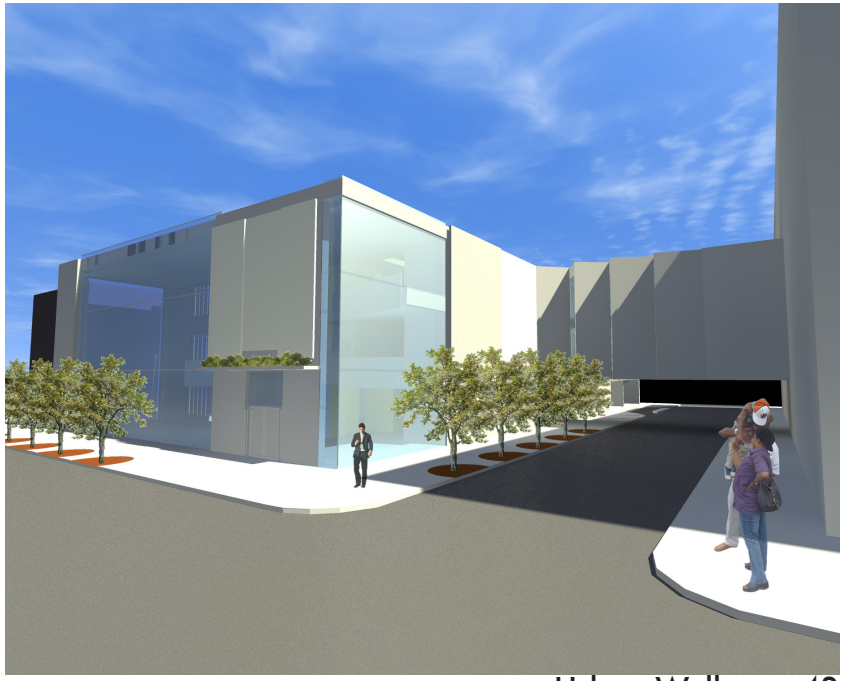
Hallway Rendering



Lighting

Lighting is apparent throughout the building in a light, airy floor plan that emphasizes south-facing windows in every room and into the hallway, and central visibility for hospital staff and nurse. North facing light is emphasized in task lighting rooms, such as the pharmacy and the operating room.



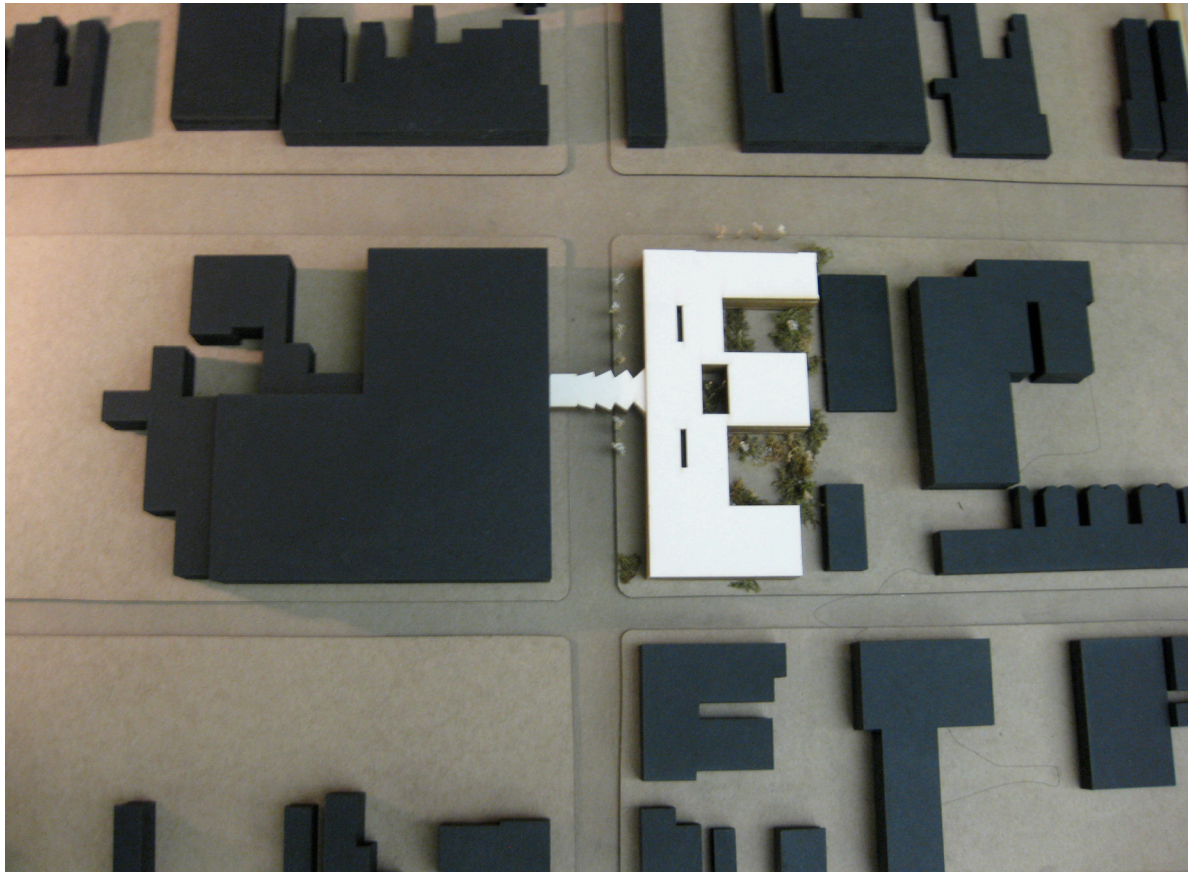


Landscaping

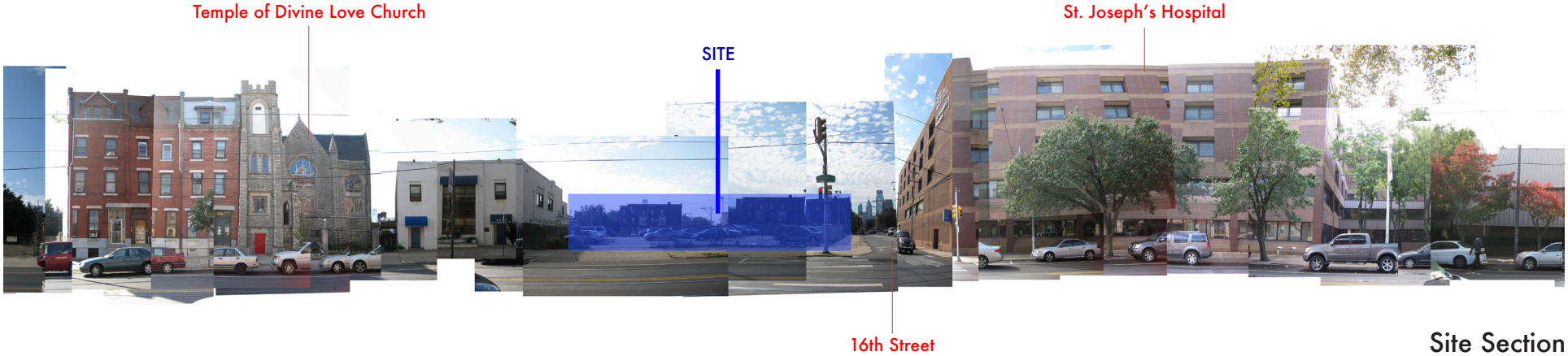
The entire building is shaped around two courtyards which are also the focal points of the buildings. Every hospital patient has a view of one of the courtyard gardens. On the first floor, multiple entrances into the courtyard allow opportunities for visitors, staff, and community members to enjoy landscaping. Finally, a green roof gives a landscape view to patients in the existing building.

6.3 Site

6.3.1 Site Plan
6.3.2 Site Sections
6.3.3 Site Model



Site Plan: Model

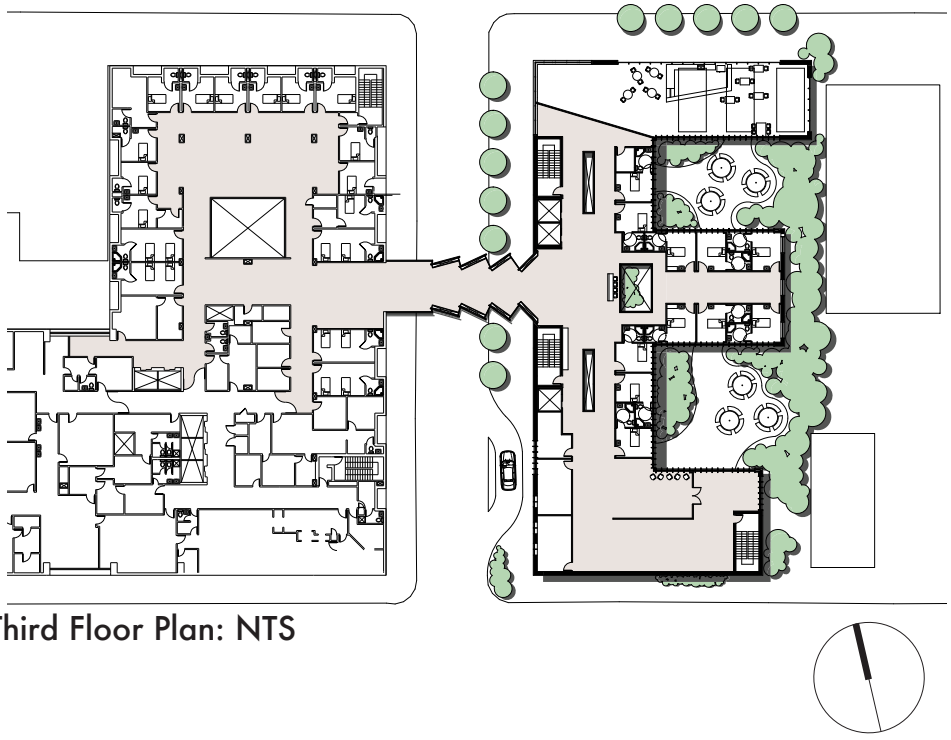


Site Section

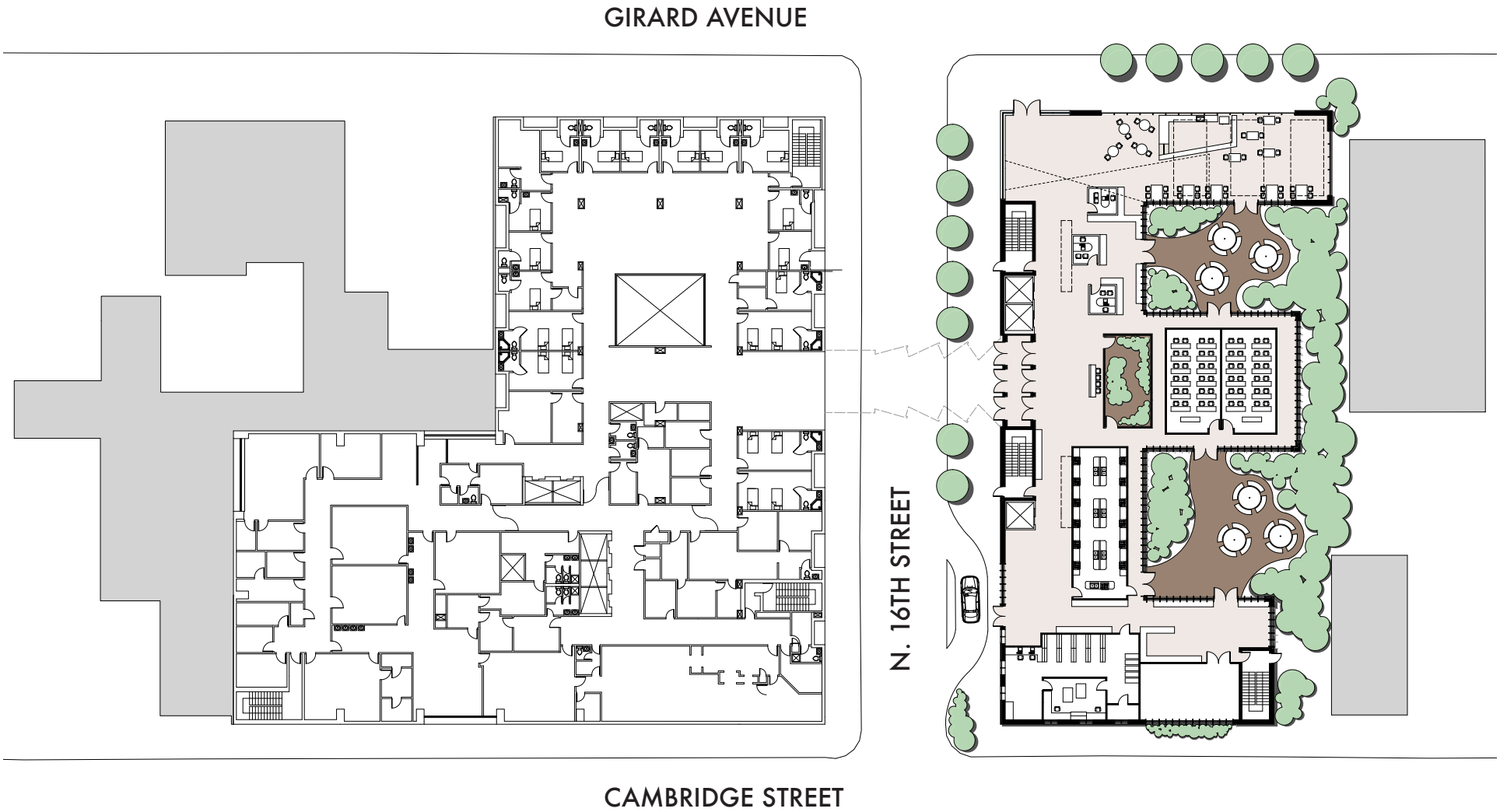
Site Plan: Scale 1/160” = 1’-0”

6.4 Building Plans

Second Floor Plan: NTS



Third Floor Plan: NTS



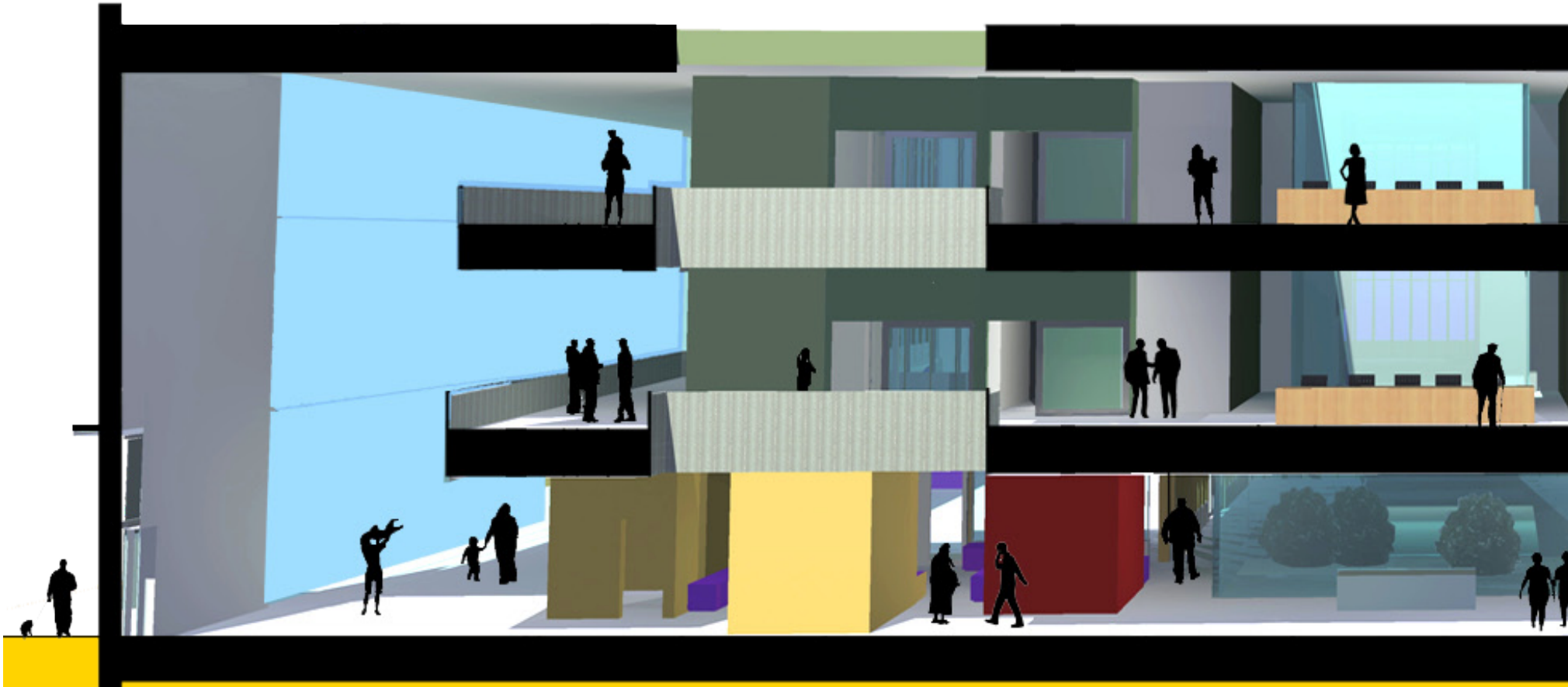
First Floor Plan: NTS

6.5 Building Elevations

16th Street Elevation

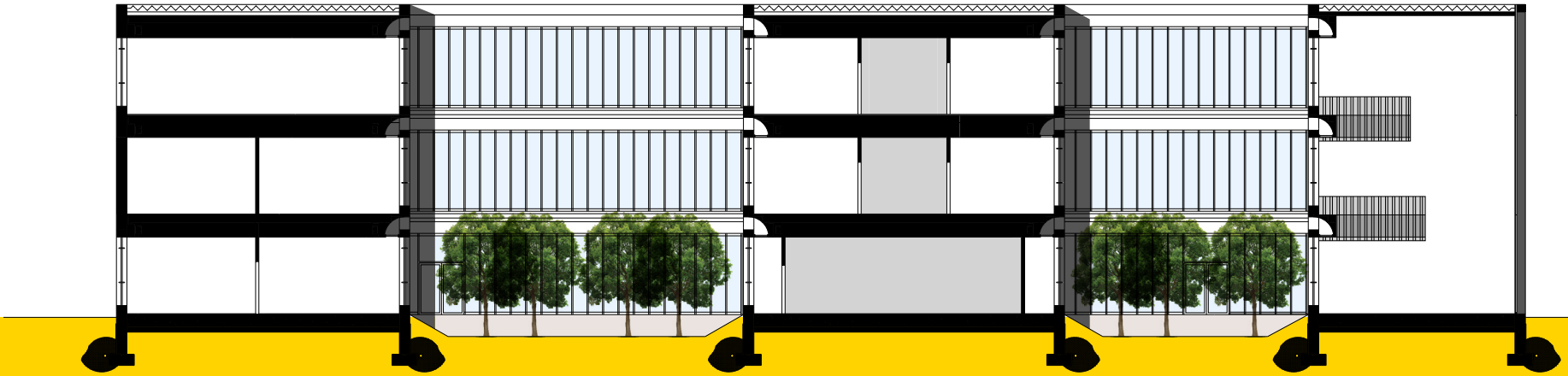
Interior Courtyard Elevation

6.6 Building Sections



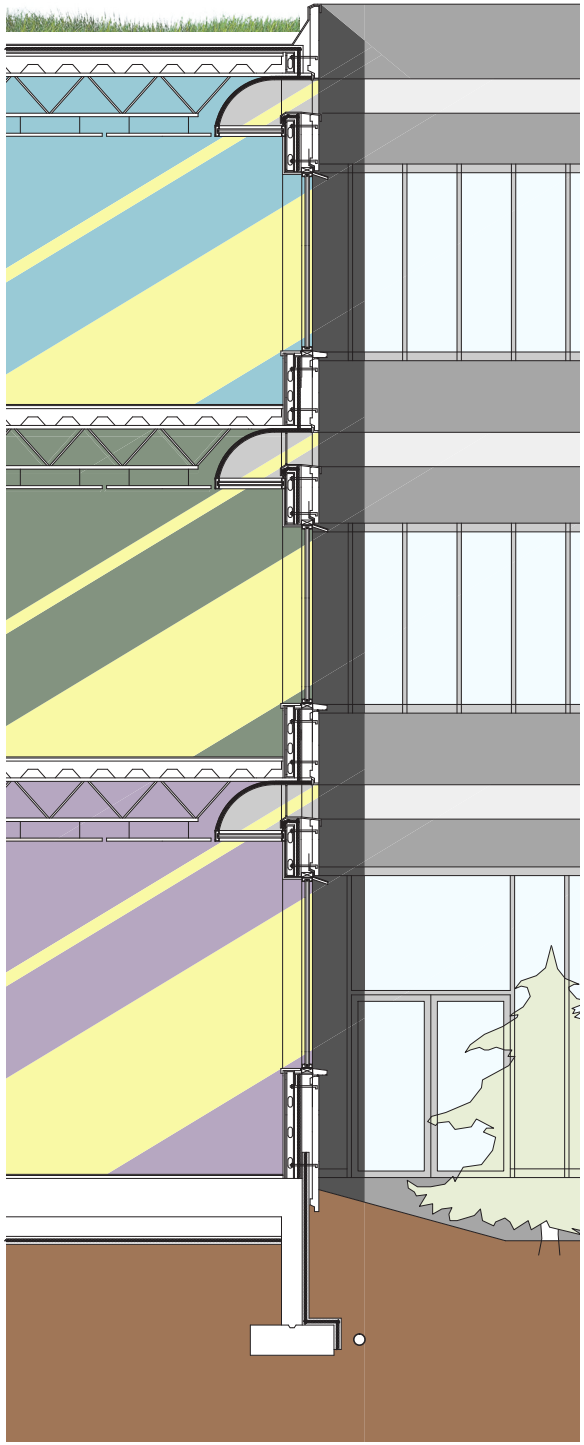
Longitudinal Section Perspective: NTS

Transverse Section: NTS



Courtyard Section: NTS

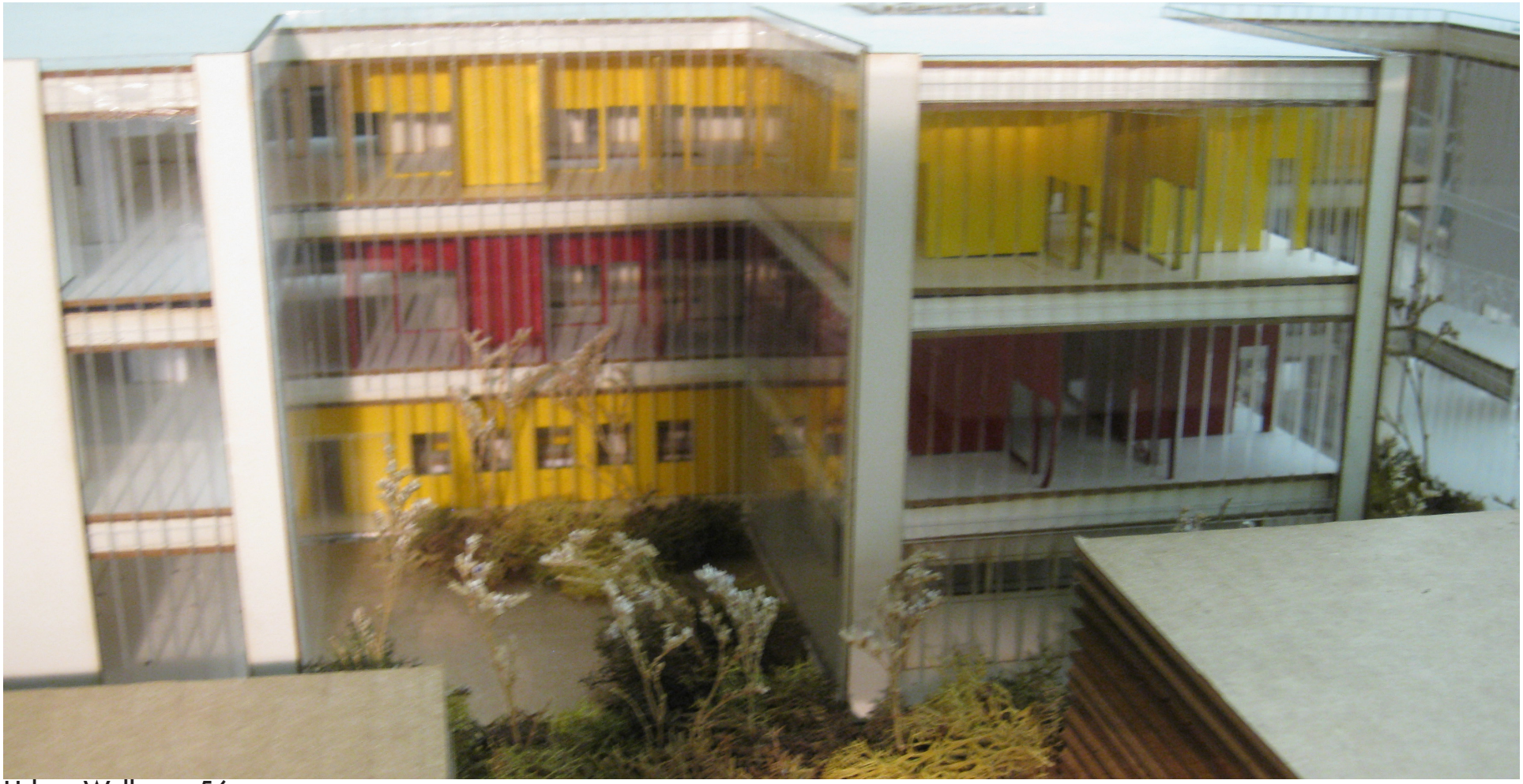
6.7 Wall Sections
6.8 Representation of Structure

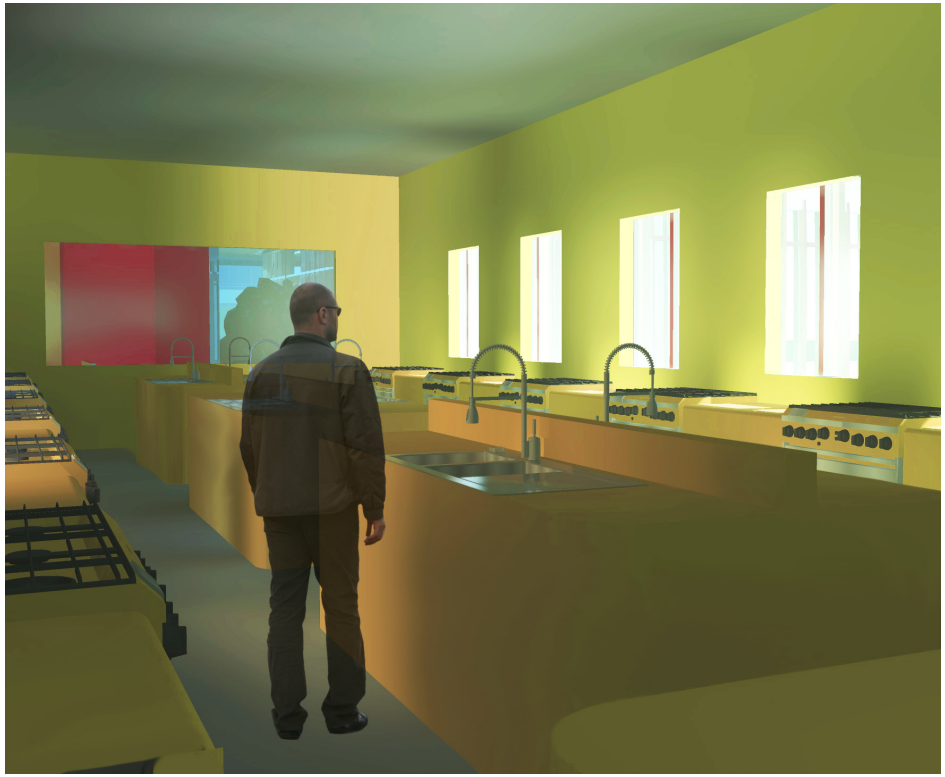


Structural Wall Section: NTS

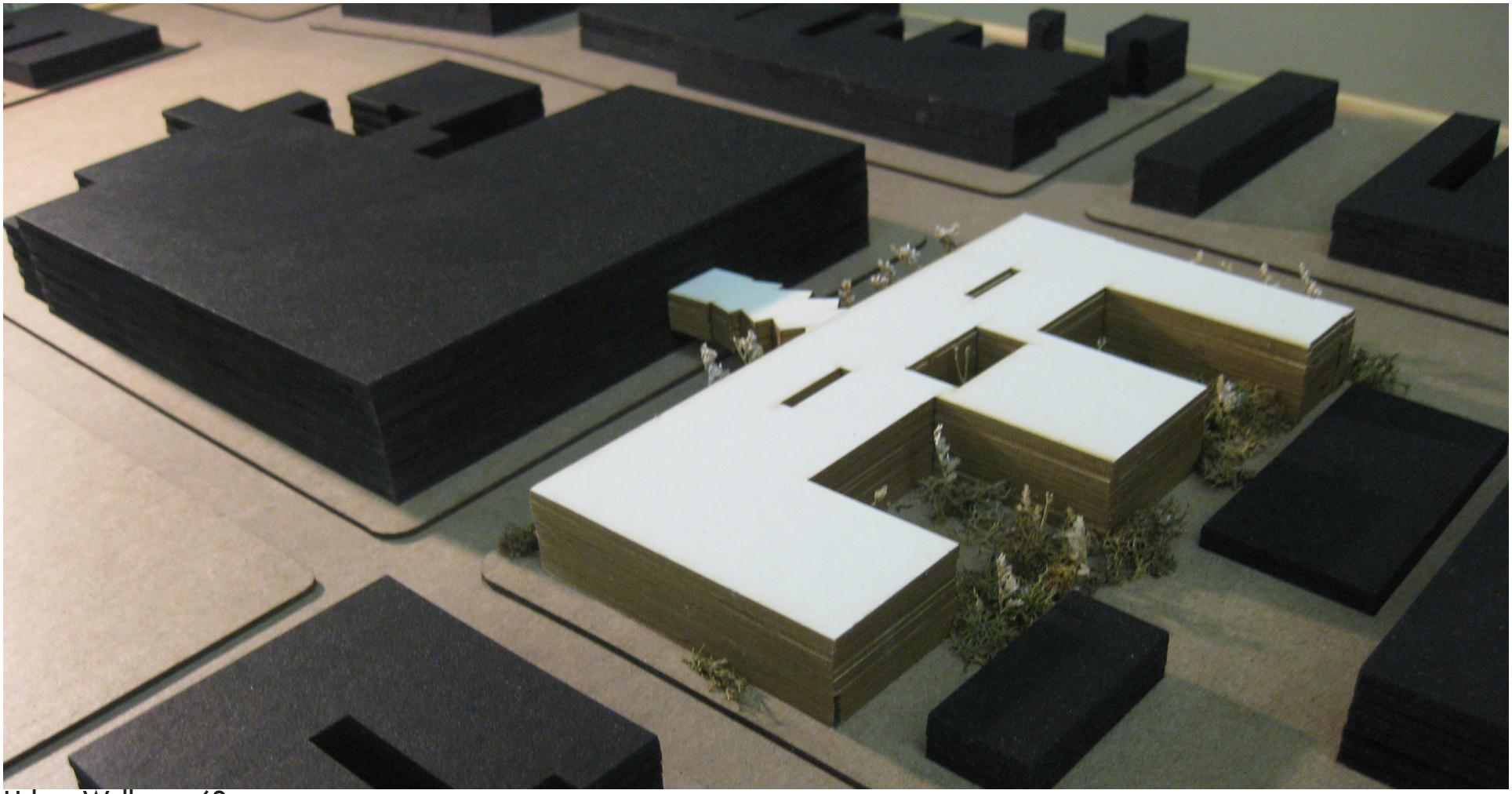
Exploded Axonometric Structural Representation

6.9 Other Project Images





Urban Wellness_60



Conclusions

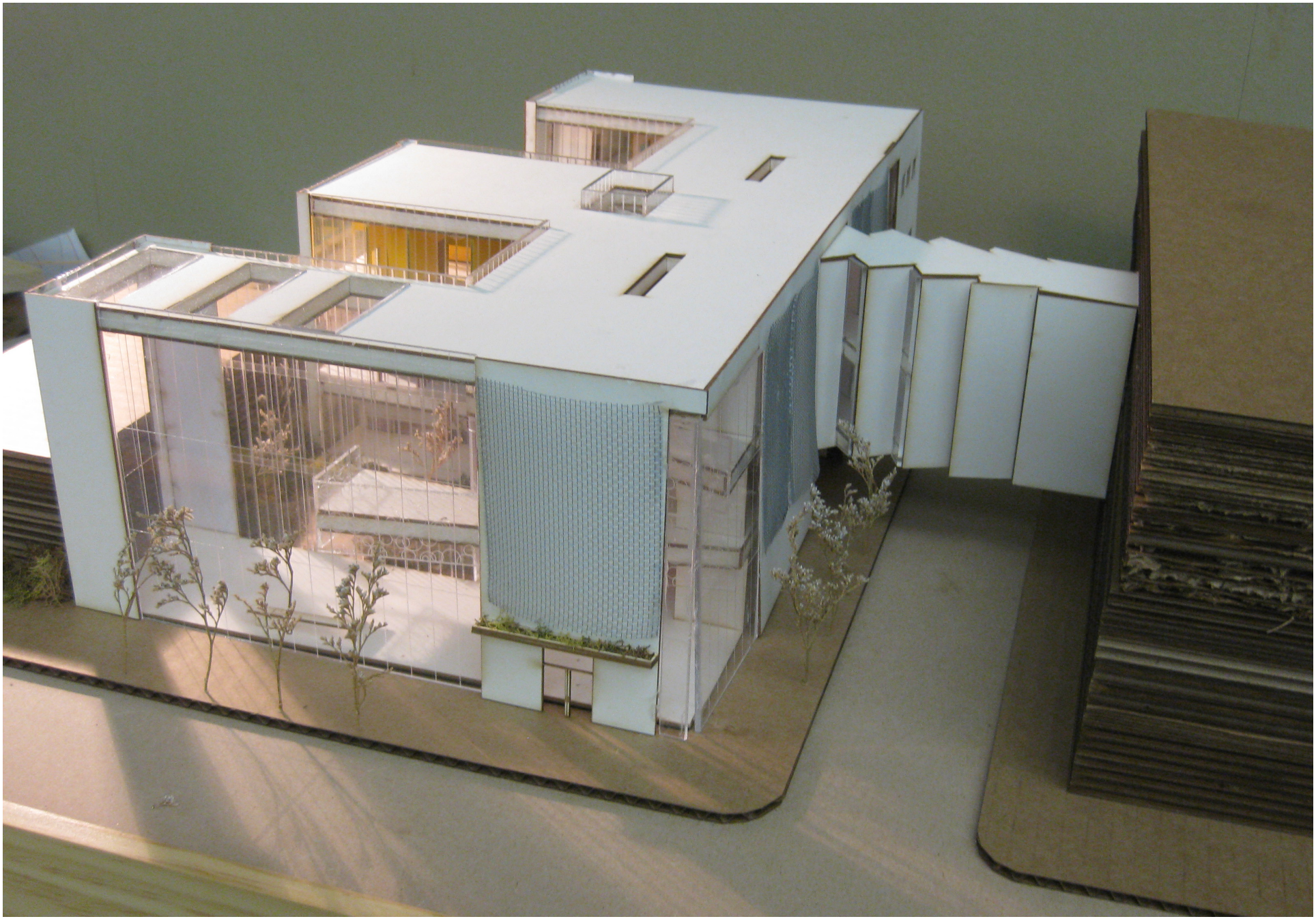
7.1 Reflections

7.1 Reflections

The intent of my thesis was to create a building design that enabled patients to recover faster. This building would speak to the idea of a building environment which impacts everyone that enters a building, and specifically focus on the impact that a building can have on hospital patients.

My design connects to my thesis idea by using four areas of impact to assess the level to which the hospital design can help patients recover faster: lighting, landscape, social interaction, and sense of place. Each of these four areas was extensively researched as clear concepts that can aid patient recovery. While a few of the areas of impact, such as lighting and landscape, translate clearly into architectonic ideas, others, such as socialization and sense of place, do not. Thus, I created architectural precedents for each of the four areas to show how each idea can be realized through design. The architectonic diagrams on pages 39 and 41 most clearly show how each idea is clearly prominent through the design of the building. Architecturally, these four concepts were kept in mind through every design decision. The building is well lit, provides access to landscape, creates spaces for socialization, and allows patients to make their room their own through architectural flexibility. All of these elements are reflected in my research as design elements that can reduce depression, accelerate patient recovery, and ultimately reduce costs for both the patient and the hospital. This leads to better and more efficient patient care.

Finally, the building embraces the site of my thesis because it responds to the local community through its program and its design, which allows it to be accessible to the area.



Bibliography

Day, Christopher. Places of the Soul: Architecture and Environmental Design as a Healing Art. Boston: Architectural Press, 2004.

Eberhard, John P. Architecture and the Brain: A Knowledge Base from Neuroscience. Atlanta: Greenway Communications, LLC, 2007.

Eberhard, John P. Brain Landscape: The Coexistance of Neuroscience and Architecture. New York: Oxford University Press, 2009.

Lawson, B. (2002) Healing Architecture. *Architectural Review*, May.

"Neighborhood Information Systems Neighborhoods: North Central." Cartographic Modeling Lab, University of Pennsylvania Sep 2009: n. pag. Web. 10 Sep 2009.

Restak, Richard M. Brainscapes: an Introduction to What Neuroscience has Learned about the Structure, Function, and Abilities of the Brain. New York: Hyperion, 1995.

Sternberg, Esther M. M.D. Healing Spaces: The Science and Place of Well-Being. London: Belknap Press, 2009.

Ulrich, Roger Ph.D. et al. "The Role of the Physical Environment in the Hospital of the 21st Century: A Once-in-a-Lifetime Opportunity." The Center for Health Design September 2004 (30 Aug 2009). <http://www.healthdesign.org/research/reports/physical_environ.php>.

Verdeber, Stephen and David J. Fine. Healthcare Architecture in an Era of Radical Transformation. New Haven, CT: Yale University Press, 2000.

Zeisel, John. Inquiry by Design: Environmental/Behavior/Neuroscience in Architecture, Interiors, Landscape, and Planning. New York: W.W. Norton, 2006.

Academic Vita

EDUCATION

The Pennsylvania State University, University Park, PA
Schreyer Honors College

NAAB Accredited Bachelor of Architecture with Honors May 2010
Minor in Geography
Minor in Architectural History

Penn State Sede di Roma, Rome, Italy

Architecture study abroad program in Rome, Italy during 2009 spring semester

WORK EXPERIENCE

Spring 2010 | SCHOOL OF ARCHITECTURE AND LANDSCAPE ARCHITECTURE, Penn State University, University Park, PA
Part-time Research Assistant

- Assisted a professor with data collection and summation using Excel.
- Contacted architects and engineers for research connected to LEED certification and sustainable building.

Summer 2009 | CITY of WILMINGTON, Wilmington, DE
Part-time Intern, City Planning Department

- Researched the benefits of density bonuses along the Wilmington waterfront.
- Wrote a 20-page report that was presented to the Wilmington City Council.

Summer 2009 | ARCHITECTURAL CONCEPTS, Exton, PA
Part-time Intern, Architecture and Design Firm

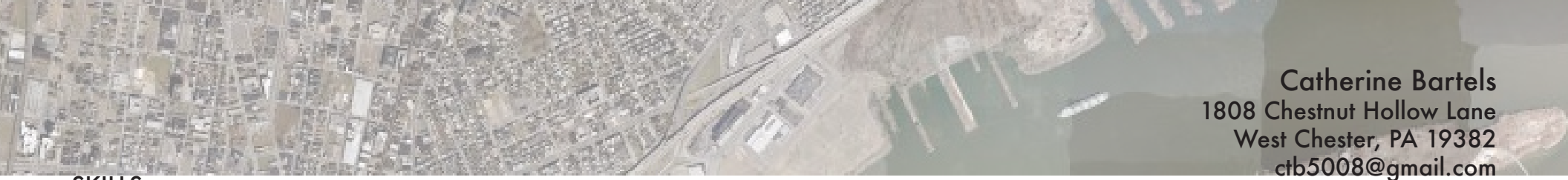
- Responsible for kitchen and bathroom specifications in the design of an Section 8 apartment complex.
- Created CAD drawings, checked for ADA compliance, and specified appliances and bathroom fixtures.
- Earned IDP credit in a variety of areas including Construction Documentation.

Summer 2008 | ARCUS DESIGN GROUP, Exton, PA
Intern, Full-service Architecture Firm

- Earned IDP credit in areas ranging from Design Development to Construction Documentation.
- Worked with licensed architects on different types of designs including master planning, commercial, residential, and institutional.
- Surveyed existing properties and sat in on client design meetings.
- Crafted graphic design presentations showcasing my company's work.

Summer 2007 | SMITHSONIAN INSTITUTION, Washington, D.C.
Graphic Design Intern, Museum Conservation Institute

- Assisted in preparing images and a layout of a book for publishing.
- Manipulated images using Adobe Photoshop and Illustrator.
- Scanned slides into digital form.



Catherine Bartels
1808 Chestnut Hollow Lane
West Chester, PA 19382
ctb5008@gmail.com

SKILLS

Computer Skills:

- Proficient in AutoCAD (3 years of work and classroom experience)
- Proficient in Adobe Creative Suite (including Photoshop, Illustrator, and InDesign)
- Extensive Experience in the following programs:
  - Google Sketchup
  - Form-Z
  - Revit
  - M-Color
  - Dreamweaver
  - Ecotect
  - Artlantis Studio
  - Microsoft Office

Language Skills:

- Intermediate Spanish (10 years classroom experience)
- Conversationally fluent Italian (2 years classroom and cultural experience)

HONORS AND AWARDS

ALPHA RHO CHI MEDAL RECIPIENT, Honored with medal awarded by the department of architecture to a graduating senior who has shown a ability for leadership, performed willing service for the department, and given promise of real professional merit through his or her attitude and personality, 2010.

AIA HENRY ADAMS RUNNER-UP CERTIFICATE RECIPIENT, Awarded with the AIA Certificate for the second highest G.P.A. in the among graduating seniors in the architecture class, 2010.

DEAN'S LIST, Achieved Dean's List 9 out of 9 semesters for attaining a G.P.A. above 3.5, 2005-2009.

SCHOLARSHIP RECIPIENT, Schreyer Honors College Merit Scholarship, 2005-2010.

SCHOLARSHIP RECIPIENT, DEXSTA Federal Credit Union Scholarship; 2005, Samuel L. Green Scholarship Foundation, 2005.

NATIONAL MERIT FINALIST, 2005.

ELECTED AND VOLUNTEER POSITIONS

PENN STATE ARCHITECTURE UNDERGRADUATE THESIS BOOK, Thesis Book Coordinator, 2010.

COLLEGE OF ARTS AND ARCHITECTURE FACULTY AWARDS COMMITTEE, Student Representative, 2010.

SCHOOL OF ARCHITECTURE AND LANDSCAPE ARCHITECTURE DIRECTOR SEARCH COMMITTEE, Architecture Students Representative, 2009-2010.

ARCHITECTURE CLASS REPRESENTATIVE, Elected Student Representative of the class of 2010, 2008-2009, 2009-2010.

PENN STATE CHAPTER REPRESENTATIVE, AIAS NATIONAL CONFERENCE Milwaukee,WI, December 2007.