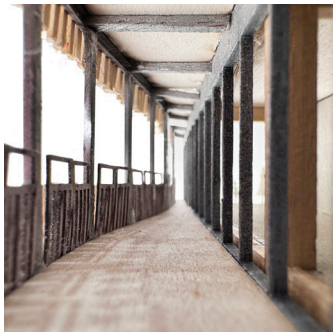

CARE AND NATURE

Delft University of Technology
Faculty of Architecture & the Built Environment

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COMPLEX PROJECTS
Bodies and Building Berlin
AR3CP100

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CARE AND NATURE

An exploration into architectural strategies that help build up the holistic care for children in pediatric facilities.

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RESEARCH

01

Problem Statement
Research Question
Research Framework
Research Methods

01 Research

This is a short substantiated explanation to account for the results of the research and design in the graduation phase.

1.1 Problem Statement

Pediatric facility design is a relatively young discipline compared to general adult healthcare space design. The domain of pediatrics was still beyond the general public's grasp 400 years ago. It was not until the 17th century that the pathological difference between adults and children began to draw greater attention from the medical experts to give specialized treatment.[1] The numbers of children's hospitals mushroomed in the early 20th century (Figure 1), and the pediatric autonomy only took shape around 30 years ago.[2] Therefore, despite the awareness of how pediatric hospitals should behave, its relatively short development history has resulted in a lack of thoughtful kid-centered design.

1.1.1 Unbalanced design

Pediatric healthcare facilities bear the responsibility of catering to young patients' particular needs. This responsibility refers to both the specific medical requirements for the children and dedicated attention to their emotional and social needs. Evident as the principle might seem, the current implementation is somewhat unbalanced. Greater emphasis is placed on efficiency and technological improvement, similar to the general adult hospitals.

The ignorance of children's needs in hospitals has also drawn attention from the pediatric medical staff. The director of the department of pediatrics at the Dr. von Hauner Children's Hospital, Christoph Klein, expressed his concerns greatly:

> "In German hospitals, we are much too focused on functional ways of thinking. Efficient processes and technological bio-engineering services are also important, but pediatric care should not be reduced to those aspects alone."[3]

The absence of holistic care for these patients became increasingly urgent. Meanwhile, the current design methods regarding children's needs are also rather discrete and rigid. Although some pediatric hospital designs pay attention to children's needs, most of the applied methods can be generalized into these two aspects: introducing colorful upholstery and adding extra activity space. These strategies are more recognized as an add-on to the basic design scheme to entertain children but are less considered as an integral part of the whole healing process at the beginning of design.

1.1.2 Personnel Shortage

The proper implementation of holistic care for young patients also relies heavily on specially trained, multidisciplinary caregivers. However, the recent pandemic has seen an aggravated personnel shortage in the current pediatric healthcare system. Introducing more digitally controlled methods may bring some alleviation, but it is important not to turn this solution-finding into a complete function-oriented game. The interface design and how are these digital elements positioned in the space should be thoroughly considered.

1.2 Research Question

Children patients are extremely sensitive to environment changes, and the generic hospital context can easily provoke their passive emotions.[4] Research[5] has shown that patients recovery benefits from a good state of emotions, therefore I would like propose the research question as such:

> How can design approaches at different scales help improve the holistic experience of children in pediatric service?

The hope is that through the exploration into the holistic care for children, we interpret the idea of health in an even broader way.

1
Jacalyn Duffin, History of Medicine (University of Toronto Press, 2010)

2
Kate A Mazur, and Stacey L Berg. Ethical Issues in Pediatric Hematology/ Oncology. (Cham: Springer, 2020)

3
Christine Nickl-Weller, and Hans Nickl. Architecture for Health. (Braun Publishing AG, 2021), 147

4
Nasab, Sara Nourmusavi, and Seyedjalal Mirbazel. "Ideal Physical Features of Environmental Design in Children's Hospital." Facilities 38, no. 5/6 (2020): 445–66.

5
Lamers, Sanne M. A, Linda Bolier, Gerben J Westerhof, Filip Smit, and Ernst T Bohlmeijer. "The Impact of Emotional Well-Being on Long-Term Recovery and Survival in Physical Illness: A Meta-Analysis." Journal of Behavioral Medicine 35, no. 5 (2012): 538–47.

Figure 1 The Royal Children's Hospital Melbourne operated in Carlton from 1876. This image presents the early model of children wards.

1.3 Research Framework

1.3.1 Theoretic Framework

When talking about the design of hospital space, Emotional Design is constantly brought up. According to Donald Norman, Emotional Design refers to the design that evokes emotion when the user interacts with the product.[6] As studies have shown 'existing relationships between perceptual "signals" and emotional arousal,' Emotional Design of space presents significant potential to improve the psychological health of patients and further enhance the effectiveness of the therapies.[7]

Among all the patient groups, children are the most sensitive group to environmental changes. The alien hospital environments might easily provoke their fear, anxiety, anger, and sadness.[8] Therefore an appropriate Emotional Design of hospital space can benefit these young patients significantly. With this said, experiments and research have been carried out to work directly with young patients to examine their experience and find out what they really need.

In an interview-based study that involves 255 children and adolescents, outdoor space falls to bring sufficient activities to the young patients due to the lack of entertaining design. Children of different group ages also showed distinct opinions toward the colorful upholstery. And the negligence of unwanted sound, smell, and temperatures also bothered these little patients.[9] Patently these so-called child-friendly hospitals are based largely on the adult assumption and do not cater to what children really need.

In another study that explores the ideal physical features for children in hospitals, 16 drawings and 24 interviews from the children are analyzed. The preferred features are play places, happy light color, television, painting, and the curve form of the building.[10] Apart from some dominant entertainment elements, fancy lights and spatial forms are also more favorable to the children.

The studies that involve direct conversations with children provide a useful guideline for later design exploration. However, it Is worth noting that these spatial features are already handled as discrete categories when the questions are delivered to the children. Children were asked about their opinions towards each of them but not the whole perception. This, in a way, hints at a lack of holistic consideration toward children's experiences in general.

Currently, the design of educational facilities seems to have more explorations regarding the children's experience. These projects are also potential precedents to analyze. In a school project (Figure 2) by Lundaard & Tranberg Architects in Copenhagen, the designers emphasize that 'materials and technical solutions take on meanings when carefully placed in a context.'[11] And they envision a poetic educational experience within the building:

> 'Hopefully, they experience a sense of calm here as they touch the columns, experiencing the cool, pleasant surface of concrete cast in smooth for work. As they play over the course of the day, perhaps they follow the rays of sun traversing the spaces, reminding them of the way light falls in a natural landscape.'[12]

Can medical facilities also become so poetic regarding the children's experience there? Can children have their own building in the hospital? The answer awaits us to explore.

1.3.2 Relevance

As mentioned in the problem statement, there have been criticisms about the over-function-oriented design in German pediatric facility design. Children are not 'small adults,' and children's hospitals should not be a simply scaled-down version of adult hospitals. As the environment impacts the patients during their recovery process,[13] it is meaningful to explore what is a more favorable environment for young patients specifically. With German pediatric medical facilities already in the lead from the technological aspect, attention to holistic care would be complementary. Therefore, this research may help find a way toward a more children-centered holistic design for the next generation of young patients.

Additionally, this research is an acute response to the current burdensome situation of Berlin's pediatric healthcare system. The precarious conditions have recently prompted the Berlin Children's Hospitals Initiative(IBK) to send another open letter to the Federal Health Minister, Berlin Health Senator, and the management of Berlin's pediatric hospitals.[14] The recent pandemic has aggravated the extreme staffing shortage and precipitated the dysfunction of the pediatric medical system: beds remain vacant despite the high demand because of the insufficient medical and nursing staff.[15] Part of the research will look into the digitalization and integration of patient monitoring, which may help alleviate the scarcity of staff to some extent. Meanwhile, if the space allows the patients to understand the healing process better in general, caregivers may spend less energy on appeasing children's emotions and focus on the most demanding situations.

6
Donald A. Norman. Emotional Design: Why We Love (or Hate) Everyday Things. (New York: Basic Books, 2004), 101.

7
Marco Maiocchi, and Zhabiz Shafieyoun. Emotional Design and the Healthcare Environment. Research for Development. (Cham: Springer, 2022), 10-11

8
Sara Nourmusavi Nasab, Amir Reza Karimi Azeri, and Seyedjalal Mirbazel. "Ideal Physical Features of Environmental Design in Children's Hospital." Facilities 38, no. 5-6 (2020): 446.

9
Jo Birch, Penny Curtis, and Allison James. "Sense and Sensibilities: In Search of the Child-Friendly Hospital." Built Environment (1978-) 33, no. 4 (2007): 405–06.

10
Nasab, "Ideal Physical Features of Environmental Design in Children's Hospital."

11
Lundaard & Tranberg Architects, "Tenderness," in Connectedness: An Incomplete Encyclopedia of the Anthropocene. Views, Thoughts, Considerations, Insights, Images, Notes & Remarks., ed. Marianne Krogh. (Strandberg, 2020), 358.

12
Ibid.

13
Roger S. Ulrich, "View Through a Window May Influence Recovery from Surgery," Science 224, no. 4647 (1984): 420–421.

14
"Catastrophic Situation in Berlin Children's Hospitals," Carola Kleinert, and Markus Salzmann, World Socialist Web Site, October 3,2022, http://www.wsws.org/en/articles/2022/10/04/Lyon-o04.html

15
Ibid.

Figure 2 Kalvebod Fælled School, Copenhagen, by Lundaard & Tranberg Architects.

1.4 Research Methods

1.4.1 Program

To investigate a rational breakdown of programs, I will select and analyze precedents of both general hospitals and children's hospitals. By comparing the differences among these projects' program bars, we can develop a proper program breakdown that guarantees the essential operation of a hospital. Within the rational frame, the portions will be later adjusted so that it is more gravitated to the space that engages more with the experience of these young patients. Additionally, kindergartens and primary schools will be specific precedents as they involve children's needs and experiences.

1.4.2 Clients

Positioned as an academic hospital affiliated with a higher education institution, universities with advanced medical disciplines are the main potential clients for this project proposal. Additionally, it is also essential to consider the administrative departments that engage with the well-being of children as secondary clients. Societally, NGOs and charity groups may also play a role.

1.4.3 Site

The search for the site would be the combined result of two parameters.

The first parameter involves the preferred environmental context for hospitals. Places with less air and noise pollution, views towards green and good mobility, present more potential to develop health-related facilities. These factors would be an essential step for the project to take on the character of a more patient-centered design.

The second parameter involves the societal context of Berlin. The aim is to help revitalize the Spree river environment, which has been relatively inactive these days. The choice of this culture parameter is due to its pertinence to the holistic care of children patients, especially on the urban scale. Adjacency to riverside bring potentials in developing the project with great connection to natures, which would be beneficial for the children patients.

DESIGN BRIEF

02

Program
Client
Site

02 Design Brief

The Charité Children's Hospital is a healthcare facility project focusing on holistic care and experience optimization for pediatric patients. Apart from enhancing efficiency and corresponding to the updating medical technologies, it places emphasis on introducing a more user-centered spatial design from urban, tectonic, and interior scales as an integral part.

2.1 Program

2.1.1 Program Breakdown

The programs of the whole project can be categorized into five parts: children's autonomy, medical service, public activity, research center, and back of the house.

While conforming with the rational division of a children's hospital according to the precedents study this proposed program breakdown introduces a specific section for children. (Figure 3) It partially incorporates the wards program which usually is categorized into the medical service part. By combining the section of the ward with their activity space(Figure 4), the idea is to introduce some degree of children's autonomy for them to explore.

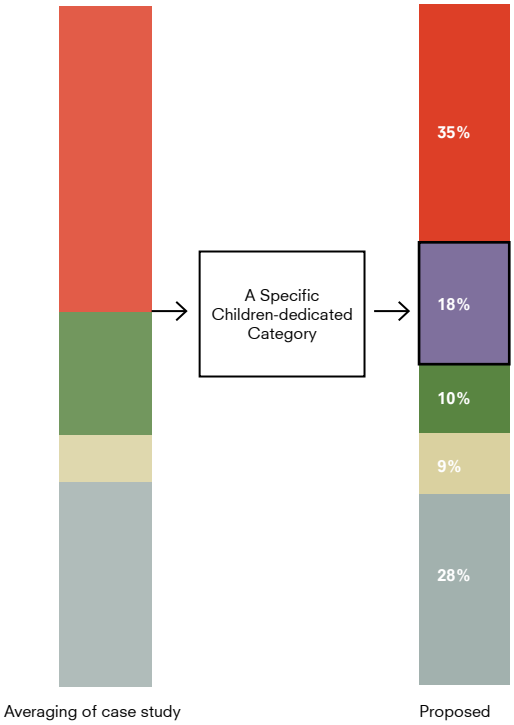


Figure 3 A specific section of program dedicated to children.

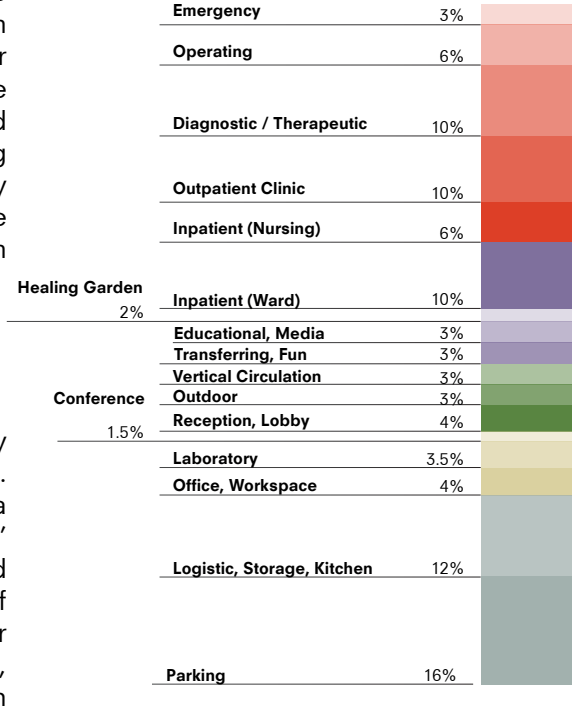


Figure 4 Program breakdown proposal.

2.1.2 User & Flow

The users' flow patterns within the facility determine the positions of each program. While the outpatients usually follow a sequential pattern (Figure 5), the inpatients' activities are obviously more ward-centered (Figure 6). In contrast, the flow pattern of doctors is more dynamically spread out over all the different sections (Figure 7). Therefore, certain programs need to be arranged with adjacency to others. The arrangement in these illustrations is a schematic proposal.

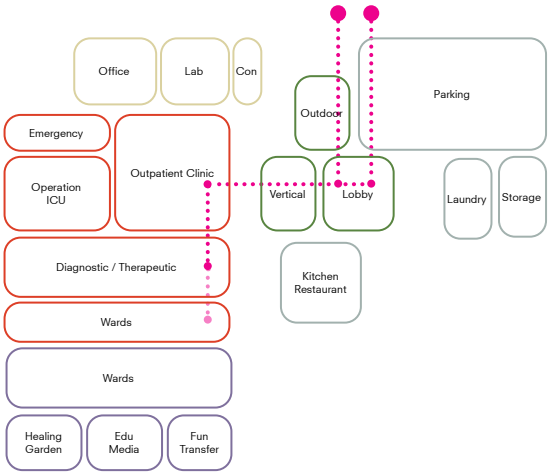


Figure 5 Outpatient flow: sequential.

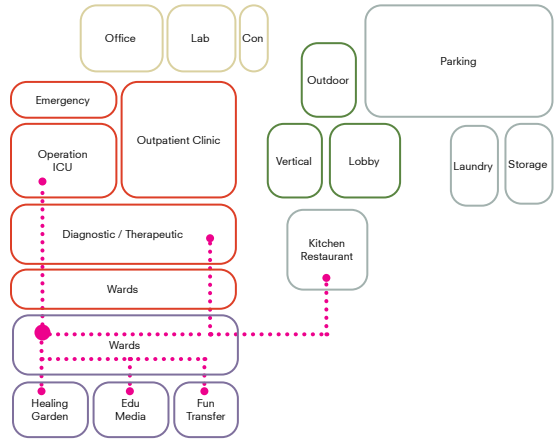


Figure 6 Inpatient flow: ward as the pivot.

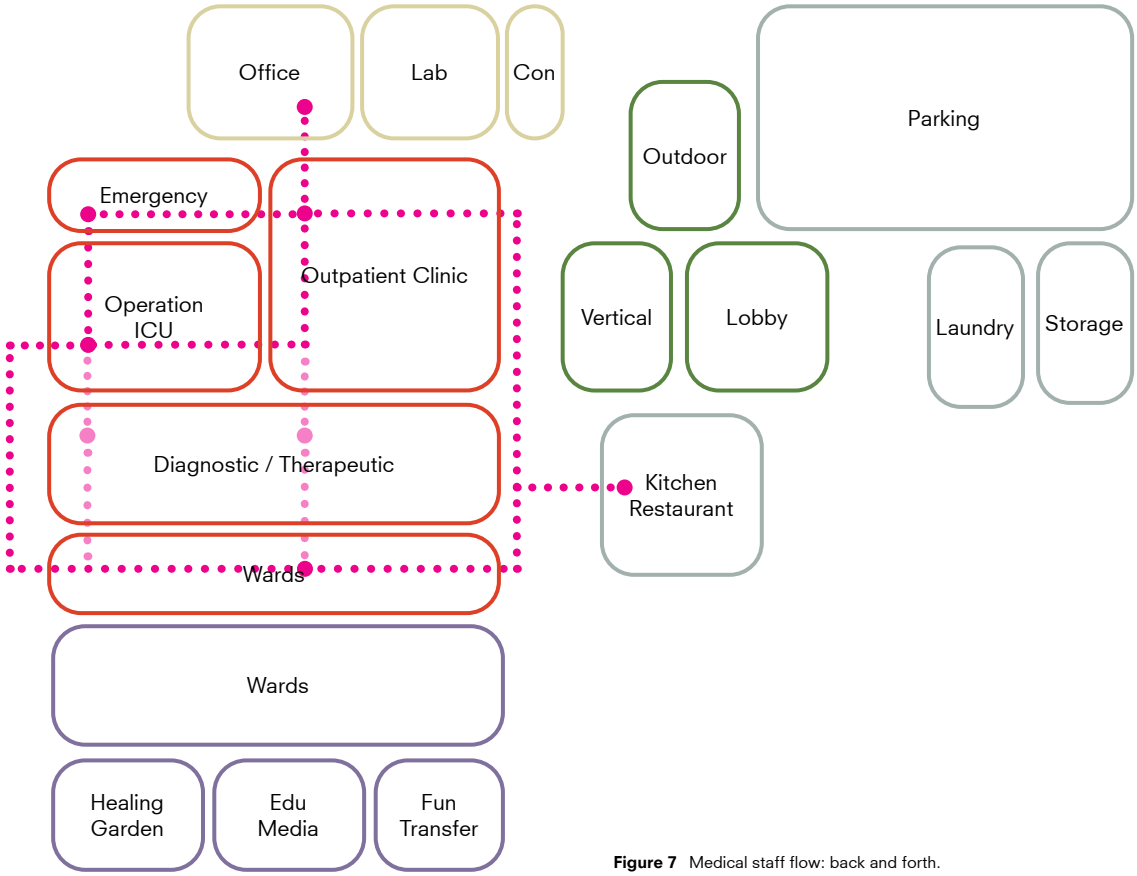


Figure 7 Medical staff flow: back and forth.

2.1.3 Assembly Strategy

Due to the constantly-upgrading medical technology, hospitals go to obsolete faster and faster after their completion. Therefore, it is preferred to develop the spatial program based on a modular system. The study of each of the spatial requirements (see Appendix 5.3) results in a 1.5m x 1.5m grid system to implement all the variations of units in the medical facility.(Figure 8)

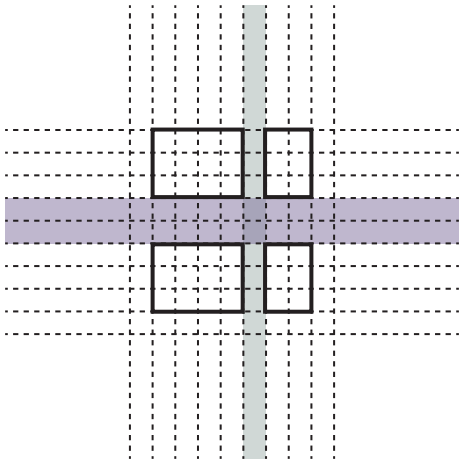


Figure 8 Aggregation based on a 1.5m x 1.5m grid system.

2.1.4 Key Space (Figure 9 & 10)

The key space study involves the ward and the outpatient clinic, which are two main programs that children patients spend time in. For the wards, the idea is to introduce a separate slice of space to accommodate parents, and a balcony connected to neighbors and outdoor activity space.

For the outpatient clinic, the idea is to embed a more generous waiting area and separate doctors' circulation from the patients.

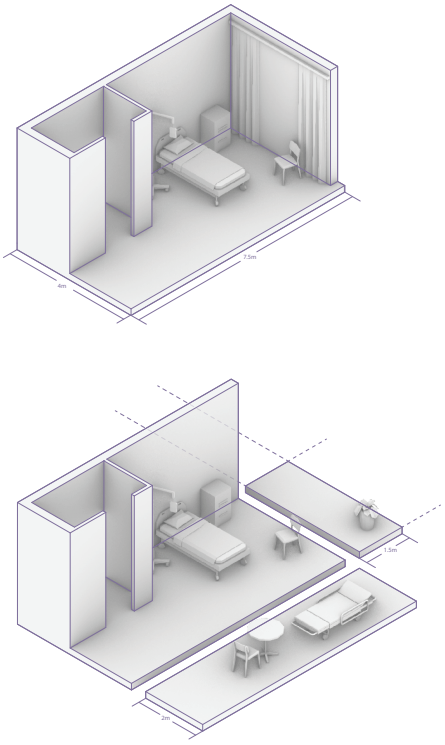


Figure 9 Proposed wards extension.

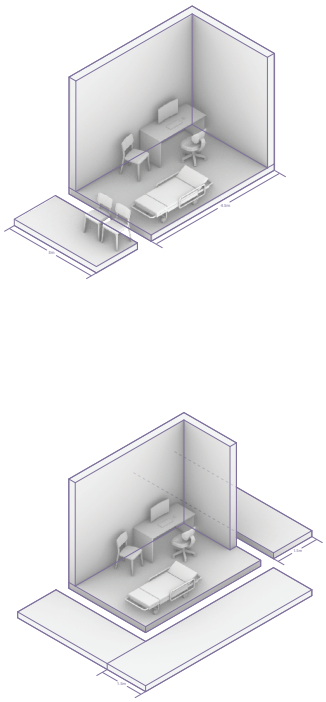


Figure 10 Proposed clinic units attachment.

2.2 Client

Charité – Universitätsmedizin Berlin (Charité – Berlin University of Medicine) is a large academic hospital affiliated with Humboldt University and Free University Berlin. The hospital currently has its pediatric department located in Campus Virchow-Klinikum. With the departments of gynecology, obstetrics, and the Institute of Medical and Human Genetics, it forms the largest medical center of the Charité: CharitéCenter 17. This academic hospital, specifically its pediatric department, will be the main client of this project.

Meanwhile, the related departments of the government: the Federal Ministry of Health, along with the Federal Ministry for Family Affairs, Senior Citizens, Women, and Youth, will also participate.

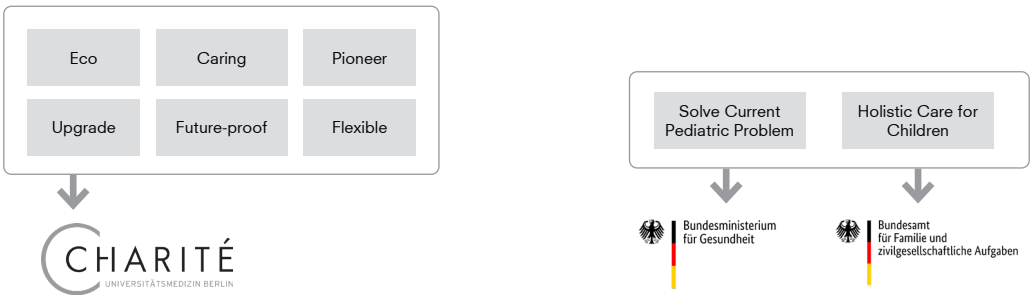


Figure 11 Clients ambitions

Figure 12 Visual interpretation

2.3 Site

The site is located in the Berlin Wedding District, next to the current Campus Virchow-Klinikum of Charité.

This triangular-shaped site faces rather different urban contexts(Figure 13) on each side. Therefore, the project needs to incorporate different responses to the features of each side.

Meanwhile, the site is embedded with a turning point of a tram route, which requires some buffer space for security reasons. Therefore the usable area would shrink slightly. (Figure 15)

The southern side is part of the Heiligenseer Weg (one of the 20 green main paths of Berlin) and faces the Spree river. (Figure 14) The strategy on this side is about continuing and even strengthening the ecological features to benefit the public more.

The northwest side faces a fast lane and looks into the Plötzensee park area. It is essential to find ways to reduce the noise and preferably build a connection towards the exuberant green area opposite the road. (Figure 16)

The northeast side shares a public road with the current Charité campus. This project, as an extension of the campus, undoubtedly requires a smooth transition toward the larger campus area.

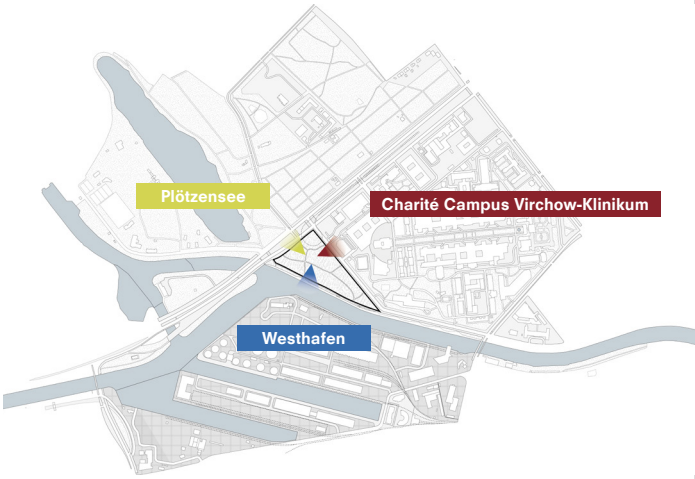


Figure 13 Site faces different urban contexts on each side.

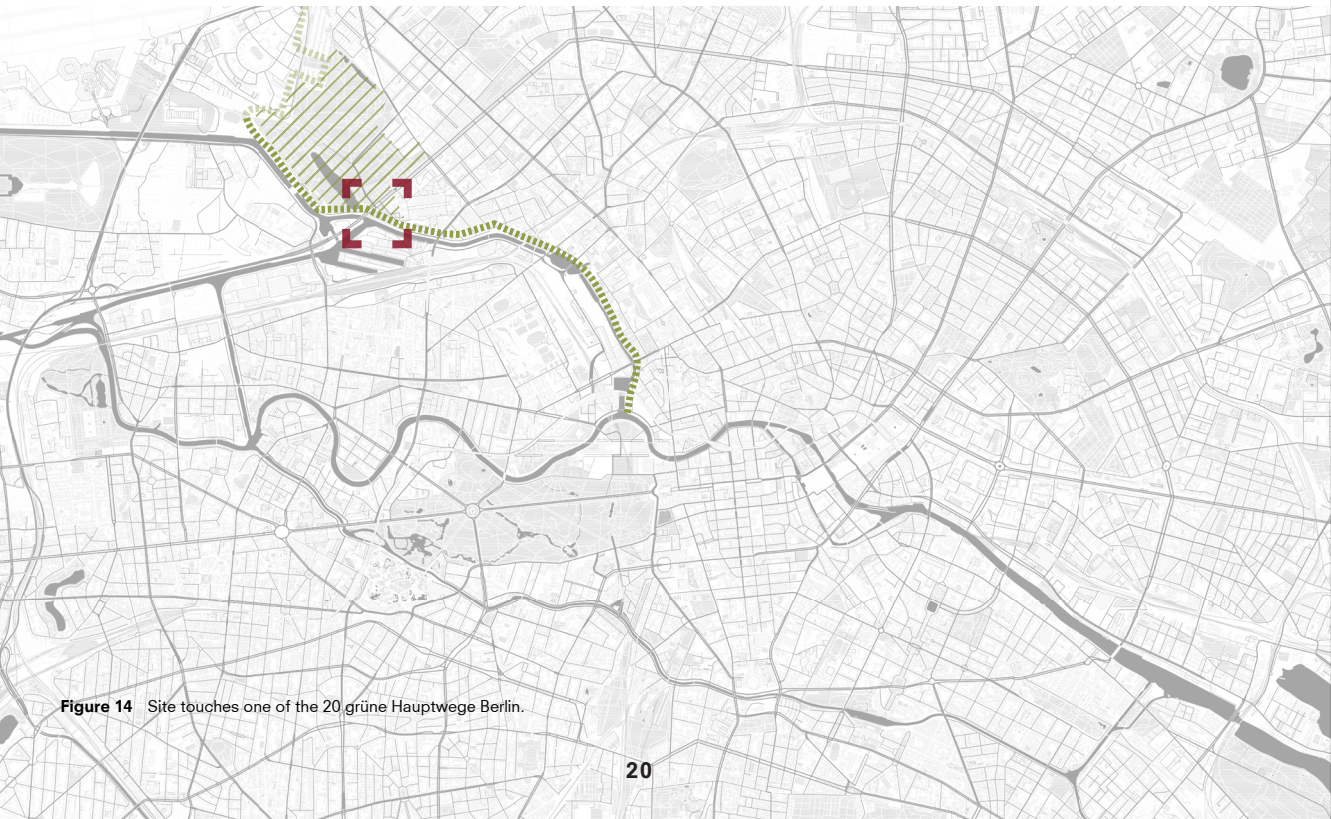


Figure 14 Site touches one of the 20 grüne Hauptwege Berlin.

(Continue) Figure 13 Site faces different urban contexts on each side.

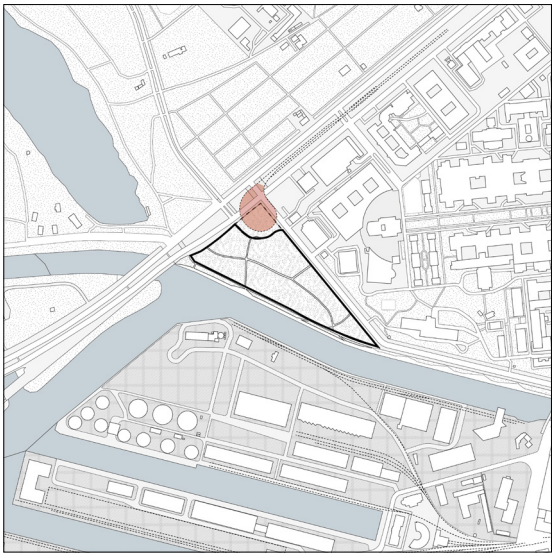


Figure 15 Ending of a tram route.

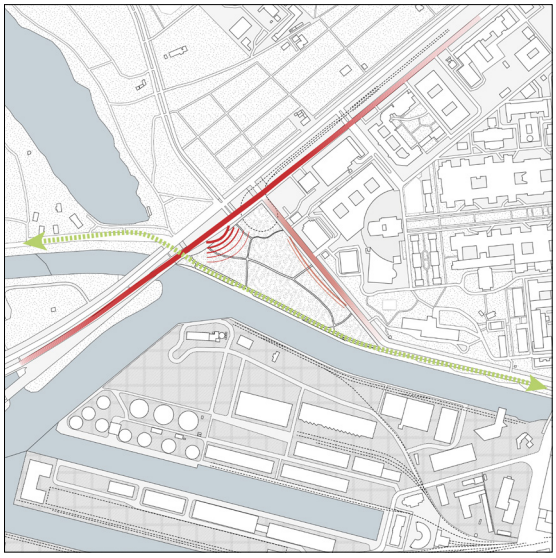


Figure 16 Each side requires offset.

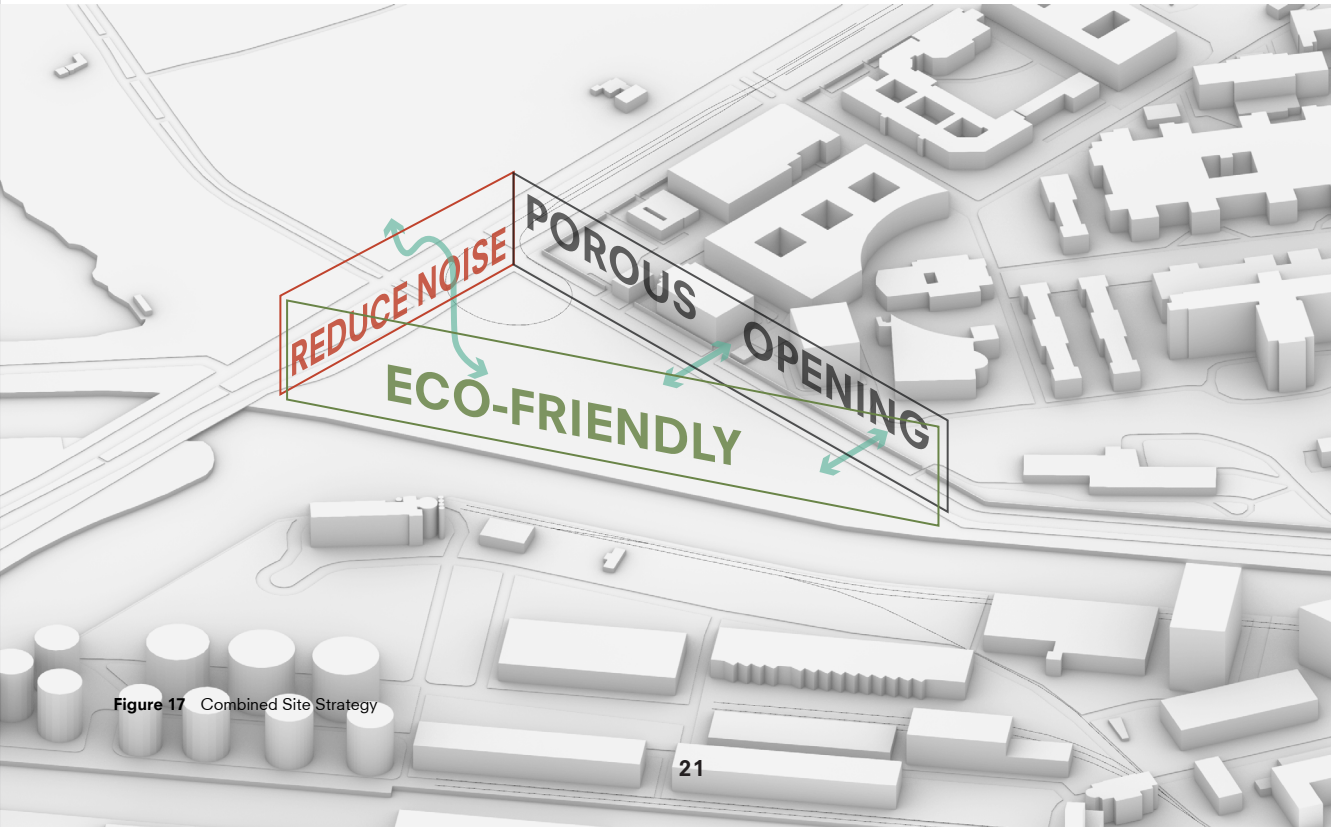


Figure 17 Combined Site Strategy

DESIGN

03

Urban Scale
Tectonic Scale
Interior Scale
Building Technology

03 Design

The implementation of the final design is gravitated to the holistic care for children. To achieve this goal, I explore the design strategies in 3 scales: urban, tectonic, and interior. The final design is the assemblage of designs that considers these three aspects.

3.1 Urban Scale

The urban-scale design primarily focuses on the building's impact within the urban environment. As a massive addition to the urban fabric, the hospital inevitably alters the dynamics of its surroundings.

3.1.1 The Original Site

The original site, currently a rarely-used park dominated by overgrown vegetation, sees most people utilizing its riverside path merely as a thoroughfare rather than a space to appreciate. The objective is to activate the ground surface of the site while preserving its green features as much as possible. The resulting concept involves a block shaped by gracefully curved courtyards.

3.1.2 No Wall

In order to diminish the exclusivity of the building, which is very common in hospital design, the ground floor maintains permeability, allowing the general public to pass through with no walls. Additionally, the ground floor functions include a restaurant and a café for everyone to enjoy. This open design not only benefits the external community but also fosters a sense of connectivity for the hospital residents who can observe activities on the ground floor, reducing their sense of isolation.

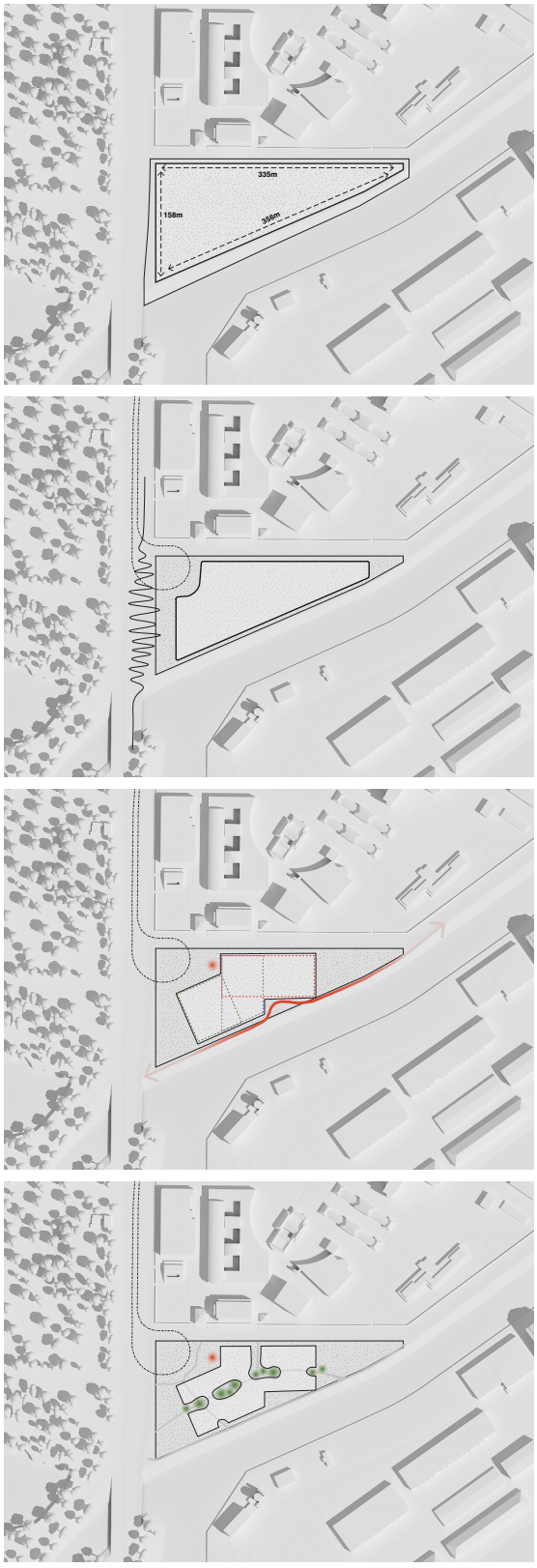


Figure 18 The massing concept development.

Figure 19 Ground surface with passages to the riverside.

Figure 20 The ground level remains permeable with curved boundaries.

Figure 21 The active curvature courtyard. (render illustration)

3.2 Tectonic Scale

3.2.1 A 2-side Building

The tectonic scale integrates thinking towards both the functionality and the spatial quality, which eventually makes this project a 2-side building. While the inner side of the building is public space juxtaposed with the curved courtyards, the out periphery discreetly houses compact units comprising patient wards and offices. Given the distinct functions of these two sides, the facades are tailored accordingly. On the courtyard side, a repeated pattern of slender wood elements is employed to convey the fluidity inherent in the curves. In contrast, the external facade features neat motorized louvers to enhance privacy and comfort for the occupants.

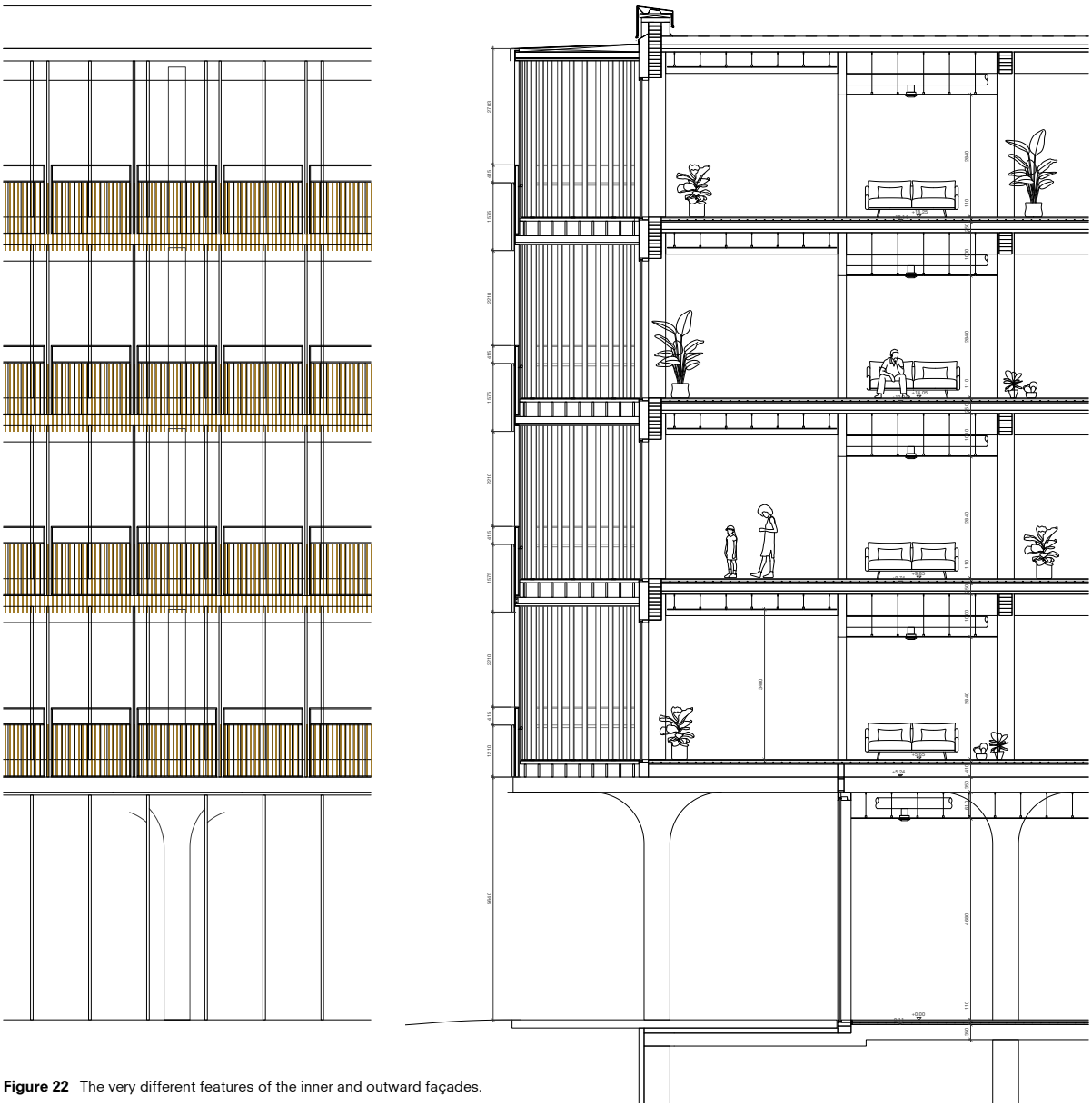
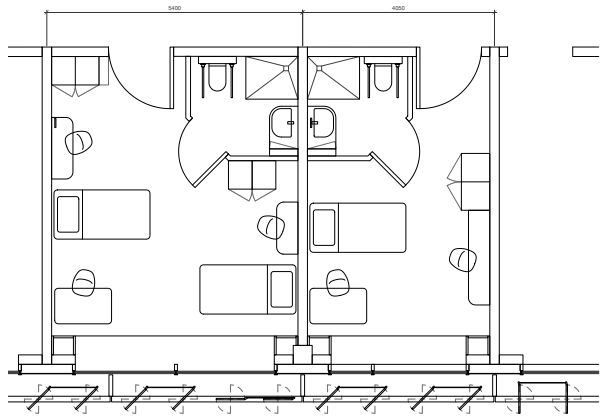


Figure 22 The very different features of the inner and outward façades.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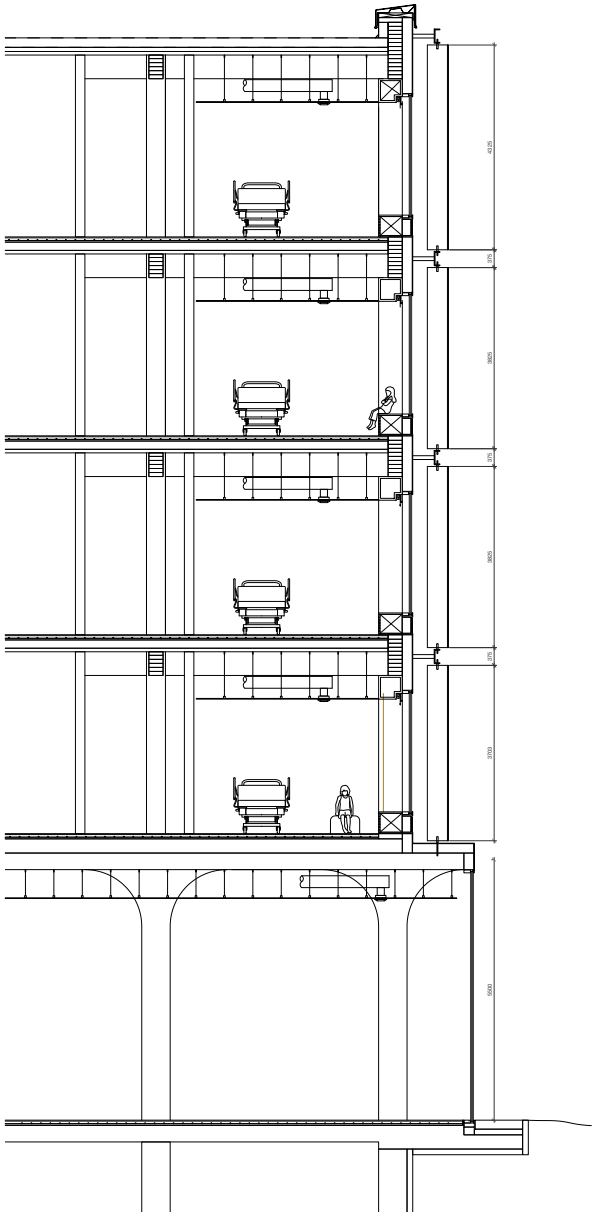
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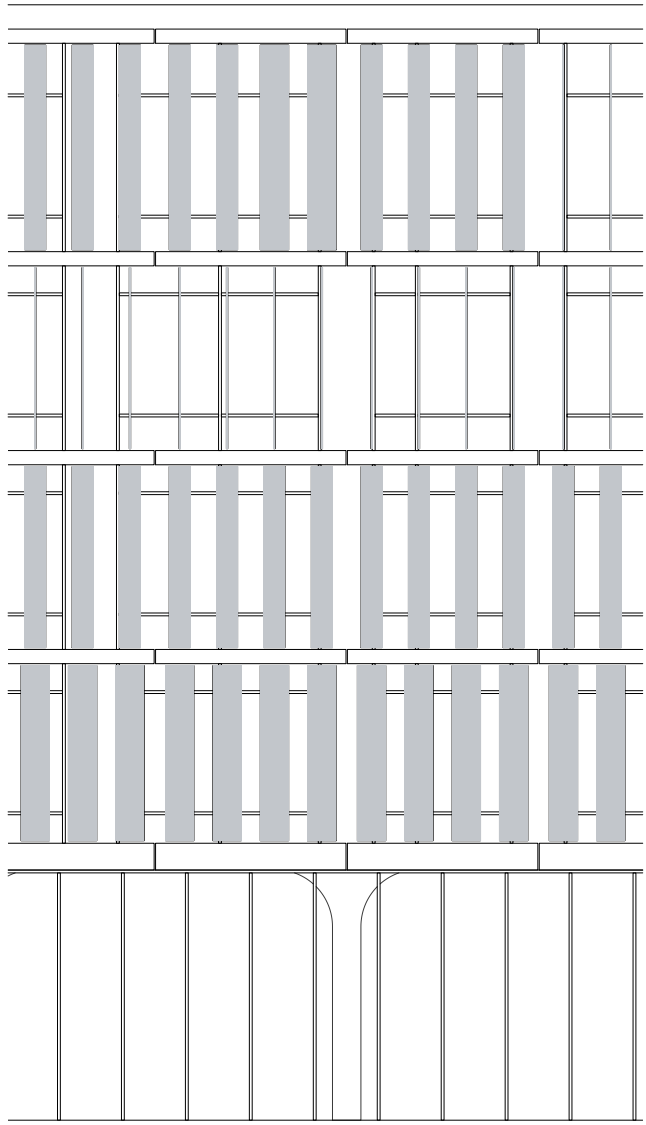
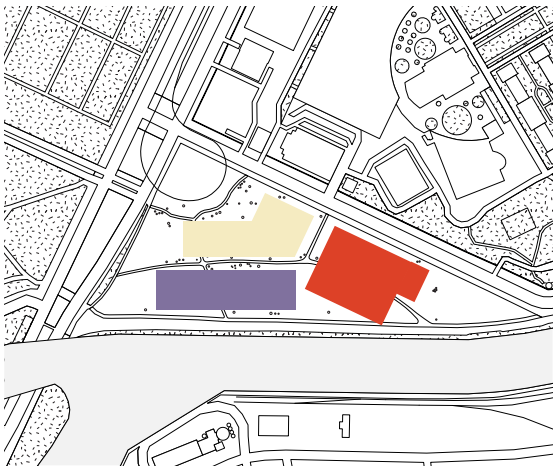


3.2.2 Zoning

The overall function of the entire building is organized into three distinct zones: outpatient (cream), inpatient (purple), and the main medical area (red). Strategically, the outpatient zone is situated close to public transportation and the main hospital, ensuring convenient access for visitors. The inpatient zone is located on the quieter side, offering scenic views of the river. The core medical area encompasses a sizable square footage with connections to both zones.(Figure 23)



Beyond the general zoning, meticulous attention has been given to the layout of each of the zones to ensure clarity and efficiency. The hospital staff has a designated circulation for hygienic and efficient workflow. In contrast, the zones for visitors and patients provide ample free space for users. Additionally, family rooms are incorporated throughout to offer privacy for the patients and their families whenever they need some personal space. (Figure 24)

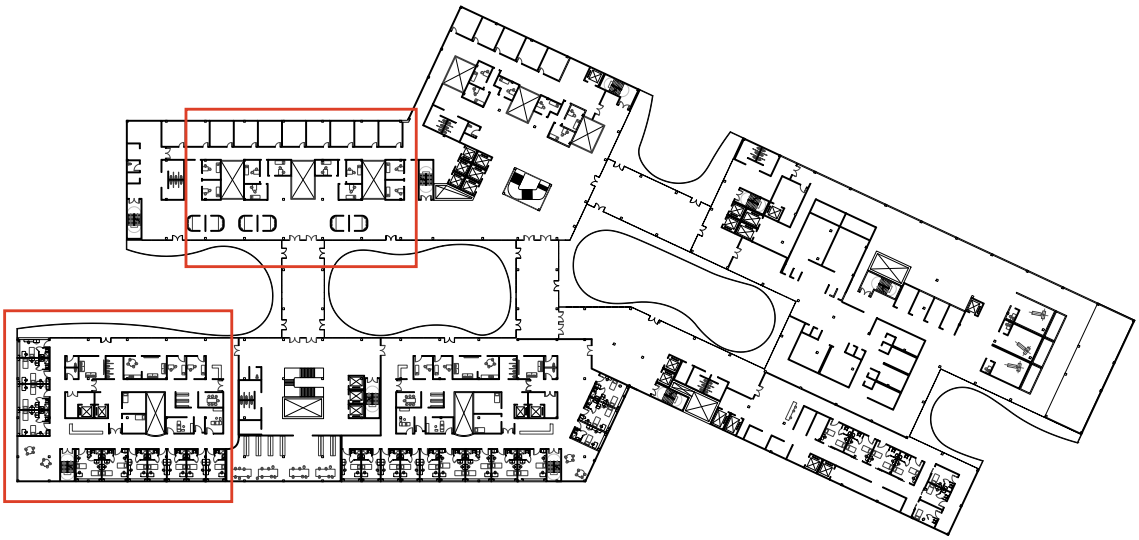
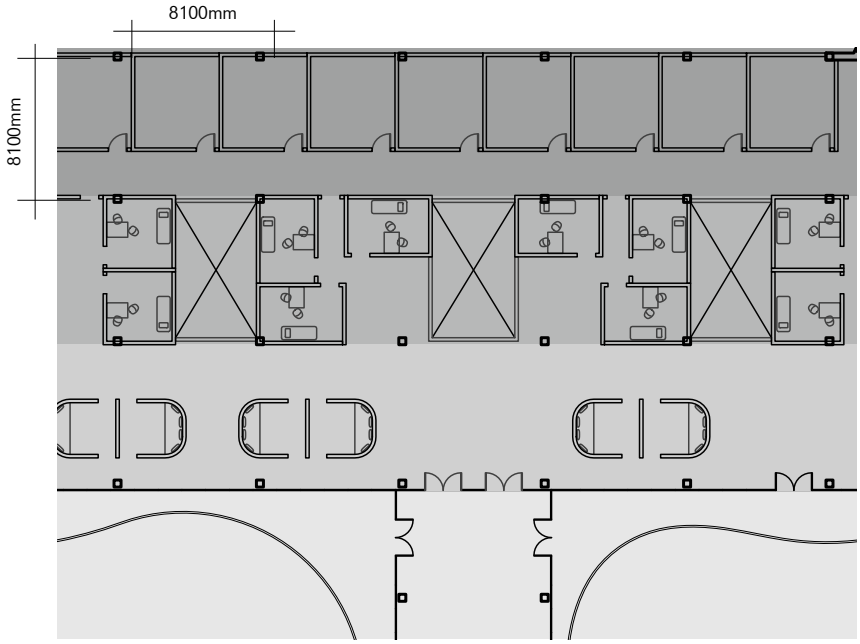


Figure 23 The whole building mainly involves three zones with connections in between.



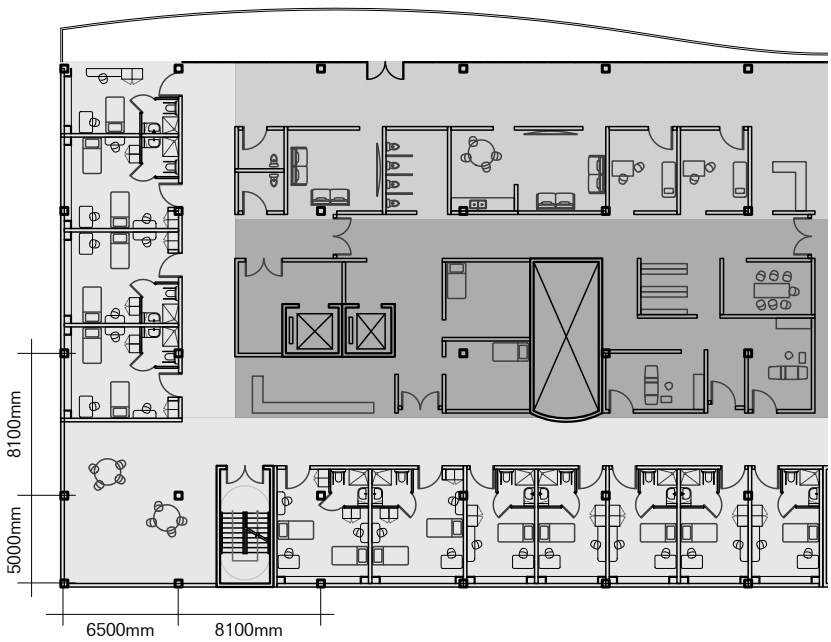


Figure 24 The zoning of different users in outpatient and inpatient department.

3.3 Interior Scale

At the interior scale, various materials with distinct tones and textures are applied accordingly. The medical staff zone emphasizes sharpness and cleanliness with cold tone, providing a professional and efficient environment for the staff. In contrast, the patient area embraces warmer materials, including wood, creating a cozy atmosphere.

Additionally, the project incorporates various family rooms and activity spaces, enhancing the overall experience and fostering a sense of living within the building for the patients and their families.

Figure 25 The inpatient public area and balcony space. (model photos)

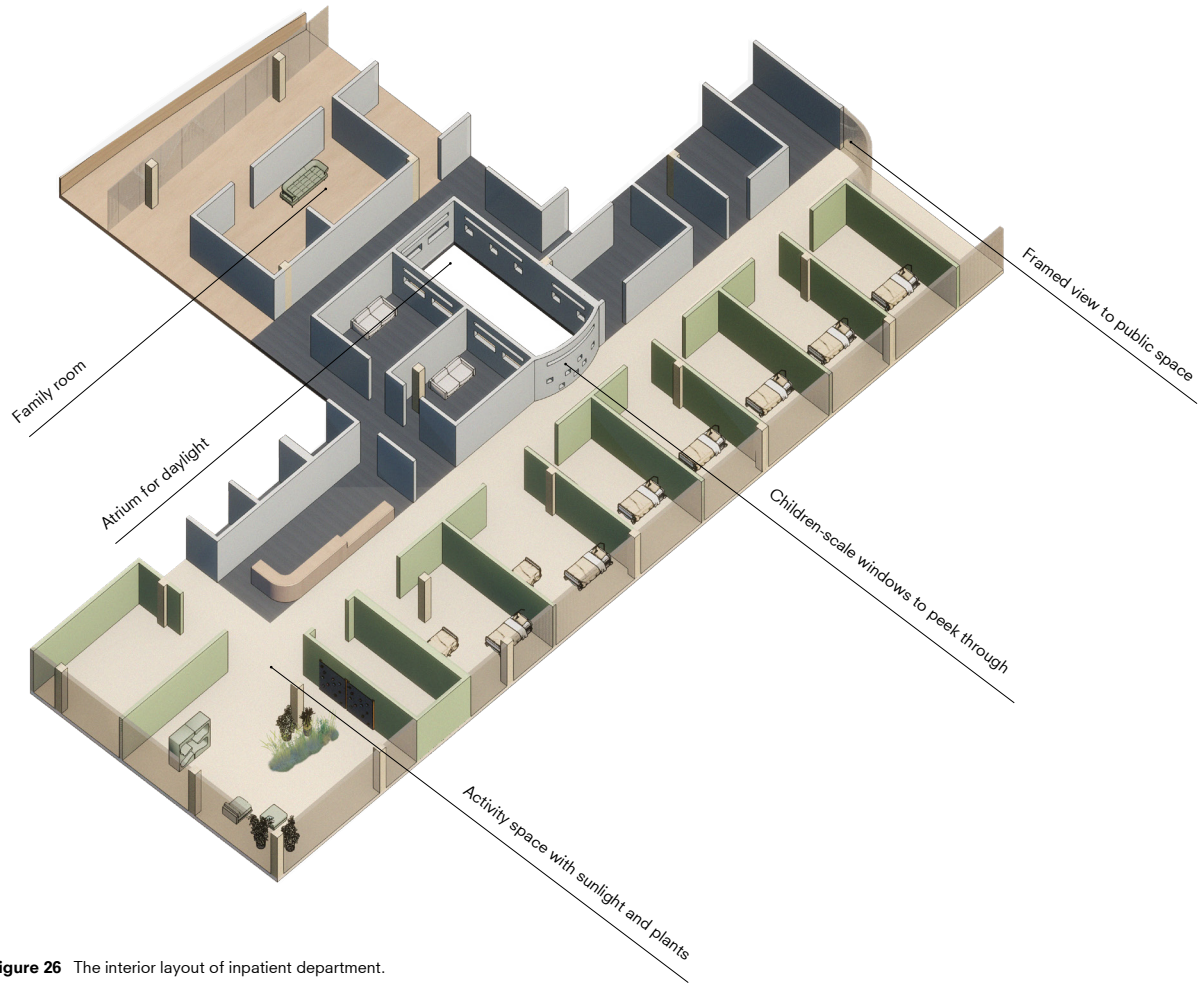


Figure 26 The interior layout of inpatient department.

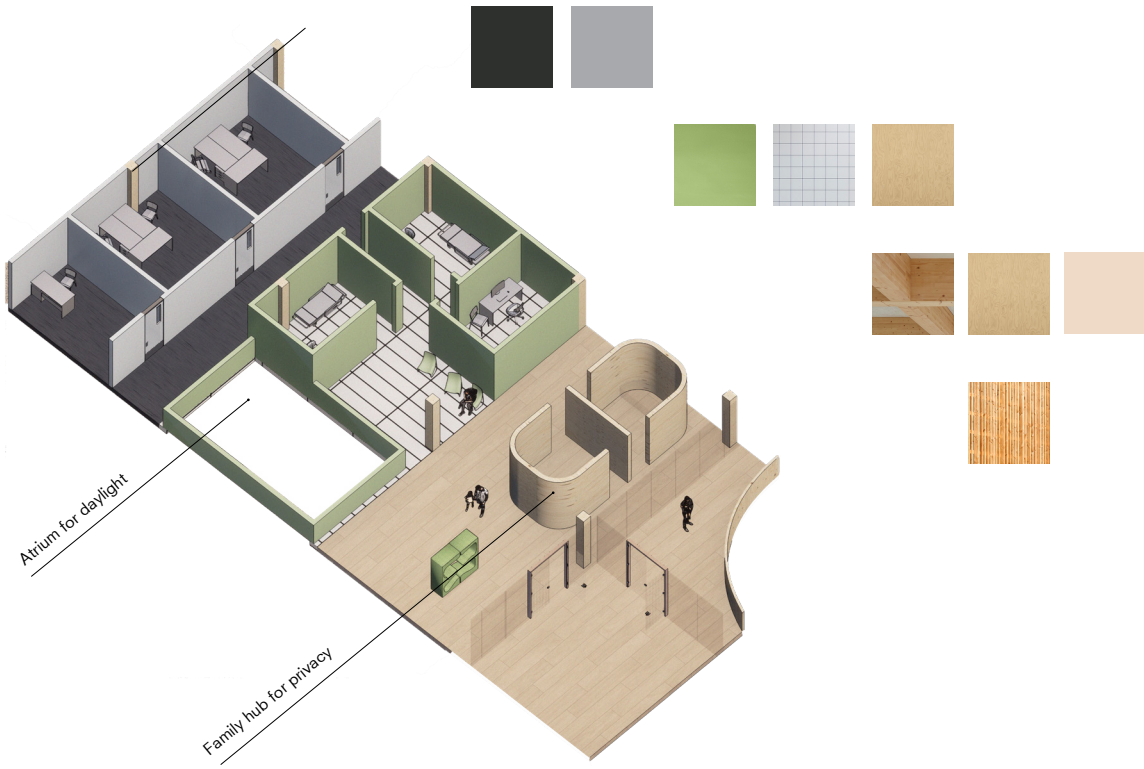


Figure 27 The interior layout of outpatient department.

Figure 28 The outpatient area. (render illustration)

3.4 Building Technology

In addition to spatial quality, ensuring a comforting climate is integral to the holistic care of building users. Taking a broader perspective, the building being resilient and future-proof also emphasizes the care towards the context, the stakeholders, and the society.

3.4.1 Environment System

Due to the stringent ventilation standards in medical architectures, the building employs mechanized ventilation and floor heating to ensure both hygiene and comfort. The passages between zones remain semi-open, allowing for natural ventilation, complemented by heating radiators. Within each ward, a natural ventilation inlet is positioned beneath the window seating, facilitating airflow and enhancing the micro-climate of patient rooms. To further enhance energy efficiency, a ground water heating and cooling system is implemented.

Solar panels are placed on roof top and southern facade to harvest energy. Rain water is also collected through roof top and supplement the water usage of the building as gray water. (Figure 29)

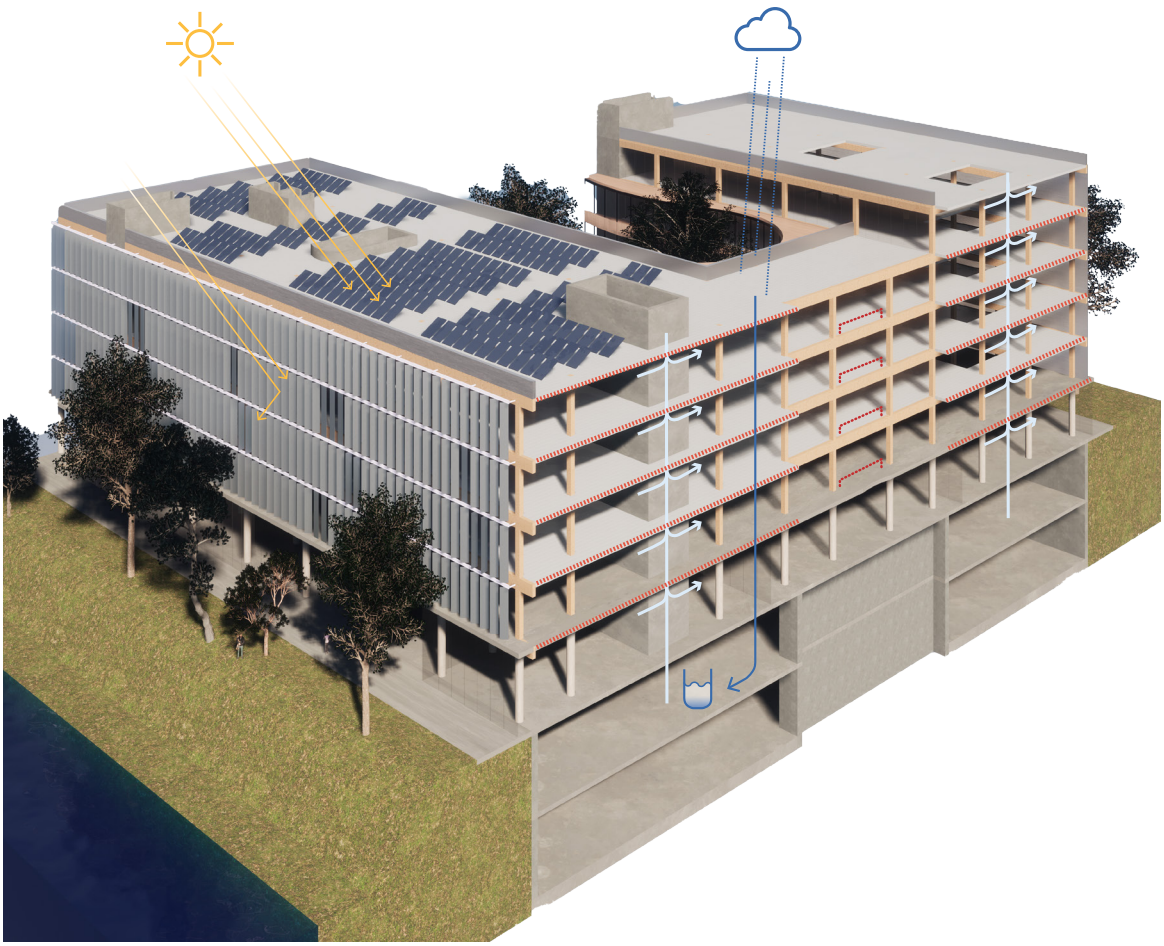


Figure 29 The climate designs and energy saving strategies of the building.

3.4.2 Construction Sustainability

The basement levels, ground floor, and cores of the building feature a flat-slab construction with watertight concrete. Atop this foundation, a mass-timber grid system is implemented, offering the potential for both vertical and horizontal expansion. The distinctive curved balconies are constructed using steel structures, seamlessly integrated as 'fill-ins' to the main structure.

The combination of three systems (Figure 30) ensures that the primary building remains within grids, facilitating effortless program changes in the future. The 'fill-ins' could potentially be altered or dismantled accordingly. Dry connections are applied in the facade installation, facilitating easy modification and reuse.(Figure 31)

Due to its proximity to the river, the project has the potential to minimize construction-related impacts on the surroundings by transporting materials via the river.

3.4.3 Social Sustainability

Spanning from the urban scale to the interior, the entire design scheme is rooted in a commitment to long-term care for the greater society. The intention to activate the ground floor involves hopes to make this site being appreciated and enjoyed by more citizens. Its immediate connection to nature make the living and working in the building also more sustainable with great comforts. The synergy between the climate control and energy savings serves as a prime example of how both comfort and economy can be concurrently achieved.

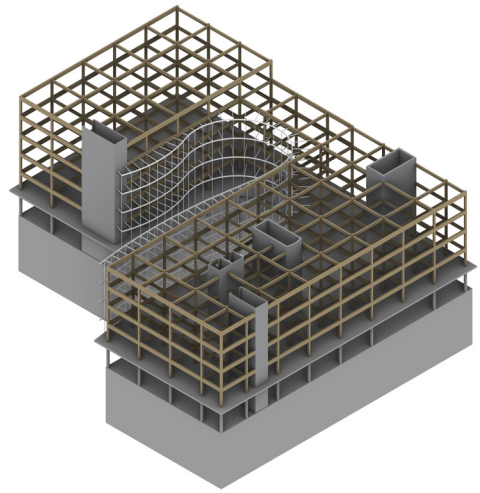


Figure 30 The structure consists of three systems.

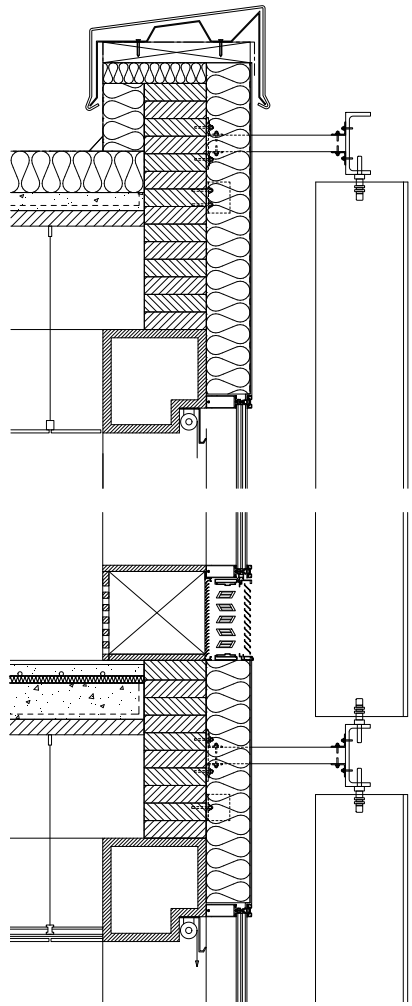


Figure 31 The application of dry connections for facade louvers.

REFLECTION

04

Academic Relations
Research & Design
Method
Relevance
Transferability

04 Reflection

This is a short substantiated explanation to account for the results of the research and design in the graduation phase.

4.1 Academic Relations

Q:
What is the relation between your graduation project topic, your master track (Ar, Ur, BT, LA, MBE), and your master programme (MSc AUBS)?

A:
My graduation topic focuses on the holistic experience of space users, which involves studies into the dynamic relations between bodies and buildings (the studio topic). To find solutions for the problem stated, the graduation topic is specifically oriented to the architectural design of the hospital space, which falls under the Architecture track and the MSc Arch program as well.

The studio topic, Bodies & Buildings Berlin, is essentially the frame and guide of the graduation topic.

As my graduation topic is about the holistic experience of the users in the children hospital, it involves studies into the dynamic relations between bodies and building a lot.

'What do the children see and touch everyday in the hospital? How do they interact with the surroundings? Do they and their parents feel less anxious and fear in the space we design? Are the medical staffs forced to walk for a longtime to check their patients? '

All these questions are under the umbrella of Bodies & Building.

Meanwhile, Berlin offers a specific context to study this topic. While the German medical system is equipped with top medical services and cutting-edge technologies, it is also criticized for being 'too focused on the functions and efficiencies'. Therefore, it is meaningful to project attentions into the holistic care design of hospitals in Berlin.

4.2 Research & Design

Q:
How did your research influence your design and how did the design influence your research?

A:
Throughout the whole process, I have been thinking about our agency as designers in the medical service:

'How can design strategies at different scales help improve the holistic experience of pediatric service for children?'

The continuous design process is essentially the test field to implement different potential approaches, compare their advantages and eventually find a proper solution. During the research part, it is repeatedly emphasized that the strategies should involve different scales, from urban to tectonic and then to interior. These strategies are only incarnated when they are being considered in a site, a situation, and an architecture. The research question guided through the whole design process to prioritize the users' experience of each space, especially the children, and the design correspondingly seeks answers to the research questions. As I went deeper into the hospital design specificities, more difficulties started to reveal. The rigidity lies in hospital designs.

4.3 Method

Q:
How do you assess the value of your way of working (your approach, your used methods, used methodology)?

A:
The research was carried out through literature reference, precedent analysis, and some consultations with designers and potential users.

The design employed a series of methods, such as site visiting, drawing, physical model making, digital modeling, and rendering, to explore and eventually deliver the experience of the users within the designed space.

These methods are largely oriented to the practicality of the design, which help me solidify the social relevance of this project. However, I do feel that it lacks a deeper degree of exploration towards theorizing.

4.4 Relevance

Q:
How do you assess the academic and societal value, scope and implication of your graduation project, including ethical aspects?

A:
Towards the academic aspect, the research and design work involves knowledge about space design, emotional design, and geographical information, which entails disciplines of architecture, psychology, and data visualization. This means that while the whole graduation project gravitates to hospital design, it will also be multifaceted and interdisciplinary.

In the scope of societal value, the graduation work could be an acute response to the current burdensome situation of the general pediatric healthcare system and aims at exploring new modes of pediatric care for the next generation.

The design process looks into not only the traditional tectonic methods, but also more recent materials, details, and environment systems.

4.5 Transferability

Q:
How do you assess the value of the transferability of your project results?

A:
Due to the fast development of medical techniques, hospital facilities are sharing shorter and shorter lifespans before they go outdated. Therefore, flexibility is one of the topic I have been trying to hold on to throughout the whole designing process. The flexibility lies not only in the ability to add and change the original building but also the adaptability of the whole design schemes towards other site and condition. This flexibility also means that it can be easily modified and adjusted according to the actual condition of the original site. While the resulting project is site-specific, the construction and design strategies in tectonic and interior scales can be adopted to another condition as well.

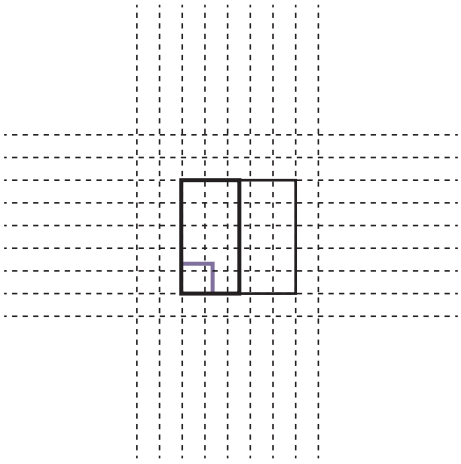
APPENDIX

05

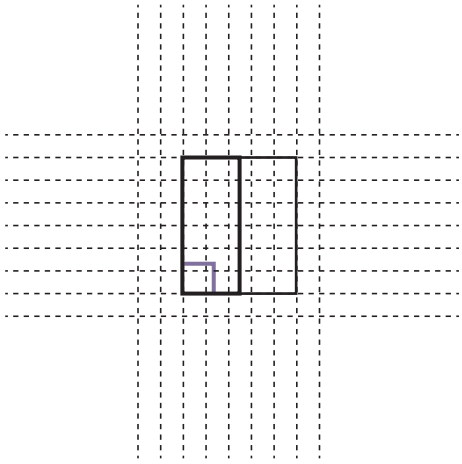
Supplementary diagrams & photos

05 Appendix

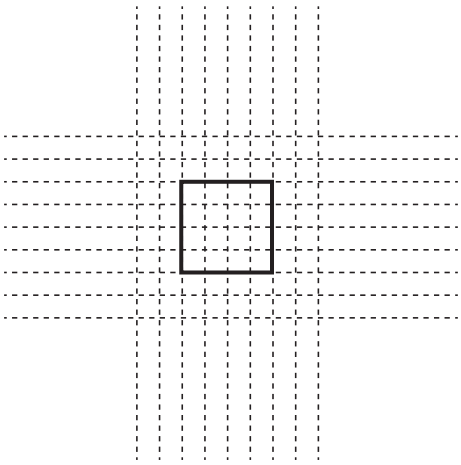
5.1 Research Analysis



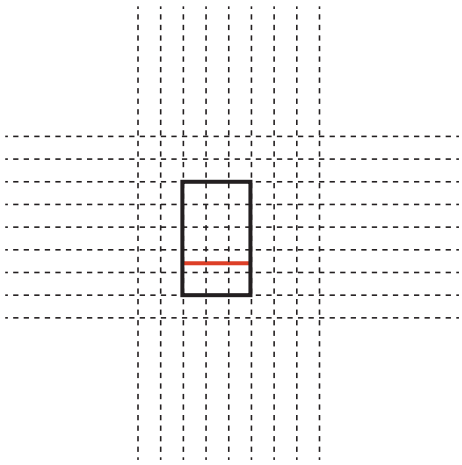
1-Bed Ward
7.5m x 3.75m



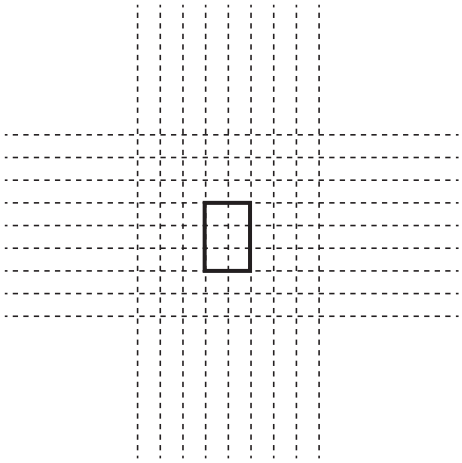
2-Bed Ward
9m x 3.75m



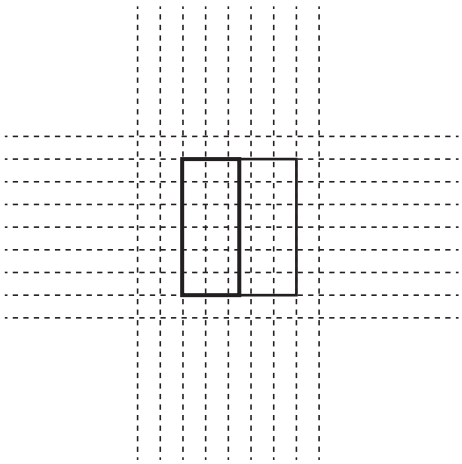
Surgery
6m x 6m



Radiology
7.5m x 4.5m



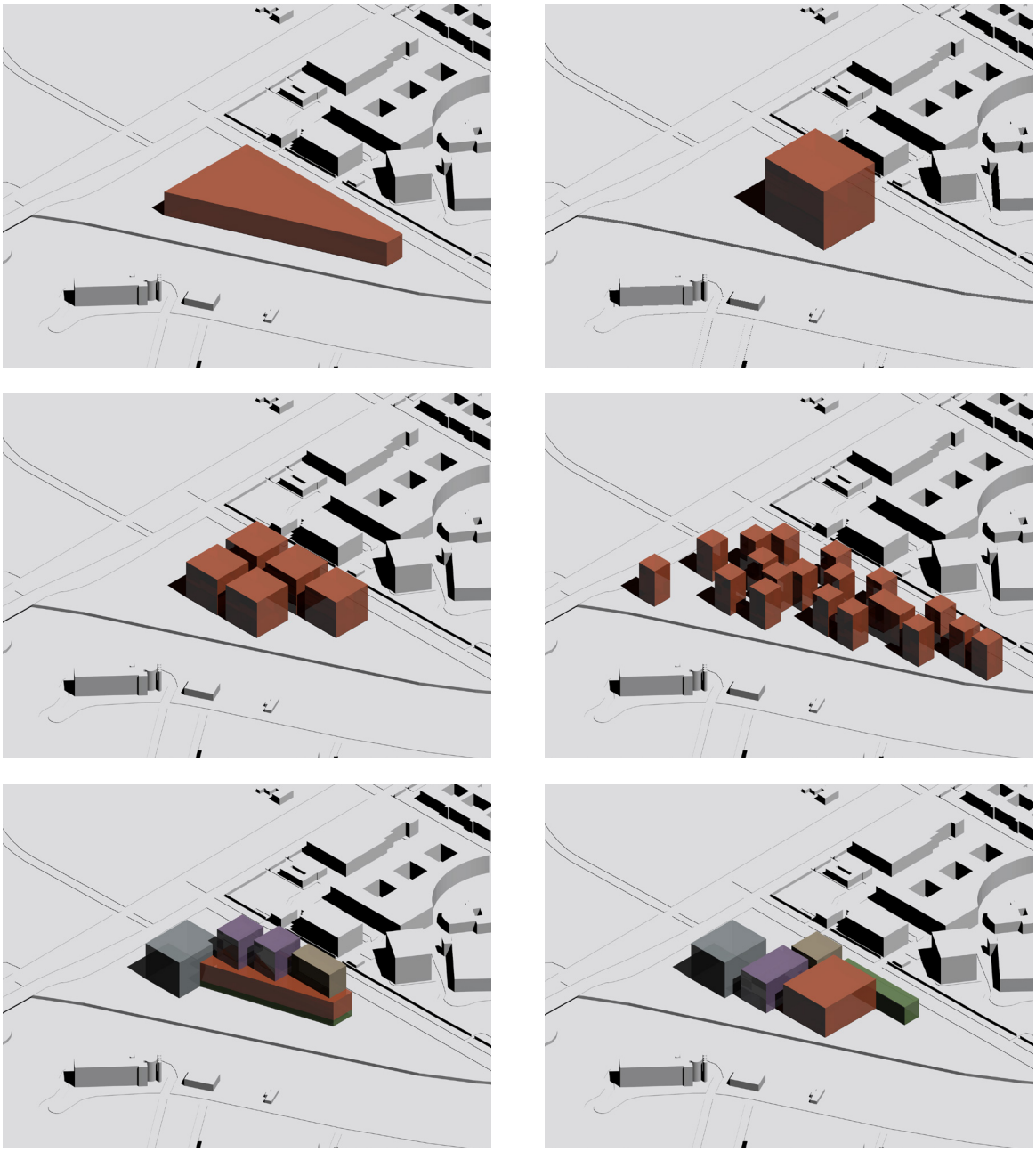
Exam / Treatment
4.5m x 3m



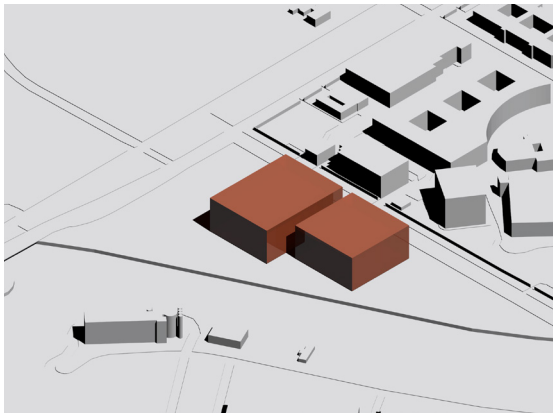
Lab
9m x 3.75m

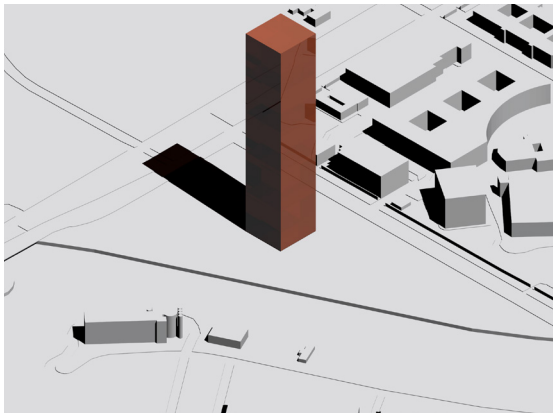
05 Appendix

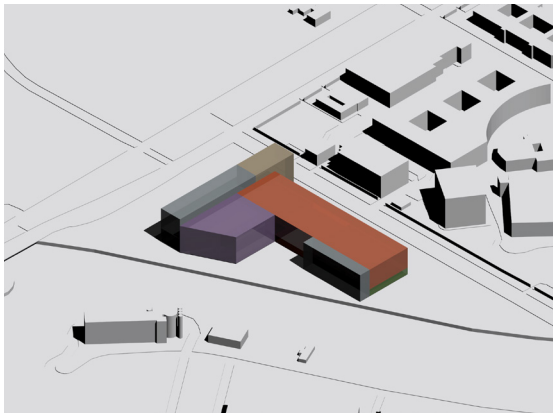
5.2 Massing study



Massing study with different focus points

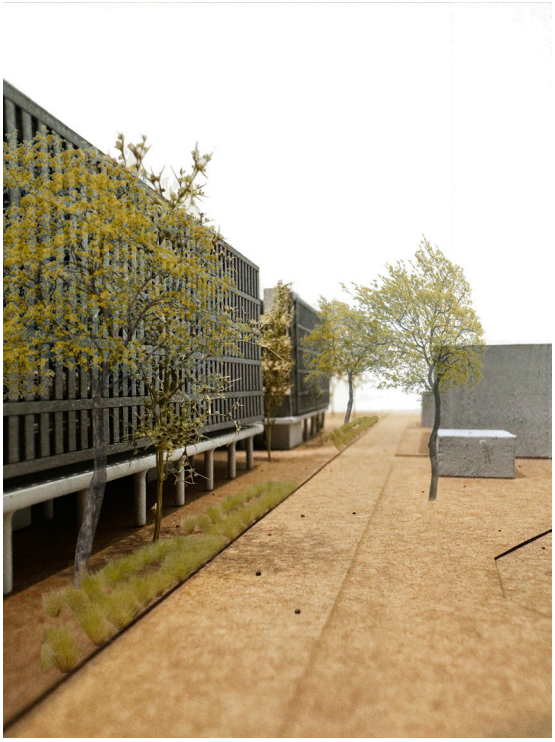


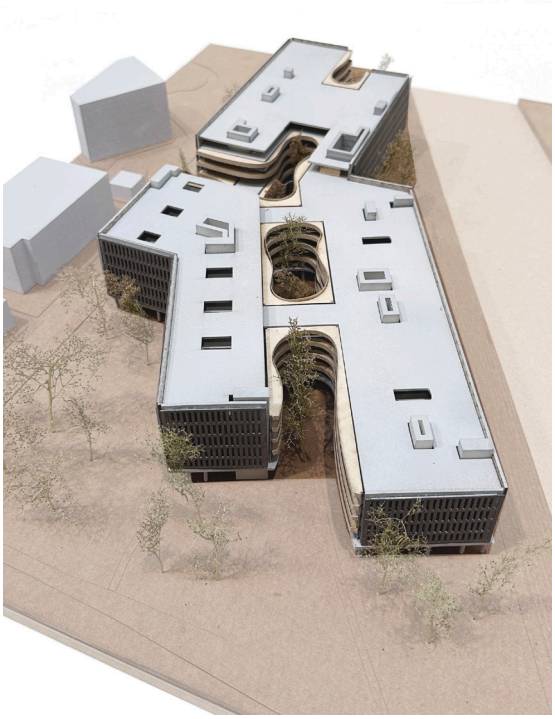




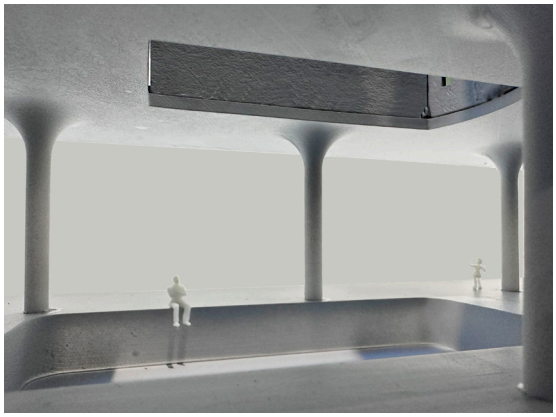
05 Appendix

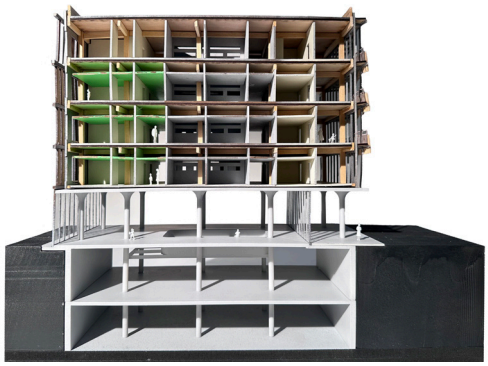
5.3 Model Photos





Photos taken from models in scale of 1:500, 1:100.





REFERENCES

06

06 References

6.1 Bibliography

Battisto, Dina. Architecture and Health. Routledge, 2019.

Birch, Jo, Penny Curtis, and Allison James. "Sense and Sensibilities: In Search of the Child-Friendly Hospital." Built Environment (1978-) 33, no. 4 (2007): 405–16.

Charité – Universitätsmedizin Berlin. "History Overview" Charité – Universitätsmedizin Berlin, accessed November 12, 2022. https://www.charite.de/en/charite/about_us/history/

Charité – Universitätsmedizin Berlin. "Facilities of Charité Center 17" Charité – Universitätsmedizin Berlin, accessed November 12, 2022. https://www.charite.de/en/charite/charitecenters/cc17_gynecology_perinatal_pediatric_and_adolescent_medicine_with_perinatal_center_and_human_genetics/

Duffin, Jacalyn. History of Medicine, Second Edition: A Scandalously Short Introduction. University of Toronto Press, 2010.

European Observatory on Health Systems and Policies. The Changing Role of the Hospital in European Health Systems. Edited by Martin McKee, Sherry Merkur, Nigel Edwards, and Ellen Nolte. European Observatory on Health Systems and Policies. Cambridge, United Kingdom: Cambridge University Press, 2020.

Hopkinson, Michael; Kostermans, Cornelis P.. Building for Health Care: A Guide for Planners and Architects of First and Second Level Facilities. Washington, D.C.: World Bank Group, 1996.

Jordan, Patrick W. Designing Pleasurable Products: An Introduction to the New Human Factors. London: Taylor & Francis, 2000.

Kleinert, Carola, and Markus Salzmann, "Catastrophic Situation in Berlin Children's Hospitals", World Socialist Web Site, October 3, 2022. http://www.wsws.org/en/articles/2022/10/04/Lyon-o04.html

Lundaard & Tranberg Architects, "Tenderness," in Connectedness: An Incomplete Encyclopedia of the Anthropocene. Views, Thoughts, Considerations, Insights, Images, Notes & Remarks, edited by Marianne Krogh. Strandberg, 2020

Maiocchi, Marco, and Zhabiz Shafieyoun. Emotional Design and the Healthcare Environment. Research for Development. Cham: Springer, 2022. https://doi.org/10.1007/978-3-030-99846-2.

Mazur, Kate A, and Stacey L Berg. Ethical Issues in Pediatric Hematology/Oncology. Cham: Springer, 2020. https://doi.org/10.1007/978-3-030-22684-8.

Murphy, Michael P, Jeffrey Mansfield, and MASS Design Group. The Architecture of Health: Hospital Design and the Construction of Dignity. New York, NY: Cooper Hewitt, Smithsonian Design Museum, 2021.

Nasab, Sara Nourmusavi, and Seyedjalal Mirbazel. "Ideal Physical Features of Environmental Design in Children's Hospital." Facilities 38, no. 5/6 (2020): 445–66. https://doi.org/10.1108/F-03-2019-0032.

Nickl-Weller, Christine, and Hans Nickl, editors. Architecture for Health: Architektur Für Gesundheit. 1st ed, Braun Publishing AG, 2021.

Norman, Donald A. Emotional Design: Why We Love (or Hate) Everyday Things. New York: Basic Books, 2004

Nourmusavi Nasab, Sara, Amir Reza Karimi Azeri, and Seyedjalal Mirbazel. "Ideal Physical Features of Environmental Design in Children's Hospital." Facilities 38, no. 5-6 (2020): 445–66. https://doi.org/10.1108/F-03-2019-0032.

Risse, Guenter B. Mending Bodies, Saving Souls: A History of Hospitals. New York: Oxford University Press, 1999.

Sunder, Wolfgang. The Patient Room: Planning, Design, Layout. Basel: Birkhäuser, 2021.

Ulrich, Roger S. "View Through a Window May Influence Recovery from Surgery." Science 224, no. 4647 (1984): 420–421

Wheeler, E. Todd. Hospital Design and Function. New York: McGraw-Hill, 1964.

World Health Organization. Regional Office for the Western Pacific. District hospitals: guidelines for development. 2nd ed. WHO Regional Office for the Western Pacific, 1992.

6.2 Figures

Figure 1. Adapted from: https://archives.rch.org.au/photography-collection/carlton-wards/

Figure 2. Adapted from: https://www.ltarkitekter.dk/kalvebodflledschool-en-0

Figure 3 - 31 Created by author.