IN THE LIGHT OF EMERGENCY

A PROPOSAL FOR POST-COVID PRIMARY CARE CENTER IN VADSTENA

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In The Light of Emergency / A Proposal for Post-COVID Primary Care Center
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0. FOREWORD P.5

A. Acknowledgment P.6
B. Student Background P.7
C. Abstract P.8

I. INTRODUCTION P.9

A. Purpose & Aim P.11
B. Research Question P.11
C. Methodology P.11
D. Delimitations P.11
E. Background P.11

II. Theory P.13

A. Definitions & Historical Perspectives P.14
B. Architecture & Pandemics in The Past P.15
C. Overview of COVID-19 Pandemic P.16
D. Impact of Pandemic on Healthcare Centers P.18
E. Preventative Architecture P.20
F. Architecture & Transformation P.21
G. Airborne Transmittable Diseases P.22
H. Swedish Primary Care Centers P.24
I. Current situation, Challenges and Future P.24
J. Design Concepts & Requirements P.24
K. Typology P.26
L. Design Strategies For Minimizing Infection Risk P.29
M. Building Material P.29
N. Ventilation P.31
O. Light P.32
P. Staff & Patient Flow P.33
Q. Adaptability & Flexibility P.34
R. Zoning & Layout P.35
S. Technology Integration P.36
T. Remote Care P.37

III. Design Proposal P.39

A. Exterior Visualization P.40
B. Location P.42
C. Historical Context P.44
D. Urban Typology P.46
E. Volume Typology P.47
F. Site Analysis P.48
G. Existing Building P.50
H. Volume Analysis P.52
I. Program P.54
J. Sustainability Considerations P.55
K. Plan / Ground Floor P.56

L.	Plan / First Floor	P.58
M.	Plan / Basement	P.60
N.	Interior Visualization	P.62
O.	Sections	P.64
P.	Patient Flow	P.66
Q.	General Flow	P.68
R.	Zones	P.70
S.	Elevation / North & South	P.72
T.	Elevation / East & West	P.74

IV. APPENDIX P.75

A. REFERENCES P.76

0.

FOREWORD

The brown bricks, charred like the embers of a long-forgotten fire, stood tall against the rising sun. The maple trees whispered secrets of times long since passed and the voice of itinerants echoed through the streets. The pungent smell of roasted vegetables from the local shop filled the air, and I can still recall them in vivid detail. One of my few remaining bright childhood memories that remain branded in my heart. My mother worked as a lab technician in a nearby primary care center. It was always a peaceful and sterile environment, and I would often accompany her rather than being sent off to kindergarten. I recall the amazing equipment she had access to: centrifuges, sampling instruments, and stools. Primary care centers have always been an integral part of my childhood memories. This thesis is therefore dedicated to my mother and my dad, who have always been heroes of my life.

I express my deepest gratitude to Lin Tan and Cristiana Caira for their outstanding guidance and support throughout my academic pursuits. Additionally, I extend a special appreciation to Sam Fallahi, my closest friend, for providing unwavering financial assistance during a challenging period in my life, which enabled me to successfully complete this thesis.

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C. ABSTRACT

The ongoing pandemic has had a profound impact on the healthcare industry, leading to the rapid transformation of healthcare systems worldwide. In 2021, the European Observatory on Health Systems and Policies noted that the resilience of healthcare systems was put to the test during the pandemic. One key area that underwent significant changes was the design of healthcare buildings. In response to the pandemic, many healthcare centers implemented temporary architectural changes to accommodate increased patient capacity while also preventing the spread of disease among patients and staff. In countries such as Sweden, where there is a shortage of medical personnel, the importance of designing safe spaces for treatment is particularly important as the spread of disease among staff can negatively impact the functioning of healthcare centers.[2]

This thesis aims to investigate the challenges and issues associated with designing primary care centers in the post-pandemic era, with a focus on air transmittable diseases and specifically within the context of the Swedish healthcare system. The research will focus on the role of architecture in preventing the spread of air transmittable disease based on the lessons learnt from the COVID-19 pandemic and will explore the use of new technologies, such as virtual healthcare, in primary care center design.

The thesis will employ a prototyping methodology, which will involve the examination of reference projects, literature, and scientific studies as well as the interviews. The ultimate goal of this research is to identify alternative design strategies for primary care centers in Sweden that can help to create safe environments for patients and staff and increase the resilience of the primary care centers during future outbreaks or seasonal transmissible diseases.

1. European Observatory on Health Systems and Policies, Sagan, Anna, Webb, Erin, Azzopardi-Muscat,Natasha, de la Mata, Isabel. et al. (2021). Health systems resilience during COVID-19: lessons for building back better. World Health Organization. Regional Office for Europe.

2. Brambilla, A., Sun, T. Z., Elshazly, W., Ghazy, A., Barach, P., Lindahl, G., & Capolongo, S. (2021). Flexibility during the COVID-19 Pandemic Response: Healthcare Facility Assessment Tools for ResilientEvaluation. International journal of environmental research and public health

3. Herman, Y. (2020). [Belgian Jozef Gouwy, 93 looks at a robot made by Belgian company ZoraBots]. Reuters

Keywords
pandemic, healthcare industry, primary care centers, air transmittable diseases, post-pandemic era, Swedish healthcare system, architecture, COVID-19 pandemic, new technologies, design strategies

I. INTRODUCTION

— Research Question I / How can the design of space improve the resilience of Swedish primary care centers against airborne transmittable diseases based on the lessons learned from COVID-19 Pandemic?

— Research Question II / How can the design of space provide triaging capability for Swedish Primary Care Centers during emergency situations?

A. BACKGROUND

During the COVID-19 pandemic, healthcare systems worldwide faced significant challenges due to the saturation of facilities. The majority of healthcare centers were not equipped to handle the influx of both suspected and confirmed COVID-19 patients, and separating COVID-19 patients from non-COVID-19 patients proved to be a difficult task.[1] This led to the spread of the virus within healthcare centers. While rapid architectural solutions were implemented to control the situation, they were not sufficient to fully address the issues. One potential solution to this problem is the utilization of primary care centers as a first line of defense for triaging suspected patients.

However, the complexities of architectural design for primary care centers to be resilient against pandemics and transmittable diseases, as well as having sufficient flexibility in emergency situations, must be considered. The lower cost of building primary care centers compared to hospitals may make them a more viable option for investigation and development, leading to a more decentralized healthcare system with multiple lines of defense during future pandemics or crises. [2]

1. European Observatory on Health Systems and Policies, Sagan, Anna, Webb, Erin, Azzopardi-Muscat,Natasha, de la Mata, Isabel. et al. (2021). Health systems resilience during COVID-19: lessons for building back better. World Health Organization. Regional Office for Europe.
2. Brambilla, A., Sun, T. Z., Elshazly, W., Ghazy, A., Barach, P., Lindahl, G., & Capolongo, S. (2021). Flexibility during the COVID-19 Pandemic Response: Healthcare Facility Assessment Tools for ResilientEvaluation. International journal of environmental research and public health,

B. AIM & PURPOSE

The primary objective of this thesis is to examine the methods by which the resilience of a Swedish primary care center can be enhanced against air-borne diseases. Specifically, this research aims to analyze the lessons learned from the COVID-19 pandemic, as well as to identify successful key projects within the healthcare sector, in order to develop design strategies that can effectively increase the resilience of primary care centers against future air-borne disease outbreaks or pandemics. The second objective of this thesis is to address the following goals of UN 2030 Global Sustainable development Agendas within the design proposals limitations: 3. Good Health & Well-Being, 11. Sustainable Cities & Communities, 13. Climate Action

C. METHODOLOGY

This research and design proposal will use prototyping to assess already available sources of information, such as books, scholarly papers, conference papers, and other pertinent materials, to become more enlightened on the topic. The successful undertakings related to this research theme will also be surveyed. The ideas extracted from these accomplished projects and the discoveries from literary studies will present new perspectives and solutions. To guarantee the practicality and realism of the results, healthcare experts and architects with experience in primary care design will be consulted. Throughout the investigation process this method of inquiring questions and challenges will be repeated.

This thesis also utilizes artificial intelligence (AI) for specific tasks, including proofreading, data sorting, spell checking, and brainstorming in certain sections. Notably, Google's large language model, Gemini, was employed for these purposes throughout the writing process.

D. DELIMITATIONS

The thesis will investigate the enhancement of architectural resilience in regards to airborne transmittable diseases, using the COVID-19 pandemic as a primary example. The focus will be limited to architectural tools and strategies specifically aimed at addressing air transmittable disease transmission, and will not include discussions of other forms of transmission such as direct contact, droplets, vectors, or vehicle-based forms. The study will not delve into the technical or medical aspects of the diseases themselves, but may include a brief exploration of relevant terminology to aid in understanding the architectural implications.

The emphasis will be on providing architects and designers with tools to create spaces that are resilient against airborne disease transmission, rather than providing recommendations for individuals such as patients or staff. The design proposal will not be constrained by economic or constructional considerations, but will instead focus on contextualizing the proposed design within the specific framework of the thesis. The historical context of the design will be taken into account, but will not be the primary focus. The design proposal will also focus on extreme but limited usage scenarios, such as usage during pandemics or seasonal diseases by providing alternative scenarios both for extreme and normal conditions.

Keywords
COVID-19, healthcare systems, primary care centers, challenges, architectural design, triaging, patients, pandemics, transmittable diseases, decentralized healthcare system.

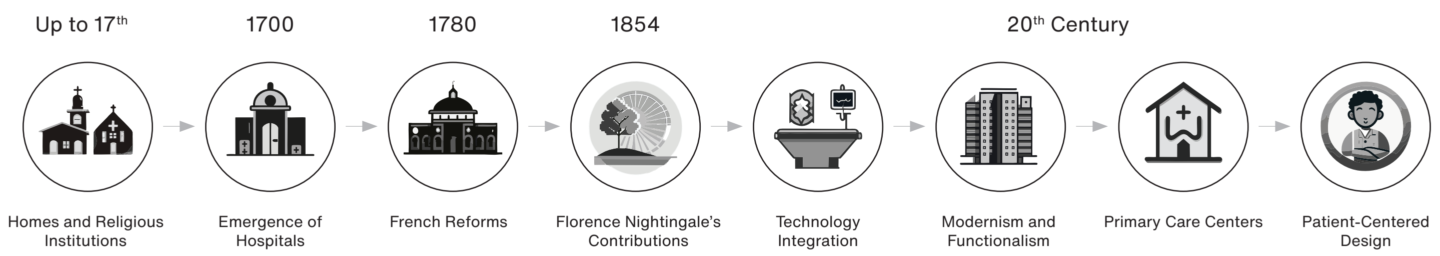
II.
THEORY

A. DEFINITIONS AND HISTORICAL PERSPECTIVE

Architecture has long played an important part in patient care and treatment. The significance of high-quality design in the treatment of patients has been highlighted throughout history. Initially, patients were mostly treated at home or in religious organizations. As religion developed, religious institutions began providing medical care. In Western countries, especially Christian communities, this was essentially the responsibility of churches. On the edges of towns and villages, the structures we now recognize as hospitals arose throughout time. Yet, they were not controlled until the late 1700s, when French reforms led to the establishment of hospitals with more clearly defined architecture. During the Crimean War in 1854, Florence Nightingale highlighted the value of natural light, air, and scenery, as well as food and hygiene, in boosting the health and well-being of patients. This focus on architecture as a crucial part of patient care arose shortly afterwards. Her innovative work emphasized the significance of building healthcare facilities that offer medical treatment and encourage patients' well-being via architecture. Throughout the years, research has progressively proved the beneficial influence of design on patient outcomes, which has led to a growing appreciation of architecture's significance in healthcare.[1]

After the pioneering work of Florence Nightingale on the relevance of design in hospital settings, developments in technology and modern medicine culminated in the development of contemporary healthcare facilities. The new kinds of diagnosis and treatment of patients that evolved over the 18th and 19th centuries began to need the development of new types of spaces that could accommodate the demands of newly created technology and procedures such as MRI machines, CT scans, ultrasound, and so on. Another significant development that began in the early twentieth century was the introduction of specialized hospitals to offer highly concentrated treatment for certain user groups and disorders such as aged care, cardiography, neurology, and so on. The emergence of modernism and functionalism in architecture had a significant influence on healthcare facilities as well. These styles prioritized efficiency, hygiene, and the utilization of new technology, resulting in a significant visual shift known as the clinical look. Nevertheless, this method was highly criticized in the ensuing years due to a disregard for patients' emotional and psychological requirements, culminating in a change toward more patient-centered and holistic design.[2]

1. Burpee, H. (2008). History of healthcare architecture. Integrated design lab Puget sound, 1-3.
2. Megan, B. (2021). Architecture and Design Magazine, June 2021
3. World Health Organization. (1978). Alma-Ata 1978: Primary Health Care
4. Health Resources and Services Administration. (2021). About HRSA



Parallel to the expansion of hospitals, the establishment of another healthcare facility, now known as primary care centers, began in the early twentieth century in response to increasing demand for healthcare services in metropolitan areas. In the United States, for example, Metropolitan Life Insurance Company in New York City founded the first primary care clinic in 1912 to offer healthcare services to its policyholders.[3]

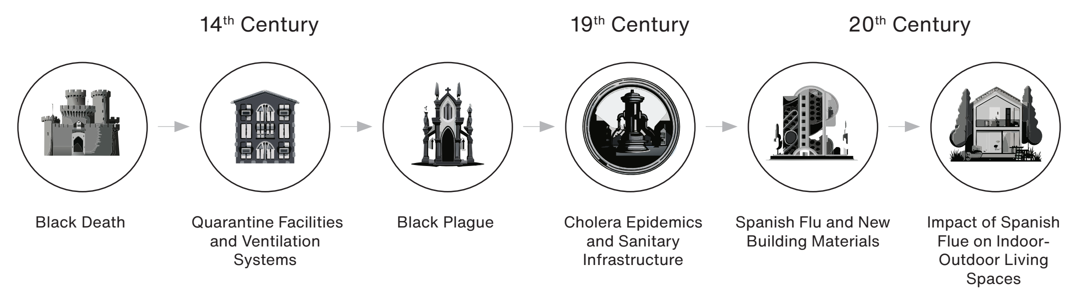
5. Utah State Historical Society Classified Photo Collection(1886). [Walter Murray Gibson (left) with Mother Marianne Cope and other sisters at Kapiolani Home in Kakaako for daughters of Hansen's disease patients]

The growth of primary care centers accelerated in the 1970s and 1980s, as policymakers recognized the significance of primary care in promoting population health. Primary health care was defined by the World Health Organization (WHO) in 1978 as "essential health care based on practical, scientifically sound, and socially acceptable methods and technology, made universally accessible to individuals and families in the community through their full participation and at a cost that the community and country can afford to maintain at all stages of their development in the spirit of self-reliance and self-determination." [4]

B. ARCHITECTURE & PANDEMICS IN THE PAST

Many people assume that the COVID-19 pandemic was the first time architecture faced a difficulty like this, but the fact is that pandemics and epidemics have always tested and influenced architecture, resulting in the construction of places. During the 14th century's black death, which killed an estimated 25 million people in Europe alone, urban architecture was drastically altered to mitigate the effects of illness. This featured a move toward fortified cities. Many people at the period felt that illness transmission was caused by filthy circumstances, overcrowding, and the presence of foreigners, therefore they began to clear out slums, erect walls, and introduce new facilities like quarantine facilities.[1] These methods were incorporated into the design of buildings, which included ventilation systems and operable windows to increase airflow. Public areas, such as markets and fairs, have been altered to reduce congestion and promote social separation.[2] Lastly, the Black Plague had a substantial effect on ecclesiastical architecture. During the epidemic, churches that had been among the grandest and most magnificent structures in medieval Europe were redesigned to meet the requirements of the community. Additional wings and galleries were erected to a number of churches to offer extra room for patients, therefore transforming them into temporary hospitals. This resulted in a new form of church building that was more utilitarian than decorative.[3]

1. Treib, M. (2020, April 22). The architectural response to epidemics through history. Architectural Digest
2. Cohn Jr, S. K. (2002). The Black Death and the burning of Jews. Past & Present, 174(1), 3-36
3. Herlihy, D. (1997). The Black Death and the transformation of the West. Harvard University Press
4. Spinney, L. (2020). Cholera and architecture in the 19th century. The Lancet, 395(10223), 1631-1632
5. Davies, C. (2020). The Spanish Flu's Impact on Architecture. Architectural Digest



Cholera epidemics in the nineteenth century was another incident that had a significant influence on architecture and urban design. Several towns started creating improved sanitary infrastructure, such as sewage systems and clean water supplies, in reaction to the illness, which was transmitted by polluted water sources. As a result, buildings were constructed to handle modern water and waste management systems, resulting in considerable changes in architecture and urban planning.[4] The development of new building materials and construction procedures was another manner in which the Spanish flu affected architecture. Building supplies, notably wood and steel, were in limited supply during the epidemic as resources were diverted to the war effort. As a result, architects started experimenting with new materials like as concrete and glass, which were more widely accessible and could be utilized to construct contemporary, streamlined structures. This exploration of new materials and methods resulted in the birth of new architectural styles such as Art Deco and Modernism, which characterized the aesthetics of the 1920s and 1930s. The Spanish flu also had an impact on residential construction design, notably in terms of indoor-outdoor living areas. As people's concerns about illness prevention grew, architects started building houses with additional outdoor living areas, such as balconies, terraces, and gardens, to give occupants with fresh air and sunshine. Its focus on indoor-outdoor living areas was a trademark of mid-century modern architecture, which emphasized natural light and ventilation.[5]

6. Combating influenza in Seattle in 1918, workers wearing masks on their faces in a Red Cross room. https://www.theatlantic.com/photo/2018/04/photos-the-1918-flu-pandemic/557663/

C. OVERVIEW OF COVID-19 PANDEMIC

The COVID-19 pandemic, caused by the new coronavirus SARS-CoV-2, appeared in Wuhan, China, in December 2019 and swiftly expanded to create a worldwide public health disaster. As of March 2023, the epidemic has afflicted over 400 million individuals and caused more than 5 million fatalities globally. The virus is transferred mostly by respiratory droplets when an infected individual coughs, sneezes, or speaks. Nevertheless, it may also spread via contact with infected surfaces or items.[1] Mild to severe COVID-19 symptoms include fever, cough, weariness, body pains, loss of smell or taste, and shortness of breath. In some instances, the condition may result in pneumonia, acute respiratory distress syndrome (ARDS), and death. Individuals who are elderly, immunocompromised, or have underlying health concerns are at a greater risk for serious illness and death.[2] Countries throughout the globe have taken measures such as lockdowns, travel restrictions, and social distancing protocols to curb the spread of the illness. These restrictions have had a substantial influence on the global economy, resulting in the closure of countless firms and the loss of millions of jobs.[3]

Vaccines against COVID-19 have been produced and approved for emergency use by regulatory authorities in a number of countries. The vaccinations have been provided to billions of individuals throughout the globe due to their shown efficacy in averting serious sickness and death. However, vaccination skepticism and poor availability to vaccines remain obstacles in many regions of the globe.[1] In addition to highlighting existing health and healthcare disparities, the epidemic has disproportionately harmed underprivileged populations. Increased rates of anxiety, depression, and other mental health illnesses have been recorded globally as a result of the epidemic.[4] The COVID-19 pandemic has had a substantial influence on global healthcare systems, resulting in an increase in the need for medical supplies, hospital beds, and healthcare workers. Several nations have failed to meet the increased demand, resulting in shortages of personal protective equipment (PPE) and other essential medical supplies in many regions.[5] Several colleges and institutions have been forced to shut or transition to online instruction as a result of the epidemic. This has interrupted the education of millions of pupils around the globe and exacerbated existing educational disparities.[6]

In addition, the pandemic has had a significant impact on global travel and tourism, leading to a sharp decline in international tourism and a loss of revenue for many countries. This has had a significant impact on the livelihoods of millions of people who work in the tourism industry.[7] The COVID-19 pandemic has also highlighted the importance of global cooperation and solidarity in addressing global health challenges. The World Health Organization has played a central role in coordinating the global response to the pandemic, including efforts to develop and distribute vaccines, treatments, and medical supplies.[8] Yet, the epidemic has also been characterized by disinformation and conspiracy theories, which have contributed to uncertainty and skepticism of public health interventions. Social media networks have failed to counteract the spread of disinformation, hence facilitating the dissemination of inaccurate information.[9] As the epidemic progresses, emerging forms of the virus that may be more contagious or cause more severe sickness are a matter for worry. There is a need for continuous surveillance and study in order to comprehend the possible effect of these variations and establish ways to avoid their spread.[10]

The COVID-19 pandemic has dramatically impacted healthcare, the economy, and our social and cultural lives, creating a global public health crisis. While vaccines have been a key factor in tackling the epidemic, we still need to do more to address the challenges the pandemic has introduced. It's essential to ensure our healthcare and social systems are stronger and more resilient to handle any future health emergencies.[10]

1. CDC. (2022). COVID-19: How it spreads
2. WHO. (2020). Coronavirus disease (COVID-19) advice for the public.
3. World Bank. (2021). The global economic outlook during the COVID-19 pandemic: A changed world.
4. World Health Organization. (2021). Mental health and COVID-19
5. WHO. (2020). WHO Director-General's opening remarks at the media briefing on COVID-19 - 2 April 2020.
6. UNESCO. (2020). Education: From disruption to recovery.
7. UNWTO. (2021). Impact of COVID-19 on global tourism made clear as UNWTO counts the cost of standstill
8. World Health Organization. (2022). COVID-19 vaccines.
9. WHO. (2020). Rolling updates on coronavirus disease (COVID-19)
10. CDC. (2022). Emerging variants of SARS-CoV-2: What you need to know
11. WHO. (2021). COVID-19: One year later—WHO Director-General's new year message.

12. Peter Cziborra (2021), Reuters

Kelly, A. (2020). Dancing through the chaos [Photograph]. Reuters.

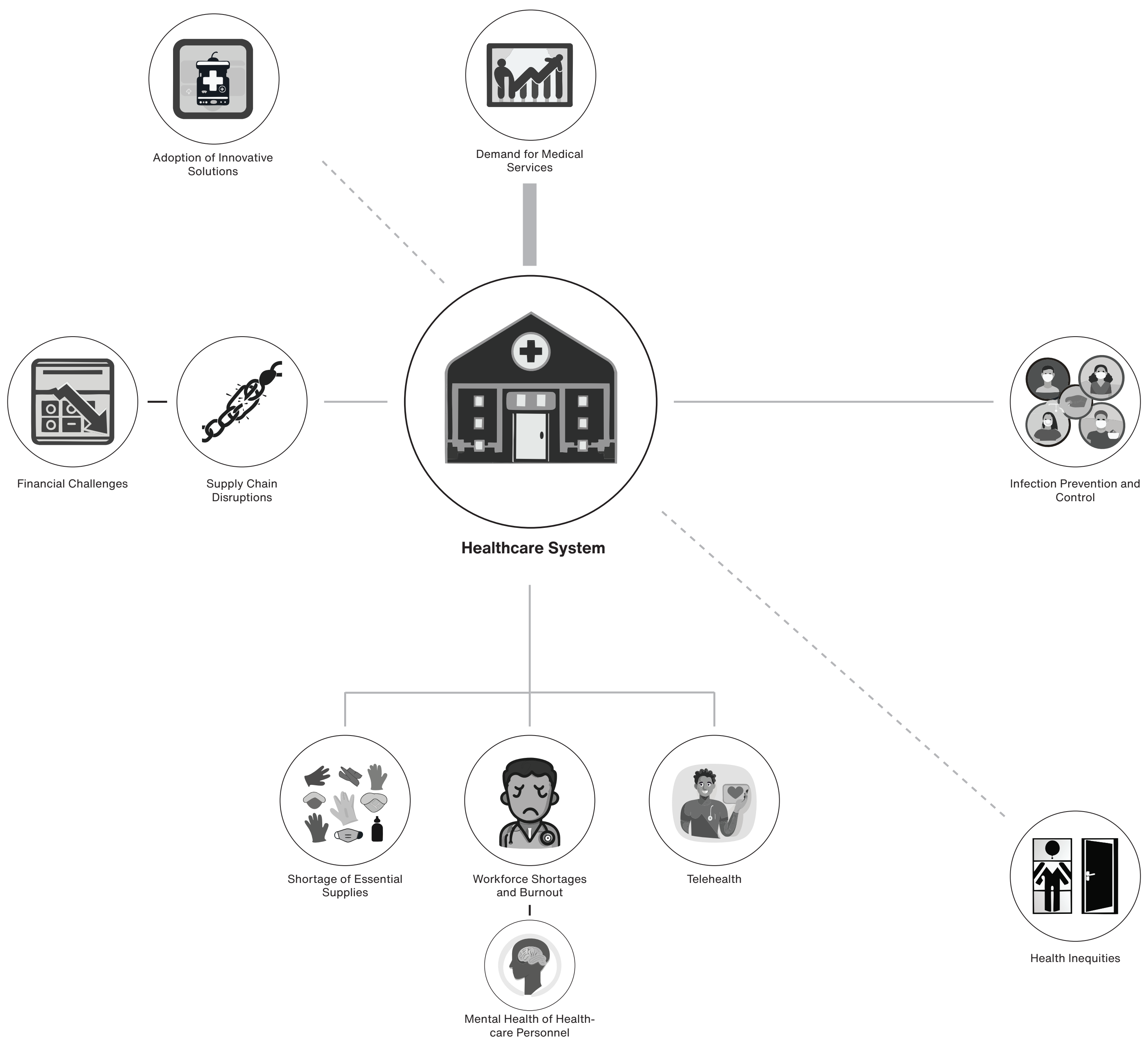
D. IMPACT OF PANDEMIC ON HEALTHCARE CENTERS

The enormous demand for medical services has been one of the pandemic's most severe effects on healthcare facilities. The increase in COVID-19 instances has resulted in a significant rise in the number of people seeking medical care. In the United States, for instance, hospitals witnessed a rise in demand for critical care services, with certain areas' healthcare systems reaching capacity. As a consequence, healthcare facilities have had to alter their operations swiftly to match patients' demands. They have had to enlarge their capacity, add more ICU beds, and repurpose other hospital sections to meet the inflow of patients.[1] In addition, the pandemic has impacted the supply networks of medical facilities. There were severe shortages of personal protective equipment (PPE), testing supplies, and other vital medical equipment at several hospitals and clinics.[2] The worldwide demand for PPE combined with supply chain disruptions resulted in shortages of essential supplies, making it impossible for healthcare facilities to meet the increased demand. These disturbances to the supply chain also affected the availability of pharmaceuticals, resulting in shortages of several vital treatments.

As a consequence, healthcare facilities have had to depend on innovative solutions, such as 3D printing and equipment repurposing, to retain a sufficient supply of essential resources[3] Workforce shortages have been another major consequence of the epidemic for healthcare facilities. Workers in the healthcare industry have been in the vanguard of the battle against COVID-19, working long hours in high-stress conditions. Several healthcare professionals have contracted the virus, and others have been quarantined owing to exposure, resulting in personnel shortages.[4] In addition, many healthcare professionals have suffered burnout and exhaustion, which has led to high turnover rates and exacerbated the labor deficit. In order to solve these problems, healthcare organizations have had to employ novel staffing options, such as recruiting temporary personnel, redeploying workers from other regions, and using telehealth technology to assist remote care. [5]Moreover, supply chains, and labor shortages, the pandemic has had a substantial influence on the financial viability of healthcare facilities. Several hospitals and clinics experienced considerable financial losses as a result of the cancellation of elective treatments, which are generally a major source of money for healthcare facilities.[5]

In addition, healthcare facilities suffered higher charges for PPE, testing, and other pandemic-related costs, significantly straining their budgets.[6] This financial hardship has compelled some healthcare facilities to furlough or lay off employees, reduce compensation, or even close their doors, therefore worsening personnel shortages and access to treatment. In addition, the pandemic has emphasized existing inequities in healthcare access and outcomes, since vulnerable communities, such as minorities and those with lower socioeconomic status, have been disproportionately impacted by COVID-19. These groups often experience obstacles in obtaining healthcare services and may have inadequate financial means to handle the cost of COVID-19 therapy.[7]

1. JAMA Network. (2020). The COVID-19 Pandemic and the Incidence of Acute Myocardial Infarction. JAMA Network Open, 3(7), e2015610
2. Centers for Disease Control and Prevention. (2021). Strategies to Optimize the Supply of PPE and Equipment
3. Food and Drug Administration. (2020). 3D Printing of Medical Devices, Accessories, Components, and Parts During the COVID-19 Pandemic
4. The Lancet. (2020). COVID-19: protecting health-care workers. The Lancet, 395(10228), 922
5. American Hospital Association. (2021). COVID-19 Financial Impact on Hospitals and Health Systems: 2021 Update
6. American Medical Association. (2021). COVID-19: Physician Practice Financial Relief
7. Centers for Disease Control and Prevention. (2021). COVID-19 Racial and Ethnic Health Disparities



To overcome these gaps, healthcare institutions have had to modify their operations, such as by improving access to telemedicine and establishing community-based testing and immunization clinics. Lastly, the epidemic has expedited the introduction of new technology and novel care delivery systems. Healthcare facilities were required to swiftly adopt telehealth and other digital health technologies to reduce patient interaction and facilitate remote care delivery. In addition, the pandemic has strengthened cooperation between healthcare facilities, public health agencies, and research institutes, resulting in the fast development of novel treatments and vaccinations.

Throughout the pandemic, healthcare institutions have encountered unprecedented obstacles, including an increase in demand for medical services, interruptions in the supply chain, labor shortages, financial hardship, and an escalation of health inequities. Nonetheless, despite these obstacles, healthcare institutions have shown resilience and adaptation by innovating and partnering to guarantee that patients get high-quality treatment amid this global health catastrophe.

The pandemic has also emphasized the necessity for healthcare institutions to focus infection prevention and control methods. As a result of the COVID-19 pandemic, healthcare facilities have developed stringent infection prevention and control policies to decrease the possibility of viral transmission between patients and employees. These standards include hand hygiene, mask use, physical separation, and increased cleaning and disinfection of surfaces and equipment.[8]

The pandemic has also brought to light the need of tackling persistent infection control issues, such as antibiotic resistance, which have important consequences for patient outcomes and healthcare resource consumption. In addition, the epidemic has altered patient behavior and preferences, with patients increasingly seeking treatment outside of conventional healthcare facilities. The pandemic has spurred the implementation of telehealth and other digital health technologies, allowing patients to get treatment remotely and lowering the risk of exposure to the virus. [9]

Additionally, the epidemic has emphasized the necessity for patient-centered care approaches that prioritize patient preferences and values, while still guaranteeing patient safety. Lastly, the pandemic has also had a profound influence on the mental health of healthcare personnel. The stress and worry associated with caring for COVID-19 patients, together with the danger of exposure to the virus, have impacted the mental health and well-being of healthcare personnel.[10] Healthcare facilities have had to emphasize the mental health and well-being of their employees by offering counseling services, peer support, and training in stress management.

In conclusion, the COVID-19 pandemic has had widespread effects on healthcare facilities. From infection prevention and control methods to changes in patient behavior and preferences, and the influence on the mental health of healthcare staff, the pandemic has emphasized the need for healthcare institutions to be adaptive, inventive, and prioritize patient safety and well-being.

8. World Health Organization. (2020). Infection Prevention and Control during Health Care when COVID-19 is Suspected
9. Mehrotra, A., Ray, K., Brockmeyer, D. M., & Barnett, M. L. (2020). Rapidly converting to "virtual practices": Outpatient care in the era of Covid-19. NEJM Catalyst, 1(3), 1-5.
10. Pappa, S., Ntella, V., Giannakas, T., Giannakoulis, V. G., Papoutsi, E., & Katsaounou, P. (2020). Prevalence of depression, anxiety, and insomnia among healthcare workers during the COVID-19 pandemic: A systematic review and meta-analysis. Brain, Behavior, and Immunity, 88, 901-907

E. PREVENTIVE ARCHITECTURE

The objective of preventive architecture is to create constructed environments that decrease or mitigate the risk of damage to people and the environment. This strategy takes into account possible environmental dangers and threats, and aims to integrate elements that might avoid or mitigate their effects. Utilizing a variety of techniques and strategies, preventive architecture includes the use of resilient building materials, the incorporation of passive or active environmental systems, the incorporation of security measures, and the design of spaces that encourage social distance and healthy behaviors.Designing structures that can resist natural calamities is one example of preventative architecture. In regions prone to earthquakes, buildings may be built with reinforced structures, while in regions prone to floods, buildings can be raised or constructed from water-resistant materials. In addition, preventative design may include passive or active environmental solutions, like as green roofs or solar panels, which may minimize energy consumption and promote sustainability.[1]

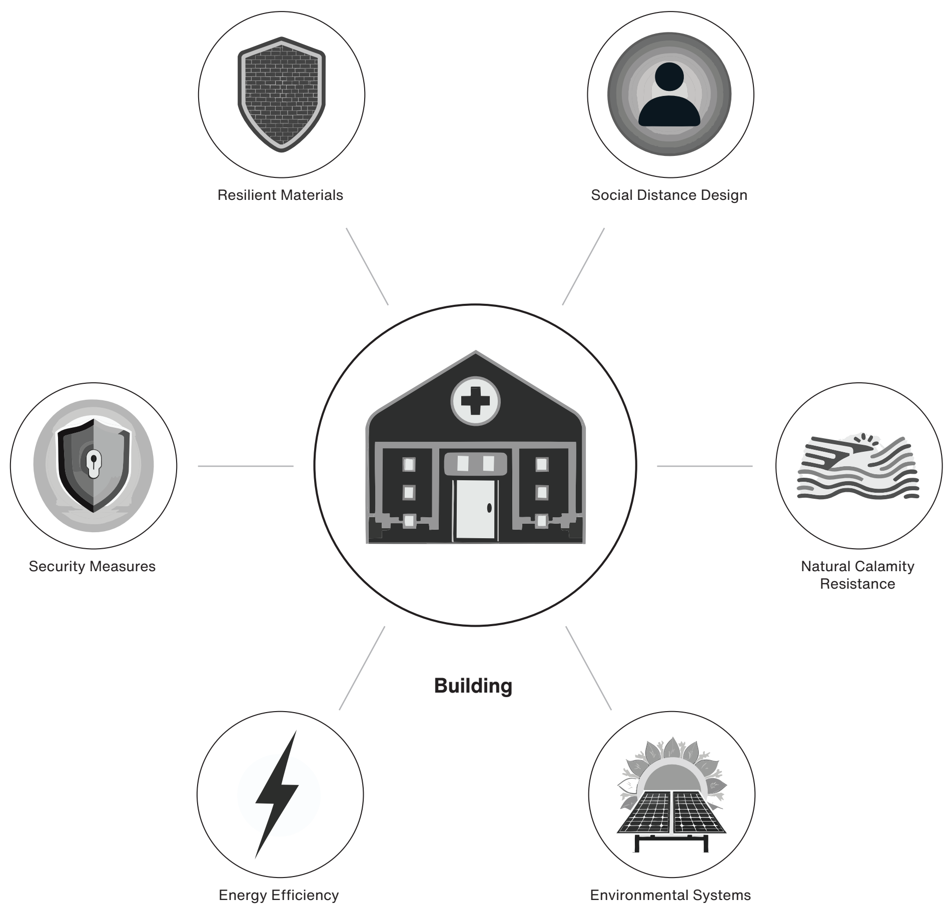
The use of preventive architecture may vary from individual structures to For instance, preventative architecture may entail the use of fire-resistant materials, emergency lighting, and redundant mechanical systems in the design of individual buildings to guarantee that residents can escape safely in the case of a fire or other disaster. At the urban scale, preventative architecture may include green infrastructure, such as green roofs and rain gardens, to minimize the danger of floods and enhance water quality. It may also entail the creation of public places that encourage social separation and healthful activities, such as the utilization of outdoor sitting areas, the introduction of bike lanes, and pedestrian-friendly roadways.

Climate change, which is anticipated to increase the frequency and severity of severe weather events such as floods, heatwaves, and hurricanes, may also be mitigated via preventive architecture. By adopting elements such as green roofs, solar panels, and passive heating and cooling systems in buildings can significantly reduce energy use and greenhouse gas emissions. Additionally, these features enhance the building's resilience against climate-related threats.[2] In healthcare facilities, which play a crucial role in reacting to public health emergencies such as pandemics, is an additional emphasis of preventative architecture. The COVID-19 pandemic has emphasized the necessity for healthcare facilities that can handle patient influxes, encourage social separation, and avoid the transmission of infectious illnesses.

Preventative architecture may address these issues by including negative-pressure isolation rooms, better air filtration systems, and adaptable floor plans into the design of healthcare buildings. Preventative architecture is a multidisciplinary area requiring the participation of architects, engineers, urban planners, and public health professionals. By prioritizing safety, health, and sustainability in the design of built environments, preventive architecture may improve resilience and preparation in the face of a variety of risks and threats.

1. Lin, B. (2018). Preventive Architecture: An Overview. The Plan Journal, 3(2), 37-48.

2. Gifford, R. (2020). Preventive architecture: A growing field. Journal of Architectural Education, 74(3), 321-330.



F. ARCHITECTURE & TRANSFORMATION

Cambridge dictionary explains the meaning of Transformation as "a complete change in the appearance or character of something or someone, especially so that that thing or person is improved." Therefore it can be understood that In architecture, transformation refers to the act of changing or remodeling old buildings or structures to better accommodate modern demands and purposes. According to renowned architectural critic Charles Jencks, transformation is the newest term in architecture. It refers to the many ways architects are adapting ancient structures into new uses, recycling old materials, and reinterpreting old styles.[1] Since retrofitting existing buildings with sustainable elements such as energy-efficient systems and green roofs may lessen the environmental effect of construction and cut carbon emissions, environmental concerns often motivate architectural change. Moreover, economic factors, such as the cost of constructing new buildings vs restoring old structures, may be a motivating element in architectural change.

There are quite a few terminologies associated with transformation, adaptive reuse, regeneration, retrofitting, restoration, reuse. Adaptive reuse refers to the technique of modifying an existing structure for a new use as opposed to dismantling and reconstructing it. Adaptive reuse is often employed to conserve historic structures or to convert buildings that have outlived their intended use. Regeneration refers to the revitalization of a community or urban region via the rehabilitation or construction of new buildings and infrastructure. Regeneration often incorporates a combination of commercial, residential, and public areas and may be motivated by economic, social, or environmental objectives.

Retrofitting refers to the process of modernizing an existing structure or infrastructure in order to enhance its performance or usefulness. This may entail the installation of new systems or technologies, such as energy-efficient lighting or heating, ventilation, and air conditioning (HVAC) systems, or the reinforcing of structural parts to increase seismic or wind resistance. Restoration is the process of restoring a building or structure to its previous state, often utilizing the original materials and methods. Historically significant structures or landmarks that are in risk of deterioration or destruction are generally candidates for restoration.

1. Jencks, C. (2005). The Iconic Building: The Power of Enigma. Frances Lincoln Limited.

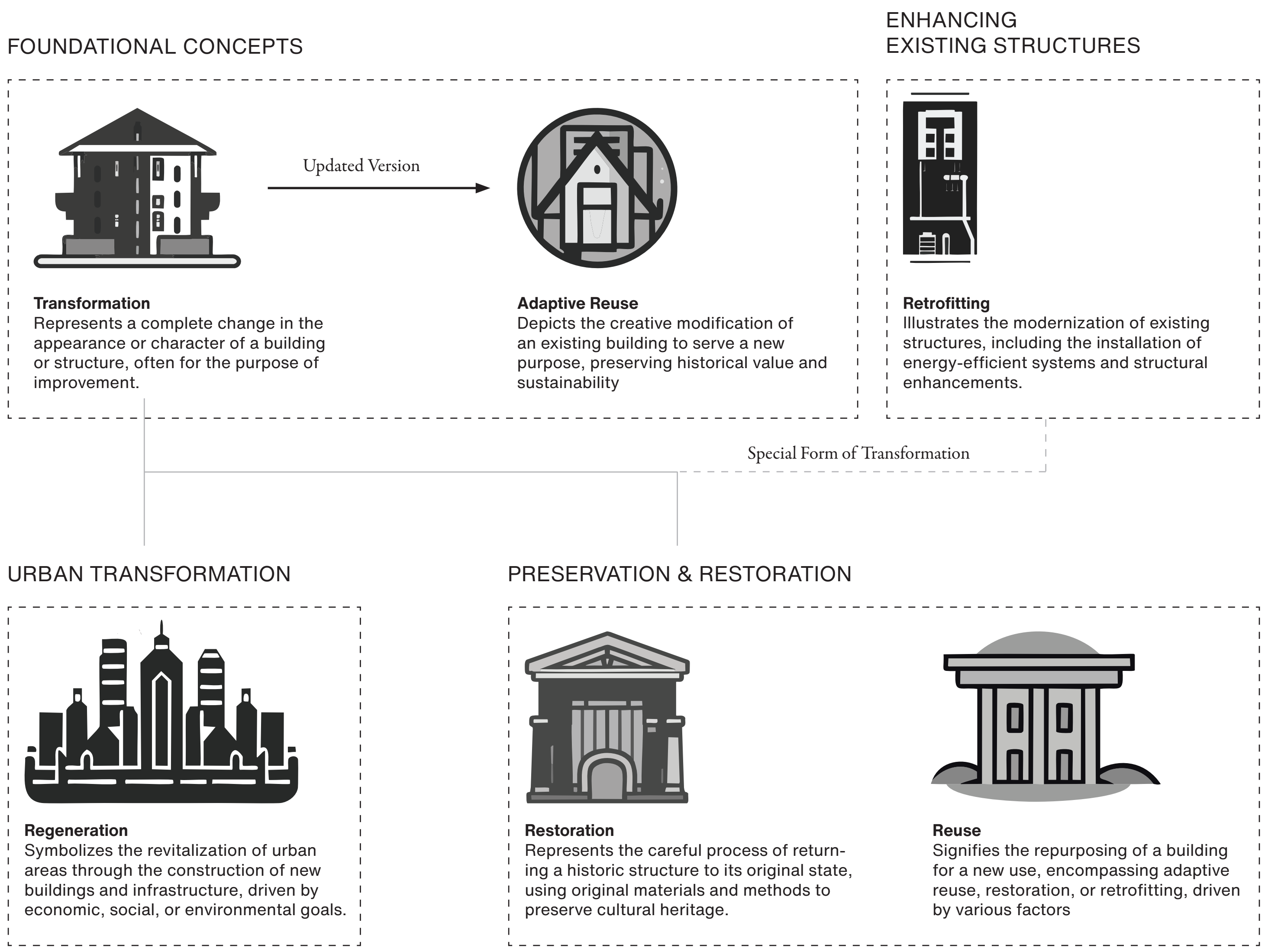
Reuse is a general phrase describing the repurposing of a building or structure for a new use. Reuse might entail adaptive reuse, restoration, or retrofitting and can be motivated by economic, social, or environmental factors. These phrases all relate in some manner to the concept of altering the built environment, whether via adaptation, regeneration, retrofitting, restoration, or reuse.[2] Generally, transofrmation promotes sutainibility in a number of ways. Architects may assist decrease waste by recycling resources and limiting the demand for new construction via the adaptation and reuse of existing structures. Retrofitting old buildings with energy-efficient components such as insulation, high-efficiency heating and cooling systems, and intelligent building management systems may help decrease energy consumption and greenhouse gas emissions.

The use of sustainable materials, such as recycled content, FSC-certified timber, and low-VOC paints and finishes, may lessen the environmental effect of building construction and maintenance. Restoration and adaptive reuse of old buildings may contribute to the preservation of cultural heritage and provide a feeling of place and community identity. Regeneration of urban areas with mixed-use development and enhanced public transit may boost walkability and decrease dependency on automobiles, therefore reducing carbon emissions and improving air quality. Creating buildings and public places that stimulate physical activity, such as bike lanes, outdoor exercise areas, and walking trails, may assist to promote healthy lifestyles and decrease the prevalence of chronic illnesses.

The Tate Modern museum in London is a great example of adaptive reuse. The structure was formerly a power plant, but Swiss architects Herzog and de Meuron turned it into a contemporary art museum in 2000. The transformation included the addition of additional gallery spaces, the installation of elevators and escalators, and the maintenance of the building's characteristic industrial design.

2. Hathaway, J. (2021). Architectural Transformation: Tips and Tools for Adaptive Reuse, Regeneration, and Retrofitting. Routledge.

3. Dixon, T., & Batty, W. (2019). Transforming architecture for a sustainable future. Routledge



G. AIRBORNE TRANSMITTABLE DISEASES

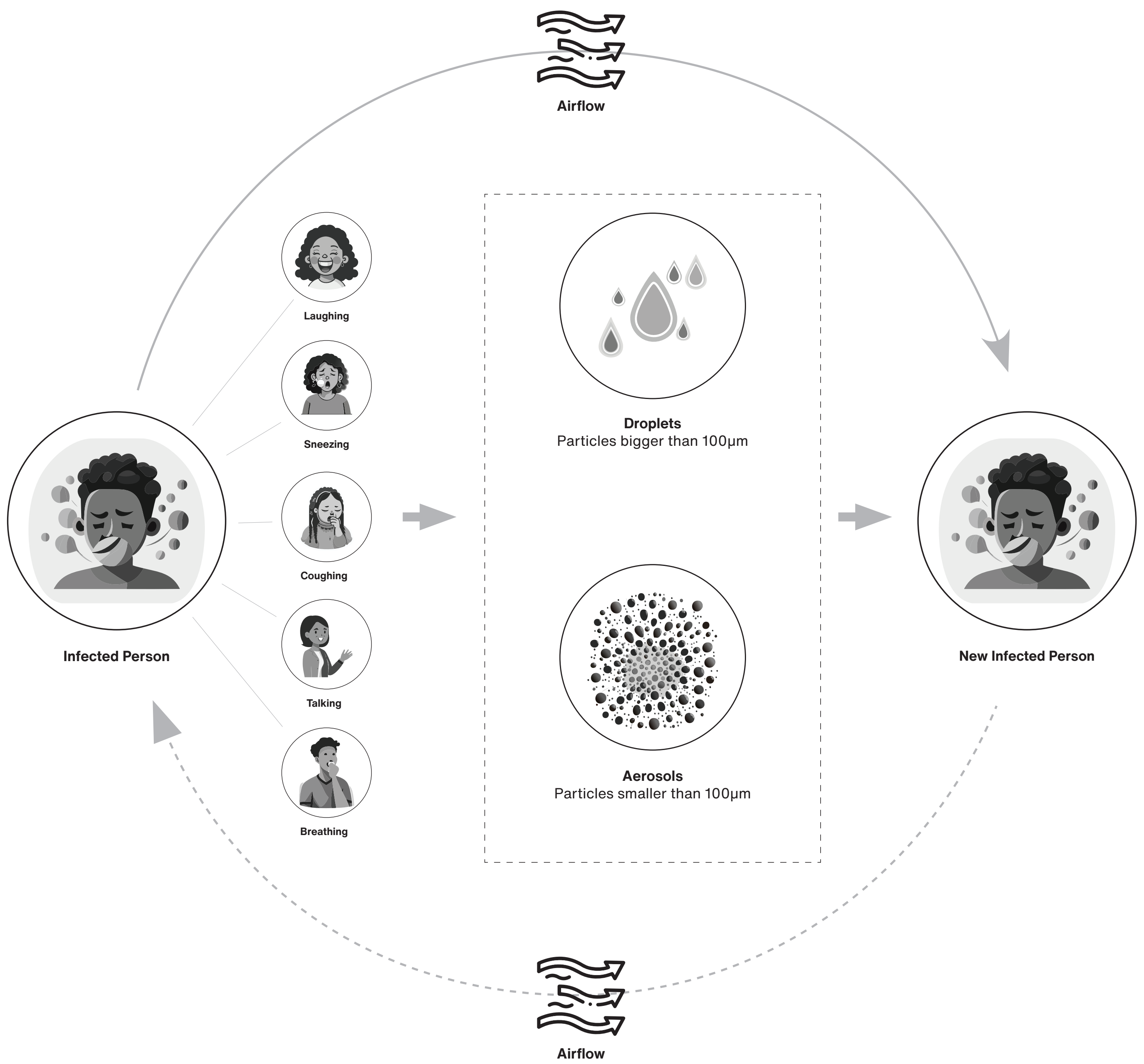
By Definition, airborne transmittable diseases are diseases which are caused by microbes that can be expelled from an infected person through coughing, sneezing, laughing, or close physical contact. While in the air, the microorganisms adhere to the dust particles, respiratory droplets, or water droplets. Some examples of airborne transmittable diseases include chickenpox, COVID-19, diphtheria, hantavirus pulmonary syndrome, influenza, legionellosis, measles, mumps, pertussis, rubella, SARS, tuberculosis, and varicella-zoster virus.[1]

The air transmission of disease-causing particles results in respiratory tract infections, which are known as airborne diseases. These particles may be respiratory droplets or aerosols. Respiratory droplets include large droplets (more than 100 micrometers) that the infectious people breathe out when they cough or sneeze. The droplets drop fast on the ground and seldom move beyond several feet away. Nevertheless, when you breathe in a respiratory droplet contaminated with an infectious particle, you may get infected. Aerosols are the small particles (less than 100

1. Maine Center for Disease Control and Prevention. (2023, November 12). Airborne and direct contact diseases. Retrieved from https://www.maine.gov/dhhs/mecdc/infectious-disease/epi/airborne/index.shtml

micrometers in size) created by the coughing, sneezing, talking or even breathing of the infected people. They can be suspended in the air for several hours or even a few days. The particles can also cover large distances. Therefore, aerosol is more effective in transporting airborne diseases compared to respiratory droplets. Airborne diseases can spread in any physical space where people exist, but they occur significantly in crowded indoor spaces, for example in schools, offices, hospitals, and public transportation centers. The air-borne infectious particles have an opportunity to circulate around and reach more people easily in crowded spaces.[2]

2. Wells, W. F. (1955). Airborne contagion and air hygiene: An ecological study of droplet infections. Harvard University Press

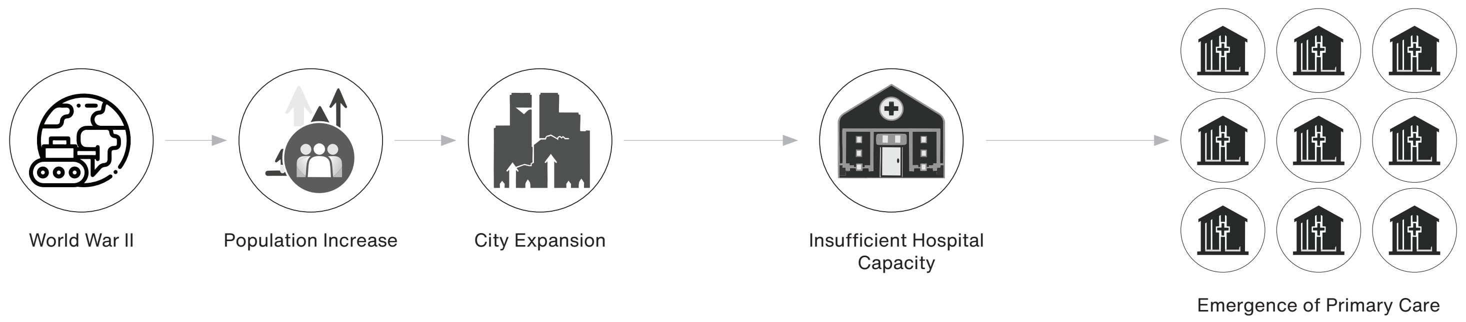


H. SWEDISH PRIMARY CARE

The first modern primary healthcare center in Sweden was established in Dalby in Scania, in 1963. After the rapid growth of population after World War II, there were the snaking of queues at the hospitals and at the clinics which made Healthcare less accessible. The National Board of Health and Welfare produced a “Principle program for open care” with guidelines for a strong investment in primary care outside hospitals. As an affordable and readily accessible hospital center, the Dalby centrein the beginning was only staffed with General Practitioners [1]. Success of the Dalby center and the official recognition of the primary care centers in 1978 made other centers to be developed in Sweden. By the 1990s, these primary care centers transformed to include secondary services of dental care, physical therapy, and social services. Sweden’s health care is provided by over 2,000 healthcare centers that serve as a first port of call for patients today. Traditionally, Sweden focused on inpatient hospital care and specialized services. However, these recent challenges like COVID-19 pandemic and demographical shifts led to a strategic shift toward strengthening of primary care. The change towards more equitable outcomes is meant to ensure better access to health services by focusing on primary healthcare rather than hospital-based approach [2].

1. Den Svenska Allmänmedicinens Historia (2006), https://shorturl.at/hkQ56

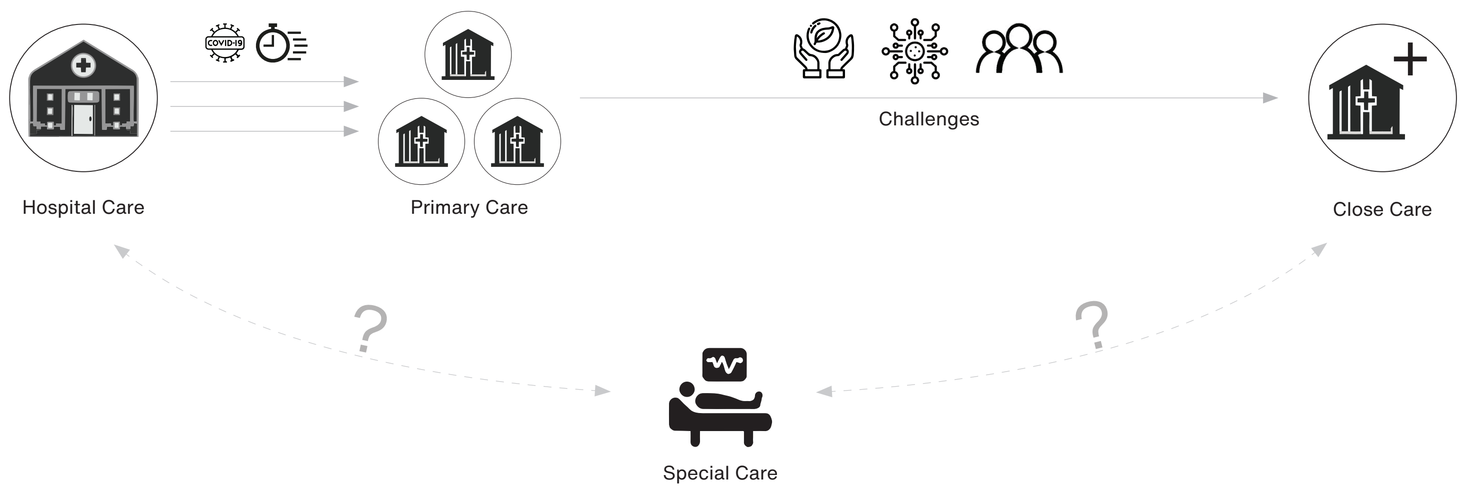
2. National Board of Health and Welfare. (2023). Primary Care in Sweden. Retrieved November 21, 2023, from https://www.socialstyrelsen.se/en/about-us/healthcare-for-visitors-to-sweden/about-the-swedish-healthcare-system/: https://www.socialstyrelsen.se/en/about-us/healthcare-for-visitors-to-sweden/about-the-swedish-healthcare-system



I. CURRENT SITUATION, CHALLENGES AND FUTURE

Currently, there is a growing discussion about shifting the focus of the Swedish healthcare system from hospitals to primary care centers. This shift has gained momentum, particularly in light of the COVID-19 pandemic. The current challenge in primary care revolves around how the future of these centers will manifest in architectural design and how digitalization will impact them. Additionally, sustainability requirements, staffing challenges, and efficiency concerns have elevated this issue for healthcare operators and planners. Furthermore, the relationship between hospitals, specialized care, and primary care centers remains unclear to planners, and the specific functions required are still under discussion. Although the concept of “close care” for the future of primary care centers has not yet reached a definitive conclusion, current indications suggest that a majority of specialist and inpatient care will increasingly be provided by primary care centers, positioning them as the central core of the Swedish healthcare system [1].

1. Konceptprogram - Primaervård 220520. Retrieved November 21, 2023, from https://ptsforum.se/media/3522/konceptprogram-primaervaard-220520.pdf

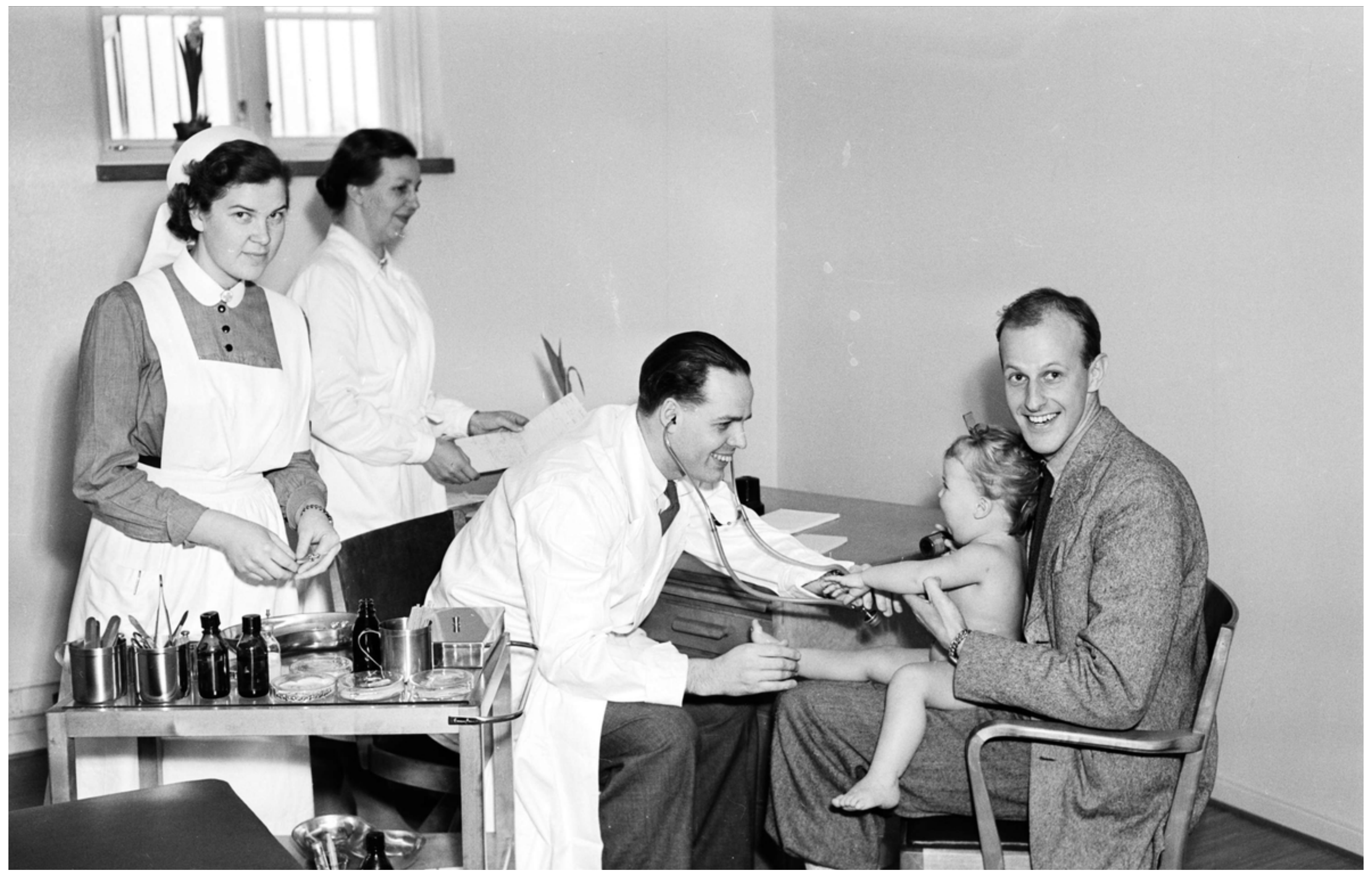


J. DESIGN CONCEPTS & REQUIREMENTS

In the context of the new concept program developed for PTS (Program för teknisk standard), the Swedish model for healthcare center design places a strong emphasis on the physical environment as a multifaceted tool. Its role extends beyond mere aesthetics, as it is expected to serve as a means for providing care, ensuring safety, and enhancing the well-being of both patients and staff.

This holistic approach envisions the physical environment as a framework for various healthcare activities. Notably, it aims to support and attract healthcare professionals, recognizing the importance of an appealing workplace to attract new staff members. Additionally, the perspective of children has gained significance, as the Convention on the Rights of the Child was enacted into law in 2020. Consequently, there is an expectation that common spaces and primary care center designs will be appealing to children, influencing their perception of healthcare and the importance of good health. The concept of “close care” is another pivotal aspect expected from

1. Konceptprogram - Primaervård 220520. Retrieved November 21, 2023, from https://ptsforum.se/media/3522/konceptprogram-primaervaard-220520.pdf



2. Uppsala Bild, Upplandsmuseet, 1954, New Children healthcare center in Uppsala, https://digitaltmuseum.se/011014013469/ny-fin-barnavardscentral-for-valskotta-upsalabarn-uppsala-1954

these new healthcare centers. Close care represents a paradigm shift in healthcare delivery, encompassing patient self-care and emphasizing primary care as a central component. It goes beyond traditional healthcare by providing personalized and continuous care, including at-home services and specialized care when needed.

To address the challenge of underutilized healthcare centers, there is a growing expectation that these facilities should have the potential for co-use. This involves interactions with various training facilities or collaborations with businesses, with a particular emphasis on the inclusion of general-purpose rooms, which are highly valued. In terms of safety and functionality, Swedish healthcare centers are increasingly adopting a zoning approach. This entails dividing the healthcare premises into distinct zones, each designated for specific functions. These zones are separated by controlled passage systems to regulate patient and staff flows, enhance working conditions, improve safety, and maintain high hygiene standards. Hygiene is a significant consideration, emphasizing the separation of examination areas from administrative spaces to facilitate thorough cleaning and protect against potential contamination.

Given the rise in outpatient visits and advanced medical procedures, preventing the spread of infections has become a paramount concern. Healthcare facilities are adapting by providing larger waiting and treatment areas, separate entrances for potentially infected individuals, and private toilet facilities for cases of suspected infection. Ventilation choices are also influenced by the specific functions within the healthcare center. The concept of “digiphysical care” has gained prominence, especially in light of the COVID-19 pandemic. This approach emphasizes the integration of digital and physical elements in healthcare provision, enabling patient triage through digital platforms or telephone consultations. It aims to reduce the need for physical visits while maintaining essential patient contact.

Furthermore, healthcare facilities are exploring the potential for remote collaboration through video meetings, allowing healthcare providers from different levels of care to work closely with health centers. Team-based healthcare is on the rise, emphasizing the need for facilities that facilitate multidisciplinary teamwork and group meetings. Finally, activity-based flexible offices are being adopted in healthcare administrative workplaces. Rather than fixed workstations, these offices offer flexibility, allowing staff to choose workspaces based on their specific needs and activities, ultimately enhancing health, job satisfaction, and the working environment [1].

K. TYPOLOGY

In Sweden, primary care centers lack a unified architectural style, contrasting with residential buildings which generally share common design elements. Healthcare centers vary in design based on their size, location, and the specific needs of their area, making it hard to identify a standard typology for these buildings. However, certain design forms are more commonly used, often incorporating a mix of these elements as a foundational design approach. These designs typically revolve around the corridor layout of the building, with most primary care centers featuring either a single corridor or a double corridor system. The double corridor design is more popular due to its advantages, but hybrid and mixed systems are also found.

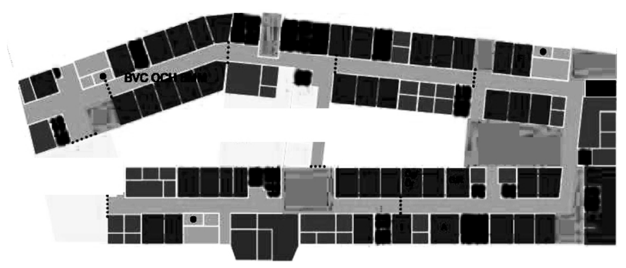
Single Corridor System:

Pros: The single corridor system is highly valued for its straightforward and efficient layout. This design facilitates proper natural ventilation and daylight in the rooms, which is beneficial not only for patients but also for the staff at nurse stations. These aspects contribute significantly to creating a comfortable and healthy environment within the healthcare facility. Additionally, the single corridor layout often results in optimal building orientation, enhancing privacy for patients and staff alike. This system is particularly advantageous in urban areas where space is at a premium, as it is space-efficient and can fit into tighter spaces more effectively than more complex designs. Another significant benefit is the reduced construction and maintenance costs. The simplicity of the single corridor design eliminates the need for complex structural elements, making it more cost-effective to build and maintain.

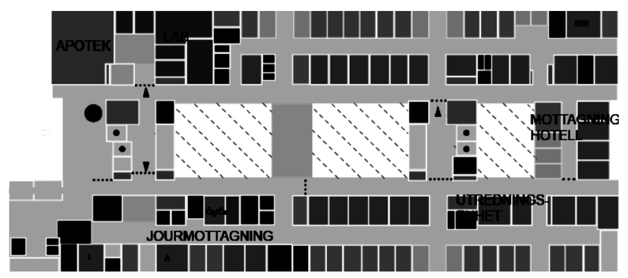
Cons: Despite its advantages, the single corridor system has notable limitations, particularly in terms of flexibility and adaptability. The linear flow inherent in this design restricts the potential for expanding or reconfiguring spaces, which can be a significant drawback as healthcare needs evolve. This limitation makes it challenging to accommodate high volumes of patients or to integrate diverse medical specialties within the same facility. Furthermore, from an infection control perspective, the single corridor design is less effective compared to more segmented layouts. The increased potential for contact between patients and staff in this linear arrangement can elevate the risk of infection spread, a critical consideration in healthcare settings. This aspect becomes particularly significant during times of heightened health risks, such as during pandemics or flu seasons.

1. Vårdcentralen i Vällingby - En historik" (2013) by Vällingby vårdcentral

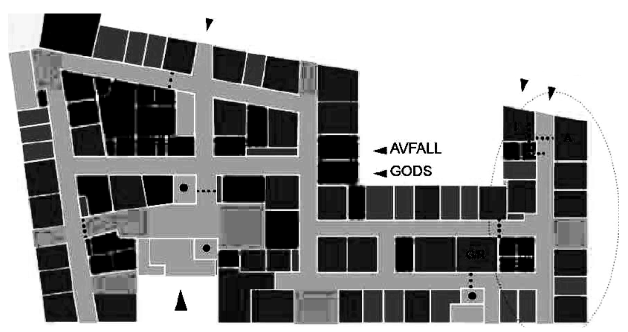
2. National Board of Health and Welfare. (2023). Primary Care in Sweden. Retrieved November 21, 2023, from https://www.socialstyrelsen.se/en/about-us/healthcare-for-visitors-to-sweden/about-the-swedish-healthcare-system/: https://www.socialstyrelsen.se/en/about-us/healthcare-for-visitors-to-sweden/about-the-swedish-healthcare-system/



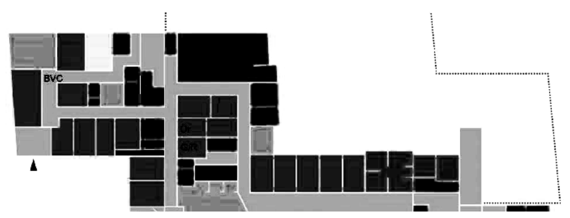
Single Corridor
Lindesberg's Vårdcentral



Double Corridor
Finspång's Vårdcentral

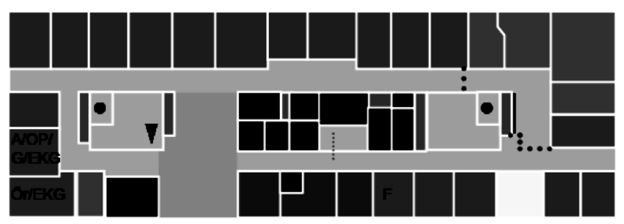


Double Corridor
Emmaboda Vårdcentral



Double Corridor
Råslätts Vårdcentral

Hybrid
Capio Vårdcentral



Double Corridor
Bredängs Vårdcentral

Dobule Corridor Design:

Pros: The double corridor system is favored for its enhanced functionality and flexibility in layout design. This system features two parallel corridors, allowing for a more efficient flow of movement and better separation of different zones within the healthcare facility. This separation can lead to improved privacy and reduced noise levels, as patient areas can be isolated from busier, operational parts of the center. One of the significant advantages of the double corridor system is its adaptability. The design can easily accommodate changes in the facility's needs, such as expanding certain departments or adding new medical specialties. This flexibility is particularly useful in adapting to evolving healthcare demands and technologies.

The double corridor layout also offers better opportunities for infection control. With more space and separate pathways, the risk of cross-contamination between patients and staff can be significantly reduced. This aspect is crucial in healthcare settings, especially during times of increased health risks like pandemics. In terms of space utilization, the double corridor system can be more demanding compared to the single corridor design. It requires more area for the additional corridor, which might not be feasible in tightly packed urban settings. The construction and maintenance costs can be higher due to the more complex layout and the need for additional structural elements.

Cons: One of the primary limitations of the double corridor system is its demand for more space. This requirement can be particularly challenging in urban settings where space is limited. This layout requires the construction of an additional corridor, translating into a larger footprint for the building. Along with increased space requirements, the double corridor system also incurs higher costs. Both the initial construction and ongoing maintenance expenses are generally greater compared to simpler designs like the single corridor system. This is due to the complexity of the layout, which requires additional materials and structural elements. The complexity of the double corridor design extends beyond construction costs. It poses challenges in terms of design and construction, often necessitating more time and specialized expertise. This complexity can also impact the end users - patients and visitors may find navigating a double corridor facility more confusing, especially if they have mobility or cognitive challenges. The layout, while efficient in some aspects, can be less intuitive compared to the straightforward nature of a single corridor system.

The larger size of facilities with double corridors can lead to higher energy consumption. This is due to the increased need for heating, cooling, and lighting larger spaces, which can affect the building's overall energy efficiency. From an environmental standpoint, the larger footprint of these facilities can have a more significant impact, potentially clashing with local urban planning and environmental goals. In healthcare facilities with lower patient volumes, the additional space provided by a double corridor system might not be fully utilized. This underutilization can lead to inefficiencies, where resources are expended on maintaining spaces that are not needed. This aspect is particularly important to consider in smaller healthcare centers where patient flow might not justify the extra space and complexity of a double corridor layout.

Hybrid Corridor Design:

Pros: The hybrid corridor system, which combines elements of both single and double corridor designs, offers a versatile and adaptable approach to healthcare facility layout. This system capitalizes on the strengths of both designs, allowing for greater flexibility in accommodating varying patient volumes and medical specialties. The hybrid layout can be customized to suit the specific needs of a healthcare center, making it an ideal choice for facilities that experience fluctuating patient numbers or require the integration of diverse medical services.

One of the key advantages of the hybrid system is its potential for efficient space utilization. By selectively incorporating aspects of both single and double corridor layouts, it can offer efficient patient flow and effective separation of different functional areas within the facility. This separation can enhance privacy and reduce noise, improving the overall patient and staff experience. Another benefit of the hybrid system is its adaptability. As healthcare needs and technologies evolve, this system can be more easily modified or expanded compared to a strictly single or double corridor layout. This flexibility is particularly valuable in rapidly changing healthcare environments.

Cons: However, the hybrid corridor system does come with its own set of challenges. The complexity of integrating different layout elements can lead to increased design and construction challenges. This complexity may require specialized architectural expertise and can result in higher initial construction costs. Navigational clarity can also be a concern in hybrid systems. The mixture of different corridor styles might confuse patients and visitors, especially in larger facilities where clear signage and guidance are crucial. Moreover, while the hybrid system aims to offer the best of both worlds, it may not fully achieve the efficiency of a double corridor system or the simplicity of a single corridor system. This could result in compromises in certain aspects of the design, such as space efficiency or infection control effectiveness.

The choice between single corridor, double corridor, and hybrid corridor systems in healthcare facilities is a complex decision that hinges on various factors including space efficiency, cost, flexibility, and patient experience.

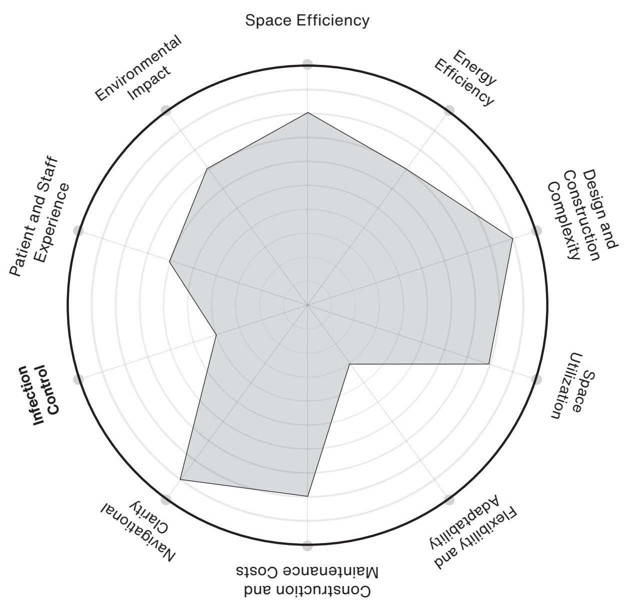
The single corridor system scores highly in terms of space efficiency, navigational clarity, and construction costs, making it an attractive option for urban areas with limited space and for healthcare facilities with tight budgets. However, its rigidity in design limits its adaptability and flexibility, making it less suitable for evolving healthcare needs. Additionally, its linear layout poses challenges in infection control, a critical consideration in healthcare settings. In contrast, the double corridor system excels in flexibility, patient and staff experience, and infection control, offering distinct pathways and zones that enhance privacy and reduce cross-contamination risks. However, this system requires more space and incurs higher costs, both in construction and maintenance, making it a less feasible option in densely populated urban areas. The complexity of its design also impacts navigational clarity and energy efficiency.

The hybrid corridor system emerges as a middle ground, combining the strengths of both single and double corridor designs. It offers adaptability and customization, allowing for efficient space utilization and potentially improving patient and staff experience. However, this system can be complex in design and construction, and it may not fully achieve the efficiencies or simplicities of the single or double corridor systems. Ultimately, the choice of corridor system should be guided by the specific needs and constraints of the healthcare facility, considering patient volume, medical specialties, urban context, and budgetary constraints. Each system has its unique advantages and drawbacks, and the best choice varies depending on the individual scenario.

Single Corridor

+ Efficient and straightforward layout.
+ Good natural ventilation and daylight.
+ Enhances privacy.
+ Space-efficient, suitable for urban areas.
+ Reduced construction and maintenance costs.

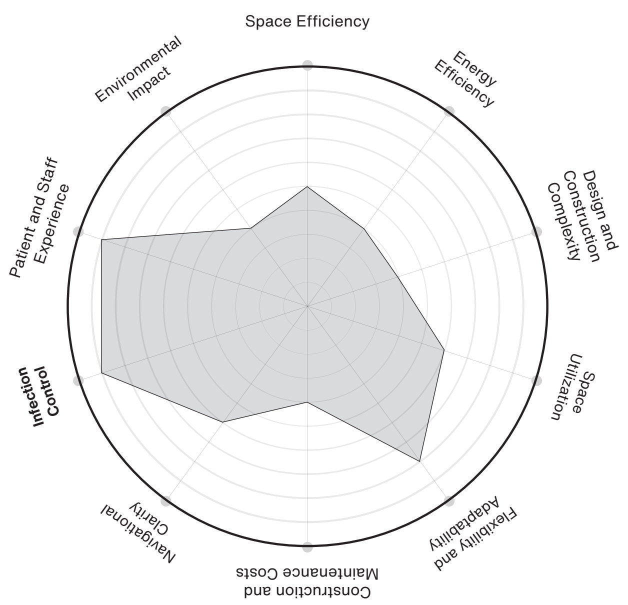
- Limited flexibility and adaptability.
- Challenges in expanding or reconfiguring spaces.
- Less effective in infection control.
- Higher risk of infection spread in linear arrangements.



Double Corridor

+ Enhanced functionality and flexibility.
+ Efficient movement flow and better zone separation.
+ Improved privacy and reduced noise levels.
+ Easily adaptable to changes and evolving healthcare demands.
+ Better opportunities for infection control.

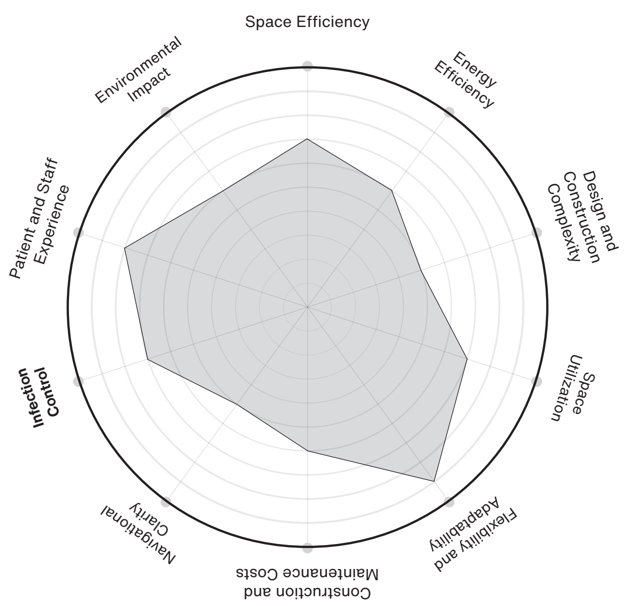
- Requires more space, challenging in urban settings.
- Higher construction and maintenance costs.
- Design and construction complexity.
- Potential navigational difficulties for patients and visitors.
- Higher energy consumption and environmental impact.
- Possible underutilization in facilities with lower patient volumes.



Hybrid Corridor

+ Combines strengths of single and double corridor designs.
+ Versatile and adaptable to varying patient volumes and services.
+ Efficient space utilization.
+ Customizable to specific healthcare center needs.

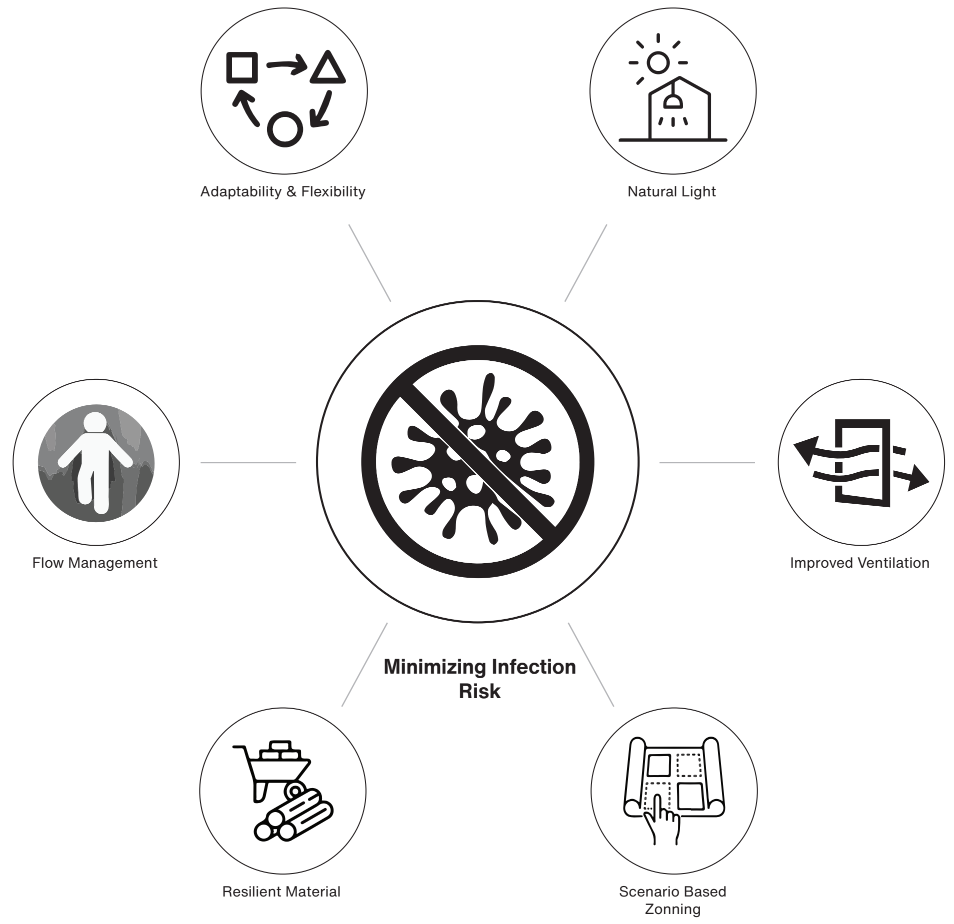
- Increased design and construction complexity.
- Higher initial construction costs.
- Potential navigational confusion.
- May not fully achieve the efficiency of a double corridor or the simplicity of a single corridor system.



L. DESIGN STRATEGIES FOR MINIMIZING INFECTION RISK

The recent worldwide health challenges highlight the importance of developing a universal approach to designing healthcare environments. These environments should not only be functional and appealing, but also inherently safe and focused on preventing infections. This part of the thesis conducts a detailed examination of design strategies, based on key insights from the influential book "Architectural Factors for Infection and Disease Control." It organizes these strategies into seven critical areas: Ventilation, Light, Patient flow and dynamics, Materials, Adaptability & Flexibility, Zoning & Layout, and integrating technology and monitoring systems. These categories together form a comprehensive model addressing the different aspects of infection spread in healthcare settings. Each category is vital in architectural planning. This framework not only meets current health safety standards but also anticipates future needs, making healthcare facilities more resilient, adaptable, and focused on the well-being of patients and healthcare professionals.

1. Bliss, A., & Kopec, D. (Eds.). (2023). Architectural factors for infection and disease control. Routledge



M. MATERIAL CHOICE

In the context of material selection, it is essential to acknowledge that thorough cleaning precedes effective disinfection. Consequently, designers need to integrate considerations of environmental cleaning and disinfecting into the material specification process. This critical insight ensures that the chosen materials not only contribute to the aesthetics and functionality of the indoor space but also align with the overarching goal of infection prevention.

The role of environmental surface materials in pathogen transmission is currently under intense scrutiny. Studies have examined various materials commonly used in community and healthcare settings, shedding light on how material composition impacts the survival of pathogens. For instance, the research found that MRSA, a resilient pathogen, exhibited survival times ranging from 4 hours to 3 days, depending on the tested material. In contrast, recoverable SARS-CoV-2 loads on 16 tested materials declined rapidly, with infectious particles detected on only four surfaces after 12 hours. This rapid reduction in SARS-CoV-2 loads underscores the importance of material choice in mitigating pathogen transmission [2] [3].

Textiles, serving diverse purposes such as providing texture, color, acoustic quality, and privacy in public and community environments, present a unique challenge in material selection. These textiles often lean towards synthetics like nylon, polyester, acrylic, microfiber, aramids, and thermoplastics. When specifying textiles, it is essential to consider not only their performance characteristics, such as abrasion and flame resistance, but also their suitability for decontamination using various disinfection solutions. Sustainability and human health criteria further complicate the textile selection process, necessitating a balanced approach that meets both functional and environmental goals. Textiles with anti-infection characteristics have become increasingly important in healthcare and public environments. Materials such as silver-infused fabrics, which utilize the broad-spectrum antimicrobial properties of silver ions, are commonly used in hospital linens and wound dressings [4]. Similarly, copper-infused fabrics exploit copper's natural antimicrobial properties and find applications in various healthcare textiles [5]. Additionally, natural fibers like bamboo and hemp offer inherent antibacterial properties, making them suitable for a range of uses from clothing to bed linens [6]. Moreover, bioactive textiles treated with agents

1. Maine Center for Disease Control and Prevention. (2023, November 12). Airborne and direct contact diseases. Retrieved from https://www.maine.gov/dhhs/mecdc/infectious-disease/epi/airborne/index.shtml
2. Ronca, S. E., Sturdivant, R. X., Barr, K. L., & Harris, D. (2021). SARS-CoV-2 Viability on 16 Common Indoor Surface Finish Materials. HERD, 14(3), 49–64. https://doi.org/10.1177/1937586721991535
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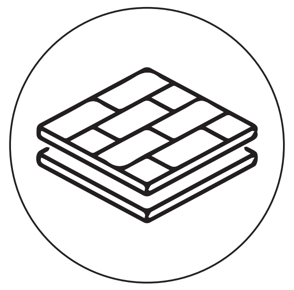
like chitosan, derived from crustacean shells, are gaining popularity in medical applications [7]. However, the effectiveness of these textiles can vary, and there is growing concern over the environmental impact of some synthetic antimicrobial agents, leading to increased regulation and a push for more sustainable alternatives [8]. Worksurface finish materials, including laminate, solid surface, stainless steel, quartz, and materials with cupric oxide, are pivotal in public spaces. Durability, impact resistance, and ease of cleaning and disinfection are paramount, as are measures to eliminate or minimize seams, grout, and gaps that could increase bioburden. While smoother surfaces may be easier to clean, research suggests that they tend to harbor heavier contamination levels, emphasizing the importance of texture in this context.

Surfaces and Finishes, flooring materials are crucial for healthcare facilities due to their high traffic and stringent cleaning requirements. Options like luxury vinyl tile, sheet vinyl, rubber, and linoleum are preferred for their durability and ease of maintenance. These materials can withstand rigorous cleaning and disinfection regimes, a necessity in healthcare settings. While carpet can provide comfort, it demands thorough cleaning and the use of disinfectants that are compatible with carpet fibers to maintain hygiene standards. Additionally, non-porous materials for wall finishes and countertops, such as laminate, solid surfaces, and certain treated metals, are pivotal. These materials are easier to clean and less likely to harbor pathogens, balancing aesthetics with practicality and safety. In high-contact areas, materials infused with antimicrobial agents like copper and silver offer added protection against microbial growth. However, the selection of these antimicrobial materials should be weighed against cost implications and environmental impact. The overall aim in choosing Surfaces and Finishes materials is to ensure a balance between hygiene, functionality, and cost-effectiveness, ensuring safety and durability in the healthcare environment. [9]

Hardware, Accessories, and Furniture in healthcare settings, the focus is on selecting materials that offer durability, hygiene, and patient comfort. This category includes furniture like patient and waiting room chairs, workstations, and storage, as well as hardware such as door handles, knobs, and plumbing fixtures. Non-porous synthetic materials and metals are preferred for their ease of cleaning and disinfecting properties [10]. Furniture often features antimicrobial upholstery to minimize pathogen transmission, a critical aspect in infection control [11].Additionally, hardware and accessories in high-touch areas frequently incorporate materials with inherent antimicrobial properties, like copper and silver, or are treated with antimicrobial coatings [12]. These choices are vital in reducing infection spread. The combination of functionality, safety, and comfort in these material selections is crucial for ensuring a safe and hygienic environment in healthcare facilities, directly impacting infection control efficacy and patient experience [13].

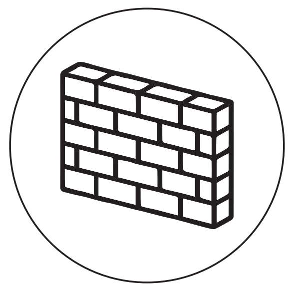


Floor & Work Surfaces

Vinyl tile
Sheet vinyl
Rubber
Linoleum
Carpet
Wood
Laminate
Solid surface
Stainless steel
Quartz
Materials with cupric oxide

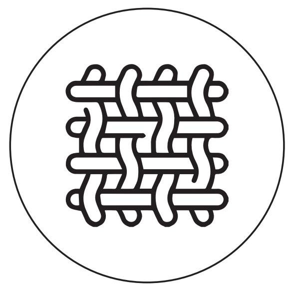
Hardware & Furniture

Copper
Stainless steel
Silver-infused materials
Antimicrobial coatings on metals
Non-porous synthetic materials
Metals with antimicrobial coatings
Laminate surfaces
Solid surface materials
Antimicrobial upholstery fabrics
Wood with protective, easy-to-clean finishes



Wall Finishes

Paint with Antimicrobial Additives
Non-Porous Wall Panels (e.g., PVC, laminated panels)
Copper or Silver-Impregnated Wall Coverings
High-Pressure Laminate (HPL) Panels
Glass and Acrylic Panels
Stainless Steel Panels
Eco-Friendly and Low-VOC Paints
Wallpapers with Protective Coating
Ceramic Tiles with Antimicrobial Grout
Fiber-Reinforced Plastic (FRP) Panels



Textiles

Silver-infused fabrics
Copper-infused fabrics
Antimicrobial upholstery
Nylon
Polyester
Acrylic
Microfiber
Aramids
Thermoplastics
Bamboo fibers
Hemp fibers
Chitosan-treated textiles

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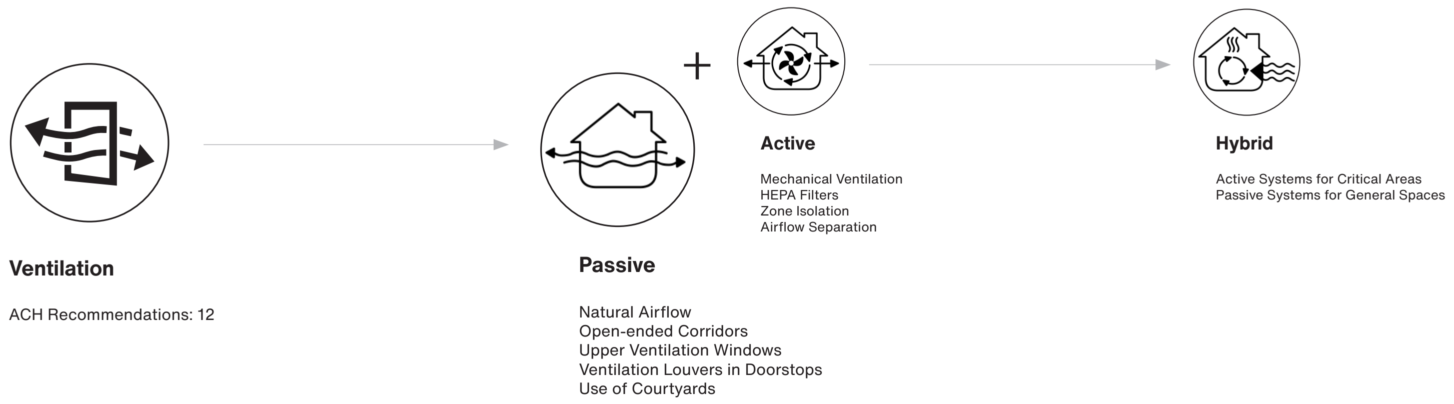
N. VENTILATION

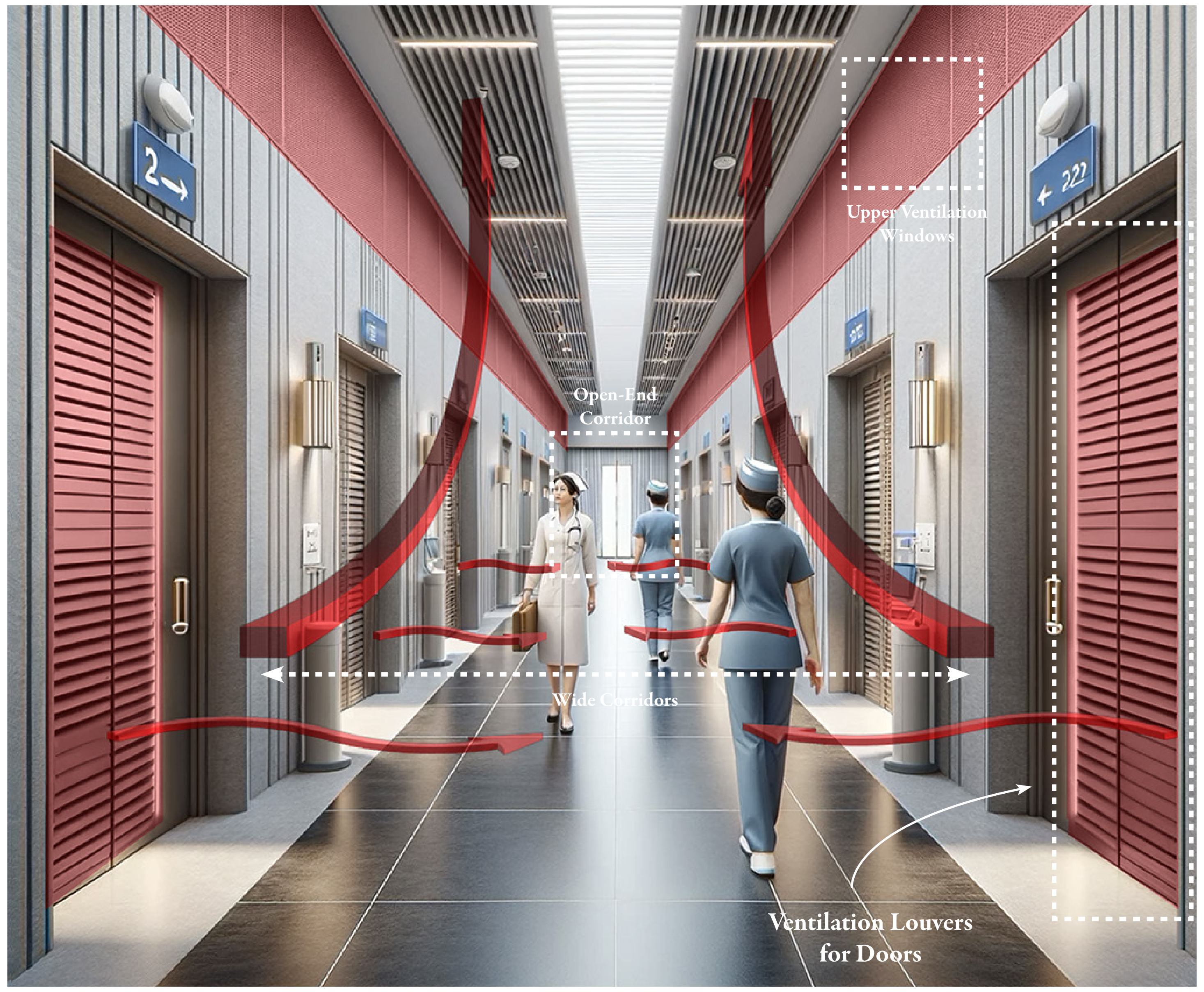
Ventilation, by definition, involves the circulation of air within a specific area, typically influenced by differences in air pressure. Implementing suitable ventilation solutions is one of the crucial aspects of controlling airborne transmission diseases. Common ventilation solutions usually fall into two main groups: Passive and Active systems [1]. Recent research has shown that maintaining an appropriate ventilation rate can effectively reduce the risk of cross-infections from airborne pathogens in healthcare facilities and public spaces [2].

However, it is important to consider that natural ventilation methods can achieve higher ventilation rates compared to mechanical ventilation while remaining energy-efficient. This was confirmed in a study on SARS infection among healthcare workers at an isolation hospital in China [3]. Ventilation rates for healthcare facilities are often expressed as room ACH (air changes per hour), with the CDC recommending 12 ACH to reduce the risk of infection. This rate significantly affects the decay of droplet nuclei concentration, produced by sneezes, coughs, or even the speech of an infected person. It only takes 20 minutes to reduce the concentration to 1.8% [4].

When it comes to active or mechanical ventilation systems, the use of high-efficiency particulate air (HEPA) filters has been seen as an efficient solution for cleaning the circulating indoor air. However, it is also important to consider other measures such as zone isolation and separation of airflow in critical areas like examination rooms in emergency areas. There is a risk that mechanical ventilation might spread infection, but there is no proof that it has aided in the spread of infection. But what do these numbers and conclusions mean for architectural design solutions?

In concludsion, Improving cross ventilation in healthcare facilities can be achieved by having open-ended corridors and using upper ventilation windows in dividing walls in hallways. All doorstops must include ventilation louvers to mitigate hot-air circulation. Courtyards can also provide a cohesive ventilation passage. These approaches will increase the ventilation rate, thereby reducing the risk of airborne transmissible disease infections. Active systems can also be used alongside natural ventilation to create a hybrid system where natural ventilation alone is inadequate [5].





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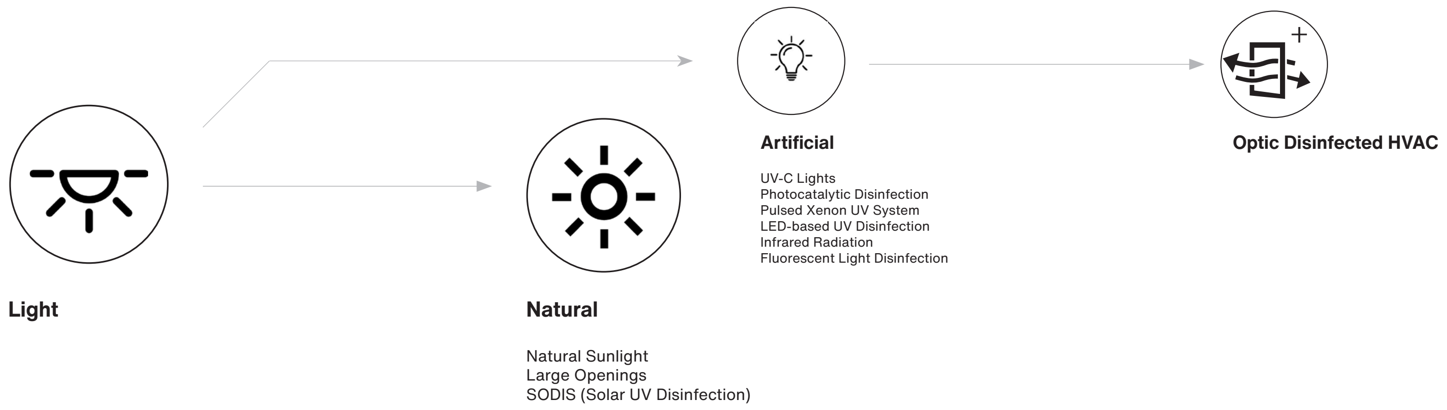
O. LIGHT

Before the invention of antibiotics, sunlight was considered to be one of the greatest disinfection tools, particularly in areas with a high amount of sunlight, such as tropical climates. This approach has been observed in traditional and cultural treatment methods as well. Research shows that direct sunlight has the capability of destroying various kinds of pathogens, such as Bacillus anthracis (anthrax) and tuberculosis (TB), within a few hours at most [1]. Some studies have also indicated a potential relationship between latitude and vitamin D levels with COVID-19 cases and the mortality of infected individuals [2].

The specific attributes of sunlight and solar radiation, such as ultraviolet (UV) radiation, can act as a natural disinfection tool against pathogens. However, unfortunately, only a small percentage of this radiation reaches the Earth, as the majority of it is absorbed by the ozone layer. Studies indicate that the disinfection capability of UV radiation peaks around 260-265 nm [3]. Therefore, design measures, such as increasing the exposure of potentially infected areas to sunlight by enlarging windows and other openings, could directly benefit and enhance the prevention of infections in these spaces. Moreover, integrating architectural designs that maximize natural light not only can contribute to reducing the spread of airborne diseases but also improve the overall well-being and mood of the occupants [4].

When it comes to the artifical solutions, there are not much to be discussed in terms of architectural design as the discussion leans towards technology rather that design, however this solutions which mainly include usage of different light sources such as UV, Fluorescent, etc might also be very efficient when combined with other design aspects such as usage in HVAC system for disinfecting circulated air.



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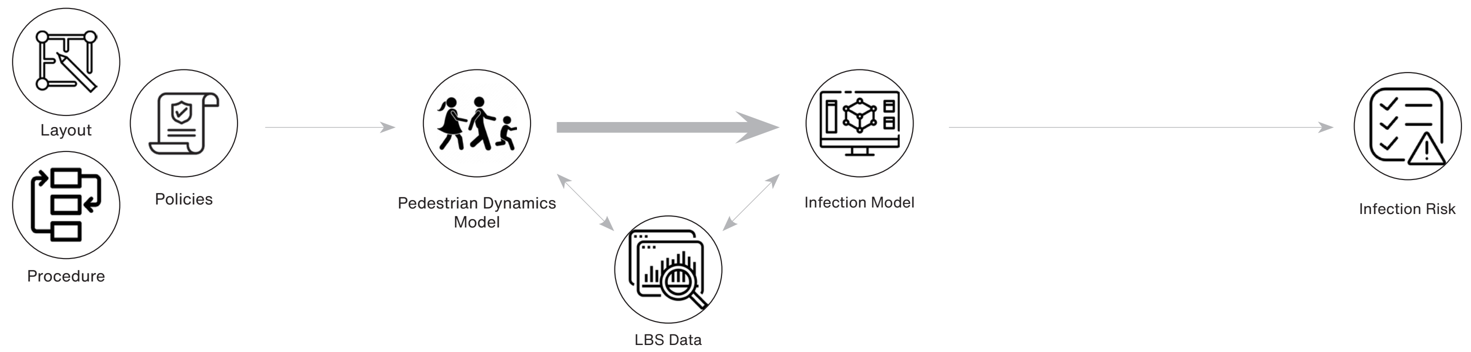
P. PATIENT FLOW & DYNAMICS

Infection control methods are greatly influenced by the movement and social interactions of people in built environments. Some of them directly provide the link between increased contact during gatherings in public spaces and infectious diseases like measles and SARS [1]. Furthermore, there is clear documentation of COVID-19 clusters emerging in various densely populated areas, including shopping malls [2], concerts (Coronavirus: 5 More Cases, 2020),Cruise Ships [3],Nursing Homes.

Studies show that many diseases have a high correlation of infection rates with contact rates resulting from mobility and interaction. Therefore, social distancing is one of the mitigation measures for combating the COVID-19 outbreak [4]. For developing the effective policy of social distancing it is critical to develop the model of disease dynamics in overcrowded urban environment accounting the mixing process of susceptible and infected people while passing pedestrian traffic. However, traditional models are not specific enough to come up with the exact policies and generally tend to suggest wide scale interventions that include the cancellation of all event-attracting activities. Such decisions may significantly affect society and the economy.

Pedestrian dynamics have become increasingly popular in recent times as a mechanism for scientifically explaining human motions as illustrated in Figure X.X. The approach helps in the development of individualized interventions which are less disruptive compared to the use of general methods [5]. This method is a specific way of modelling how people walk in diverse settings. This includes things like people's starting positions, velocities, motives, and the obstacles they encounter as they move towards their final points of destination. This technique can be utilized in practical scenarios like airports layouts development or investigating how infections spread in dense environments. One can use pedestrian dynamics as a tool in designing healthcare centers thus resulting in reduction the risk of infection transmission.



In order to achieve full capacity of this technique, computational analysis of LBS data along with infection models of different diseases should be done. However, useful knowledge can be derived from preceding assessments employing this approach.

One of the lessons learned from implementing this method is implementation of specialized small waiting areas for different patient's groups. This strategy limits mobility among patients and curbs contact. Directional flow path should be established because it will lead to ordered traffic movement and thus avoid back flows and unnecessary patients' encounters. The incorporation of wider corridors with more spacing is also aimed at avoiding overcrowding and closeness that will endanger patients. Furthermore, using open spaces for waiting and triage will lower the internal crowding and improve patient safety. Finally, in terms of flexibility, designing adaptable spaces that are easily reconfigurable is key for dealing with different patient flow demands such as unexpected emergencies turning the facility more resilient.

There are a number of key strategies, which are necessary for good healthcare management, that can enhance the safety and efficiency of patients' movement within a hospital. One such strategy includes making staggered appointments to maintain patient flow without congestion. Rapid routes for triaging patients are essential for the prioritization of patients, improving movement, and reducing useless contacts. Identification of separate doors for different patient categories directs the traffic effectively and minimizes patient contacts. Measuring and controlling waiting room occupancy using digital systems for optimum flow patterns improves patient satisfaction.

The separation of flow as applied to minimize the infection transmission to the staff have some limitations and disadvantages that should be given thorough thought about. It adds to the complexity of the flow and decreases the flexibility of the building. Construction costs and materials are also affected by the increased space within the corridors. Besides, psychologically, for patients left in patient corridors is an important aspect in the social sense. However, the second corridor often faces problems such as lack of natural ventilation and sunlight. Thus, the division of flow is expensive but reduces the risk of infection spread to staff and it may be set aside for sections with high infectious disease transmission risk.

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Q. ADAPTABILITY AND FLEXIBILITY

All designs should involve flexibility and adaptability as the central values. The COVID-19 crisis also revealed an extraordinary opportunity for innovative changes in the conception of material environments. Design guidelines have historically been established as they apply to certain type of buildings. However, the pandemic revealed the versatility of spaces: hospitals turned into homes, parking lots for vaccinations, sport stadiums as substitute hospital wards and even port terminals are also engaged in vaccinations. Education and practice could also shed more light on the importance of design in housing different functions, equipping individuals for unforeseen incidents such as pandemics and ice storms, and ensuring financial viability. [1]

Looking ahead, it is imperative to explore innovative design principles that incorporate inherent flexibility to adapt non-treatment areas and public spaces within healthcare centers into screening, triage, and treatment spaces during times of contingency. While successful instances of using external structures to expand healthcare center capacity have been observed, studies have raised concerns about this approach. These concerns encompass challenges related to the distribution of staff, climate control, patient and staff experience, as well as the potential costs and resource wastage, given that these structures typically have a short lifespan and cannot be preserved for future use [2]. Furthermore, some studies have indicated that certain makeshift facilities were underutilized even during pandemics [3]. Healthcare center environments designed with built-in flexibility have the potential to respond to pandemics more swiftly, efficiently, and cost-effectively. Features such as modular designs with pods, universal rooms, adaptable space utilization, and compartmentalized ventilation systems with separate air-handling units (AHUs) for different zones empower healthcare centers to adjust treatment capacity in response to shifting patient volumes during various pandemic stages. [4]

The concepts of convertibility and flexibility, including the reconfiguration of spaces, the incorporation of adaptable partitions to create separations within areas, reversible air pressure, and the versatile use of treatment and non-treatment spaces within and adjacent to healthcare centers, are essential to address the unique challenges posed by the evolving nature of pandemic outbreaks. Employing a combination of design strategies becomes necessary to minimize disease transmission within healthcare centers during pandemics. These strategies aim to reduce contact with infected patients, limit contact with contaminated surfaces, control airflow, and provide surge capacity to accommodate an overflow of patients.

One of the examples of adaptive use of healthcare facilities which were quite successful during COVID-19 pandemic and also SARS infection is utilization of Non-treatment Areas for Patient Care. Public spaces within the facility and other areas not traditionally used for patient care were transformed to meet the changing demands. This approach not only increased the capacity for patient care but also ensured a more efficient use of available space during a critical time. Another useful experience was utilization of temporary and portable facilities, temporary structures such as tents and portable partitions were used. These served as additional spaces for treating low-acuity patients or as isolation areas. While these solutions were beneficial in the short term, the book notes their limitations and advocates for more sustainable designs with built-in flexibility for future needs. Studies has shown facilities with built-in flexibility were more effective in treating high-risk patients. They employed adaptive strategies such as creating separate cohort isolation units and specialized zones for suspected patient admission. This adaptability was crucial in ensuring that patients received the appropriate level of care while minimizing the risk of infection spread within the facility.

Ultimately, the concept of built-in flexibility not only increases healthcare center capacity but also enhances the quality of care provided. As we continue to learn from past experiences and adapt to evolving healthcare challenges, investing in adaptable design is an essential step toward a more resilient and effective healthcare system.

Modular Design Using Pods

Reconfigurable Spaces

Convertable Non-Treatment Zones

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R. ZONING & LAYOUT

It's evident that strategic planning of layout to manage traffic flow and reduce contact among individuals can significantly minimize the risk of infection spread in high-traffic areas. One effective strategy for addressing zoning and layout concerns is the implementation of zone-based design. A case study conducted in an Emergency Department (ED) that adopted a zoning strategy to mitigate SARS-CoV-2 transmission risk demonstrates the effectiveness of this approach.

To prevent the spread of infections within hospitals, many studies have embraced a comprehensive patient diversion approach, which involves categorizing patients into different risk levels, such as no risk, low risk, moderate risk, and high risk [1]. Additionally, some emergency departments (EDs) have further stratified patients based on their suspected infection status [2].

For instance, a study described how they created a dedicated area for COVID-19 patients (known as the 'hot zone') in a busy Emergency Department. This method was effective in preventing the spread of SARS-CoV-2 within the department. This strategy successfully contained the spread of SARS-CoV-2 within the department. This hot zone consisted of eight rooms, each with its own entrance and exit, allowing it to be isolated from the rest of the ED and reducing traffic near the high-risk areas. Similarly, Seak and their team (2020) restructured their ED into distinct zones: a red zone for high-risk cases, a yellow zone for moderate-risk patients with specific symptoms, and a green zone for asymptomatic patients with other health concerns.

Another ED organized its spaces into four zones: a pre-triage unit, a red zone for high-risk or suspected patients with unstable conditions, a yellow zone serving as a buffer for patients with lung issues but a negative risk history, and a green zone for non-suspected patients [3]. The red zone was further divided into red zone 1, which housed four negative-pressure isolation rooms inside the ED for high-acuity patients, and red zone, an outdoor tent for low-acuity patients. Non-suspected patients received treatment in the green zone of the main ED. Another study has also emphasized the importance of maintaining separate pathways, entrances, triage areas, and treatment zones for COVID-19 and non-COVID-19 patients. These measures collectively contribute to a more effective approach to infection control in healthcare settings. The following are examples of zoning according to this principle for the ED department, however this can be easily extended to the whole built environment of healthcare center [4].

1. Seak, C. J., Liu, Y. T., Ng, C. J., & Investigators, S. (2020, Aug). Rapid responses in the emergency department of Linkou Chang Gung Memorial Hospital, Taiwan effectively prevent spread of COVID-19 among healthcare workers of emergency department during outbreak: Lessons learnt from SARS. Biomedical Journal, 43(4), 388–391. https://doi.org/10.1016/j.bj.2020.06.002
2. Schreyer, K. E., Daniel, A., King, L. L., Blome, A., DeAngelis, M., Stauffer, K., Desrochers, K., Donahue, W., Politarhos, N., & Raab, C. (2020). Emergency department management of the Covid-19 pandemic. The Journal of Emergency Medicine, 59(6), 946–951.
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S. TECHNOLOGY INTEGRATION

Healthcare use and evolution of technology is critical to good patient care and infection control, especially during health emergencies such as the SARS and COVID-19 pandemics. The evolution in technological scales and stages has impacted the healthcare center building design and functions. To illustrate, use of certain technologies in patient rooms has played a major role in control of infections such as SARS and COVID-19. Some of the technologies that are now used include the UV lighting for disinfections, touchless light and shade controlling and toilets. These are now regarded as new standards in healthcare design because they are effective and prevent infections [1].

Video conferencing equipment has been integrated into examination rooms as part of the growth in remote care enabling telehealth consultations. A recent study points out that voice-activated and hands-free technologies, in particular, are very useful in shared places like restrooms, especially when it comes to soap, hands, and towel dispensers as they help lower infection risks. Equally, waiting rooms have experienced the same advancements and particularly in the use of these instruments for regulating ventilation and natural light to help enhance safety [2]. Another significant innovation in this area involves monitoring tools that include real-time patient data and automated contact tracing. These are important technology tools for immediate response to infection control and management. Robotics systems are now more and more often used for disinfection, which is one of effective infection control. The robots are used in cleaning, and sanitizing surfaces, floors, and equipment reducing the risk of infections among the staff and patients [3].

In addition, robots in healthcare are now used to dispense medications, sample collection and thus, reduce the chance of infections spreading amongst health care workers. For architectural purposes, integration of telehealth-equipped patient rooms and smart building management systems is pivotal in adapting healthcare space fast during pandemic cases. The design of healthcare spaces should be based on modularity and flexibility so that there will be prompt implementation of changes when the needs in healthcare change [4].

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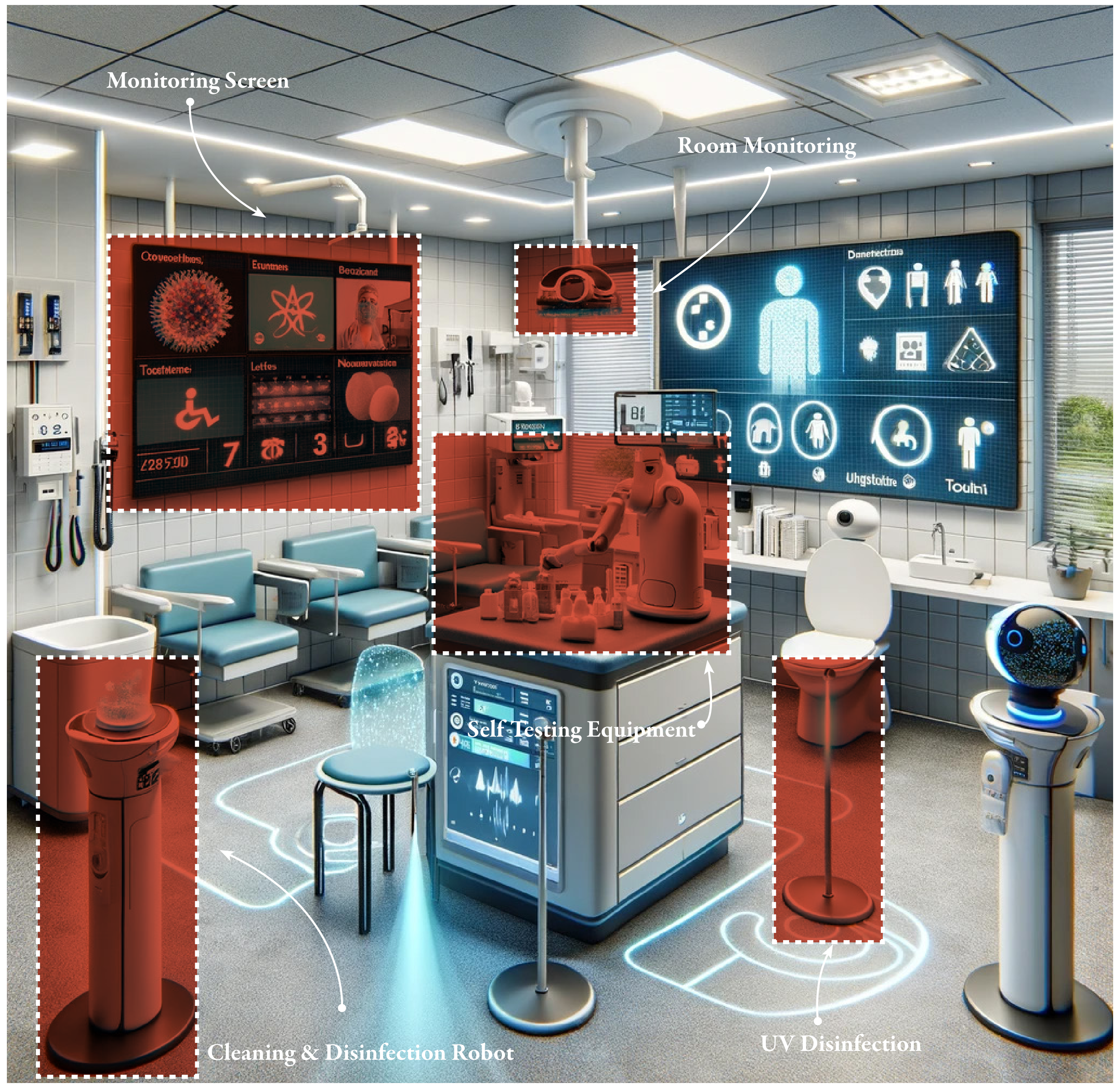
2. Birnbach, D. J., Nevo, I., Barnes, S., Fitzpatrick, M., Rosen, L. F., & Everett-Thomas, R. (2015). The impact of environmental cleanliness on infection rates. American Journal of Infection Control, 43(5), 495-499.
3. Scott, R. D., Blake, P., & Sifuentes, L. (2018). Costs and benefits of robotic cleaning and disinfection technologies in health care settings. Journal of Hospital Infection, 100(4), e85-e93.
4. Hamilton, D. K., Shepley, M. M., & Watkins, N. (2020). Design for Critical Care: An Evidence-Based Approach. Architectural Press.



T. REMOTE CARE

Advancement in remote care and telehealth has been an emerging trend in healthcare to meet the challenges created by the covid-19 pandemic. The notion of telehealth involves using different technologies and approaches for the supply of medical, health, as well as educational services online instead of having them face to face.

Telehealth is among the most vital changes that impacts health care delivery system and one of the most significant of its benefits is that it helps filling gaps of health access particularly in patients residing far off or those not served adequately. Patients gain access to telehealth services where they get advice, diagnosis and even some treatment without traveling hence saving time, cost and easing pressure on health facilities [1]. The use of video conferencing tools that are now common in telehealth provides a more personal touch to the patient-physician dialogue, resulting in a more patient-centered experience. Thus, telehealth has been shown to be effective in addressing chronic diseases, mental health, and post-surgical care. The remote monitoring tools help in prompt health interventions and chronic disease control and management based on real time health data tracking [2]. This is even more important for patients with diseases like diabetes and heart where frequent tests are vital for the results.

Telemedicine has also transformed mental health services in which individuals who live far, are bedridden, cannot come out due to embarrassment, etc., can now receive services from mental health professionals. Many people have embraced these forms of therapies because they can be conducted at home while ensuring privacy [3]. In terms of post-operative care, telehealth has been essential in lowering hospital readmissions and bettering patient conditions. Post-discharge virtual visits for monitoring of patients' recovery process detect complications early and prompt medical intervention that could prove vital for the patient. [4]. Additionally, telehealth has been fundamental in education and training to healthcare professions, which have been more convenient, flexible, scalable and efficient for continuous medical education and specialized training. Telehealth therefore improves the skills of health care professionals and ensures consistency in quality of care provided in various places [5].

The integration of remote care and telehealth into the healthcare system has been transformative, offering improved access to care, enhanced management of chronic conditions, significant advancements in mental health treatment, effective post-operative care, and valuable opportunities for professional development in healthcare.

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2. Tuckson, R. V., Edmunds, M., & Hodgkins, M. L. (2017). Telehealth. New England Journal of Medicine, 377(16), 1585-1592
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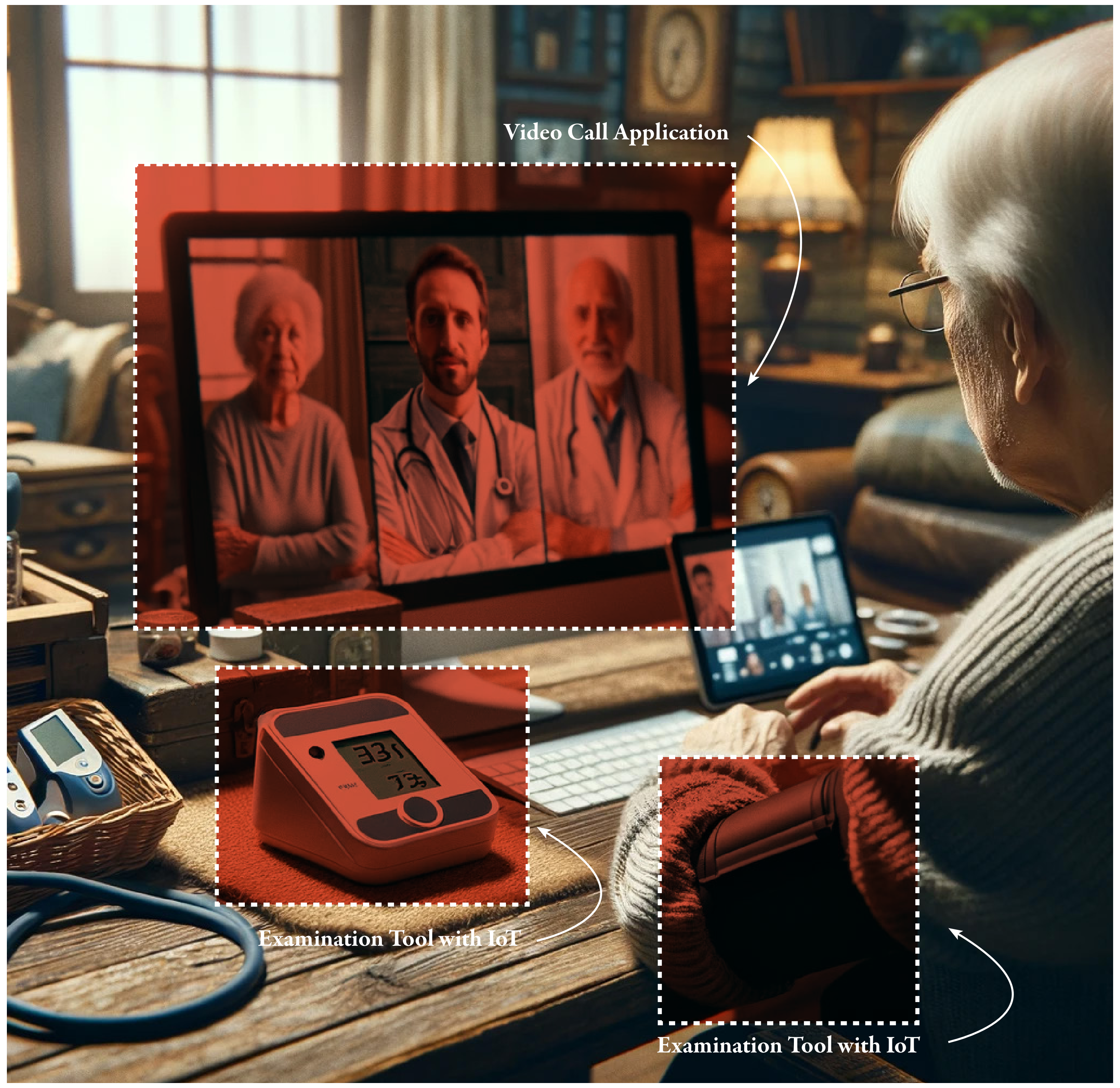

III. DESIGN PROPOSAL


BIRGITTAS
VÅRDCENTRAL

B. LOCATION

The project site is located in the city of Vadstena in Östergötland County. Ostergotland County is one of Sweden's twenty-one counties, situated in the southeast of the nation. The county has an approximate population of 460 thousand people and an area of 10,691 square kilometers. Ostergotland County is renowned for its extensive past, stunning scenery, and dynamic culture. The county has several historical sites, including as the Viking settlement of Birka, the medieval fortress of Linkoping, and the Vadstena Abbey. It also features a number of stunning natural attractions, including the Gota Canal, Lake Vattern, and Tiveden National Park. Vadstena's location is noteworthy for a number of reasons. First of all, the city is located on the eastern bank of Lake Vattern, the second-largest lake in Sweden and a renowned tourist attraction. It is a wonderful spot for boating, swimming, and fishing due to the lake's pristine waters and gorgeous surroundings. Second, Vadstena is situated next to the Birgittin Monastery, which had an important influence in the development of the town.

During the 15th century, the monastery, which was built in the 14th century, became a wealthy institution and a cultural hub for Scandinavia, drawing pilgrims and other tourists and fostering economic and cultural variety. Finally, Vadstena's proximity to the Bergslagen area, which is renowned for its rich mineral resources and mining sector, bolstered the town's status as a commercial centre and port of departure for nearby landscapes. In the late Middle Ages, this led to Vadstena's expansion and development as a significant political and cultural center in Sweden[1].

1. Berglund, B. (2017). Vadstena - A town by the lake. Visit Östergötland.

C. HISTORICAL CONTEXT

Vadstena was founded near the site of the Birgittin Monastery on its territory. Historical records indicate that a town existed there as early as the 1380s, and Queen Margareta awarded it privileges in 1400. Its proximity to Bergslagen assisted Vadstena's rise as a commercial hub and departure point for nearby regions. Throughout the fifteenth century, the abbey flourished and became a cultural center for Scandinavia. The constant flow of pilgrims and other visitors fostered economic and cultural variety in late medieval Vadstena. It also become a significant political hub and gathering place. With the Reformation, the prominence of the Birgittin Monastery declined, and it was finally closed in 1595. Although though a decision was made to settle new people in Vadstena in 1544, the town continued to stagnate, and by the 1770s, its population had reached roughly 1,400. In the second part of the nineteenth century, the town's population was little over 2,000. Since then, its expansion has been gradual, and Vadstena has mostly served as a service town, with a major healthcare industry controlled by Birgitta's hospital during the 20th century. Vadstena has grown throughout time, with several projects contributing to its expansion. The creation of a road connecting the castle to the city, which aided transit and communication, was one such improvement. The building of additional housing units, which enabled more people to live and work in the region, also contributed to Vadstena's growth.

The town's library has undoubtedly played an important part in its intellectual and cultural growth. In addition, the Trinity Church has been expanded, which may be indicative of the town's continuous development and the significance of religion to its history and culture. Vadstena has kept a significant portion of its medieval setting, with some historic structures still standing. The palace of Folkungaatten, which was constructed in the 1260s and eventually became the Birgit sisters' first monastery, is the oldest structure in the city. The Town Hall was constructed on the city's oldest plaza immediately after Vadstena was granted city powers in 1400. In Town Hall Square, several homes from the 15th century to the present day may be found. From the beginning of the 15th century, a number of structures have been constructed and devoted to various healthcare objectives in the hospital district, which has kept a substantial portion of its architecture history. Vadstena Castle, constructed by King Gustav Vasa in 1545 and situated on Lake Vattern, is one of Scandinavia's best-preserved Renaissance fortresses. There are also some historical homes in the city, notably the 1705 Pharmacy House and the 1473 Bishops House. Built in the middle of the 18th century, the Stora Drhuset was the first mental hospital in Sweden and is now a museum. The Nun Monastery and the Monk Monastery, which have served numerous functions throughout history, are now, respectively, a hotel and a restaurant.

The Vadstena Monastery Church, one of the biggest medieval churches in Sweden, is a popular pilgrimage destination. From the beginning of the 15th century, the city has had a long heritage of hospital care, with a number of healthcare facilities founded. The number of patients at the Vadstena hospital increased throughout time, with around 1,100 employees at its height. The old hospital buildings are being utilized for a variety of functions, such as flats, a healthcare center, and a forensic mental clinic. Architectural aspects of Vadstena vary, but often include low, narrow houses made of light-colored bricks or plastered bricks, with a red brick tile roof and paned windows.

1. Burpee, H. (2008). History of healthcare architecture. Integrated design lab Puget sound, 1-3.

D. URBAN TYPOLOGY

The urban structure of medieval Vadstena, which has a monastery and a castle, shows the city's historical development. The city exemplifies the Swedish typo-morphological technique, which examines urban form and evolution by using types and typologies. The city's urban morphology and urbanization processes are akin to those of other Swedish or European cities. It contains architectural styles and urban shape from several historical eras, spanning from the Gothic to the Baroque. The city's urban tissue is small and homogeneous, comprised of low-rise buildings and narrow streets. Vadstena, unlike other Swedish cities, lacks a diversified or divided urban fabric. In the majority of places, buildings do not conform to a street grid, and the cityscape has an organic pattern. Instead, structures adhere to predetermined angles and shapes.

The city's architecture is minimalist, and buildings have access to an abundance of open space. This affords structures in the region unique advantages, such as access to natural light and fresh air. Yet, it might also make it difficult to distinguish between public and private places and impede the area's rate of growth. The angle of the city's buildings, which conforms to a 3-degree angle, is a distinguishing trait of urban typology.

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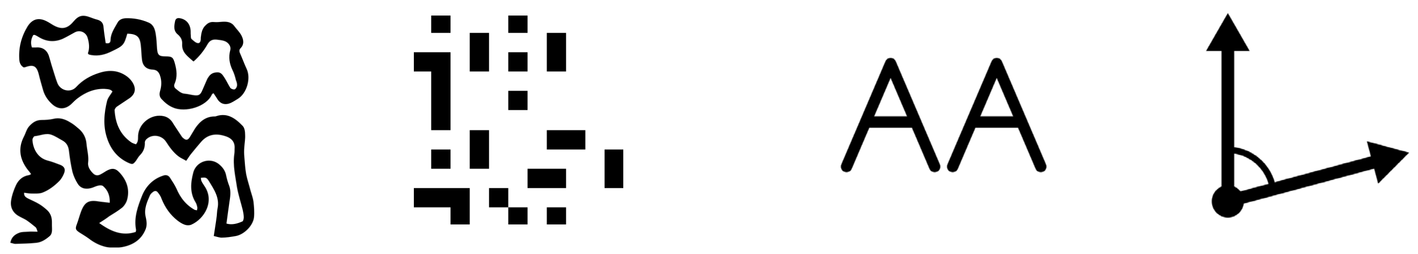
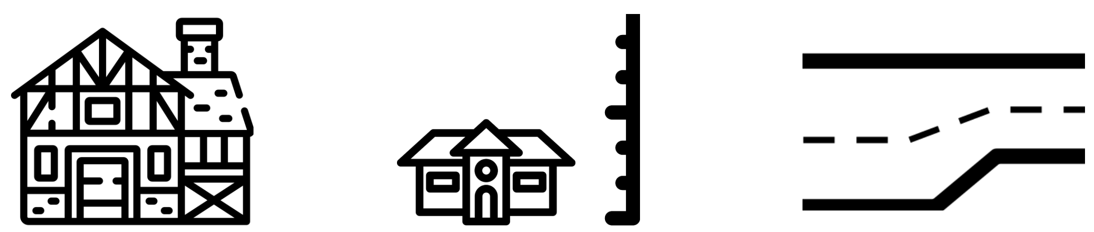
2. Boeri, S., Zinzi, M., & Oliva, F. (2020). Urbanization processes and typologies: urban overlays for the 21st century.

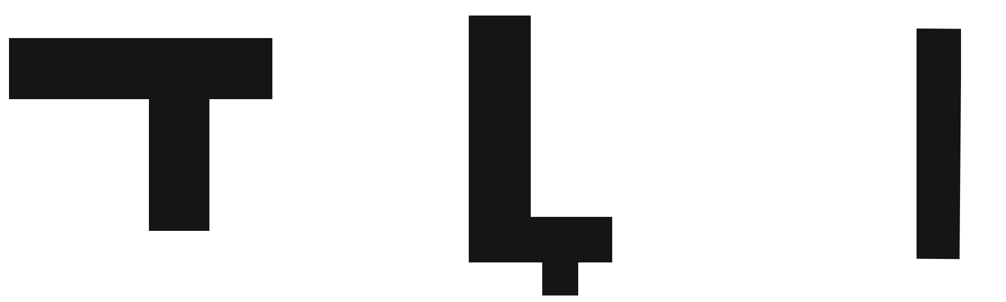


Organic Landscape | Sparse & Low Density City | Homogenous Tissue | 3°Angle to Opposite Building



Medieval Character | Low Rise Buildings | Narrow Streets

U Form | H form | E Form | F Form



T Form | L Form | I Form

E. VOLUME TYPOLOGY

Vadstena's architectural type is defined by low-rise structures that produce a dense and cohesive urban fabric. Several buildings in Vadstena are merely one or two floors tall, resulting in a rather horizontal skyline. This architectural style produces an intimate and pleasant atmosphere in the city and helps buildings to fit in with their surroundings. Vadstena's low-rise design creates a unique interplay between the city's architecture and its open space. As a result of its volume type, buildings occupy less vertical space, giving greater area for open space between and around them. This open area offers a buffer between the developed environment and the natural landscape, as well as more natural light and airflow. Furthermore, the volume typology of Vadstena's structures is directly tied to the city's historical evolution. During the medieval era, when building methods And materials did not permit the construction of lofty structures, many of the city's buildings were created. This has resulted in the preservation of a uniform building height across the city throughout the years. The volume typology of Vadstena's buildings produces a distinctive urban fabric that reflects the city's historical and cultural legacy. It also gives inhabitants and tourists the chance to enjoy a compact and intimate urban environment that is integrated with the natural surroundings.

The majority of the structures in Vadstena are made from native resources, such as bricks and plastered bricks in light hues, red brick tiles for roofing, and paned windows. This material emphasizes the historical importance of the area and is congruent with the traditional construction methods utilized across Sweden. Several of the buildings also include wood into their construction, which gives warmth and character to the architecture. This utilization of natural materials lends cohesion and harmony to the design of the town, so enhancing its overall aesthetic appeal.

In addition, the use of natural construction materials such as brick and wood helps to the longevity and sustainability of the structures. These materials have a long lifetime and can survive extreme weather conditions, making them appropriate for the often-cold and snowy environment of Sweden. In addition, their local sourcing decreases the carbon impact caused by shipping resources from distant regions. Traditional architectural methods in Vadstena, such as the use of plastered bricks and paned windows, have been perfected over generations, highlighting the town's extensive history and cultural heritage.

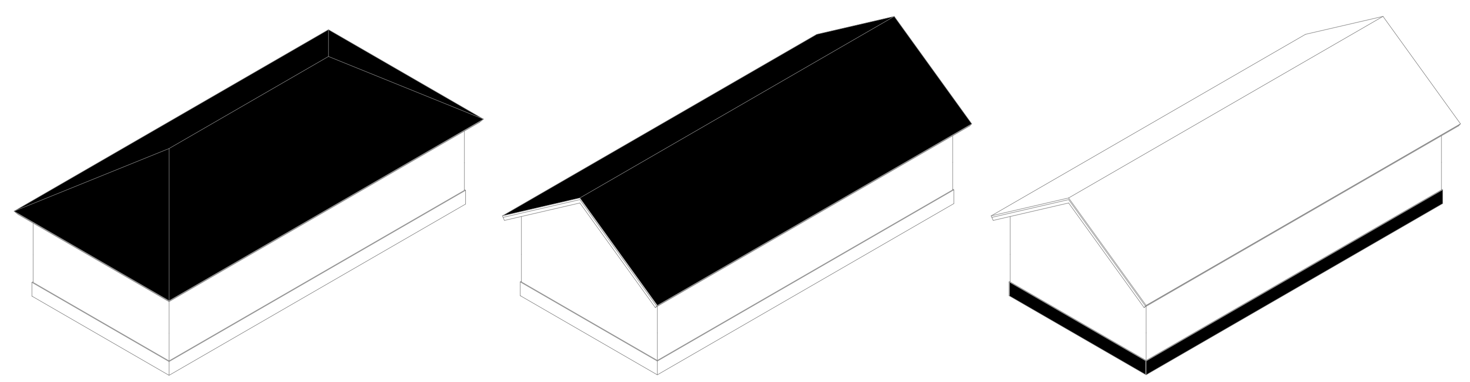
1. Mondragón, C., & Villegas, E. (2019). Urbanization Processes and Typologies: Urban Overlays for the 21st-Century. Springer Nature.

2. Vadstena Municipality. (2021). Vadstena – Culture and history. Retrieved March 11, 2023, from https://www.vadstena.se/en/visitors/culture-and-history/

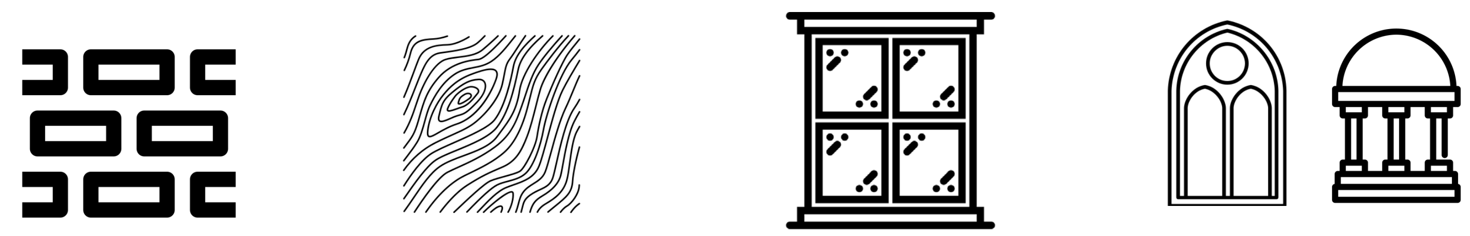
3. Björnsson, M. (2012). A Few Words on Vadstena. The Royal Swedish Academy of Letters, History and Antiquities, 4, 9-25.

4. Ekblom, A. (2017). Urbanization Processes and Typologies: Urban Overlays for the 21st Century. In N. Casalegno & M. Ryser (Eds.), From Disciplinary Knowledge to Transdisciplinary Research and Practice (pp. 157-176). Springer International Publishing.

5. Nilsson, L. (2017). Urban Morphology, Cognitive Mapping and Urban Typologies: A Case Study of Vadstena, Sweden. Journal of Urbanism: International Research on Placemaking and Urban Sustainability, 10(1), 66-83.



Type I | Type II | Plinth Course

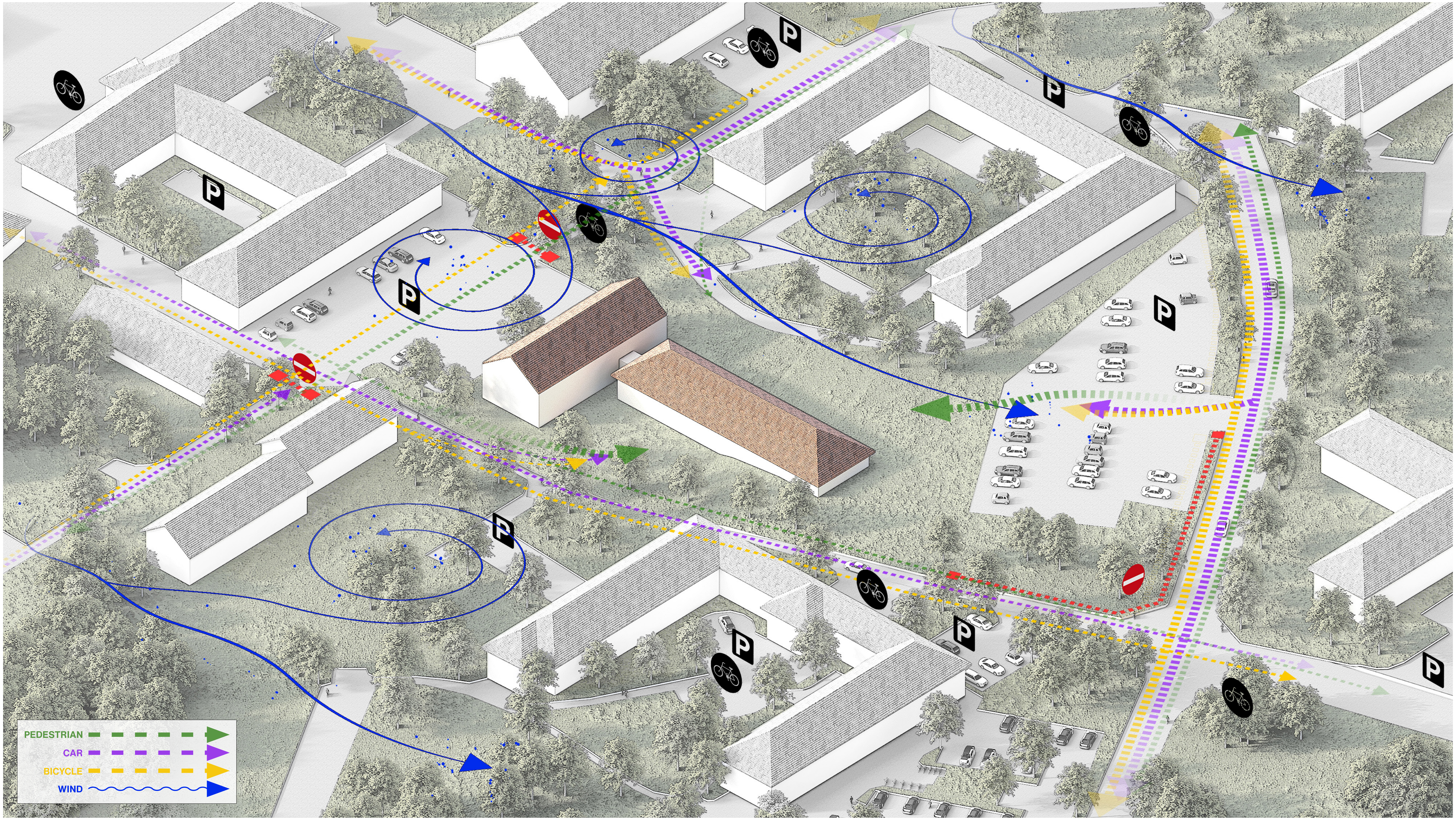


Brick | Wood | Paddled Windows | Gothic to Baroque Styles

Falu Red | Ochre Yellow | Beige | Pastel Shades

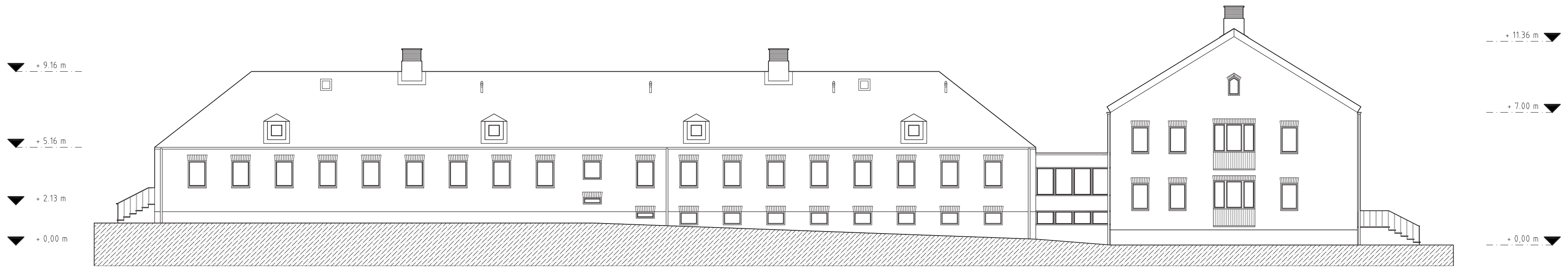
F. SITE ANALYSIS

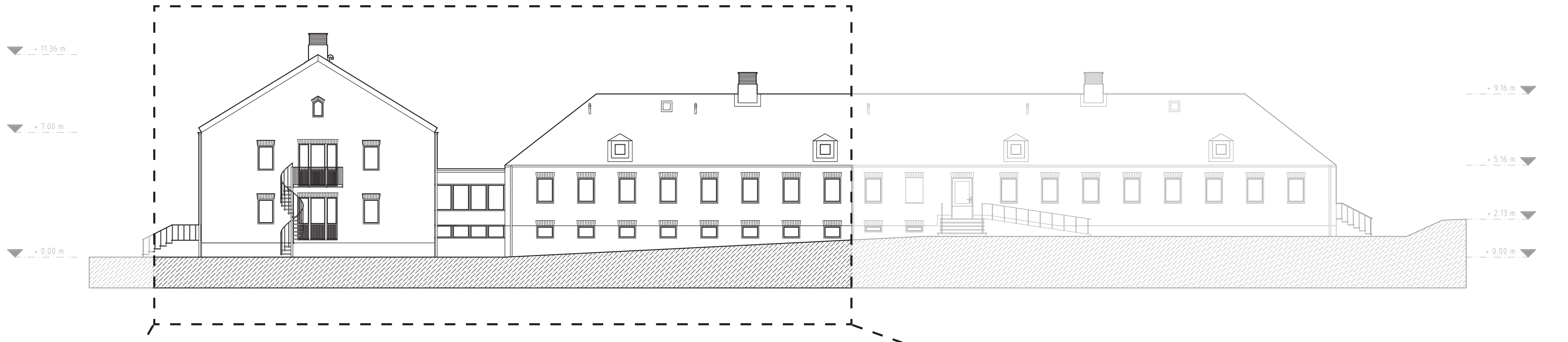
The site analysis revealed several key factors that have shaped the design proposal. Pedestrian traffic patterns are a primary driver, with the majority of flow originating from the southwest due to its connection to the city center. This has directly influenced the placement of building entrances and the location of public functions within the proposed design. For example, the main entrance will be positioned on the southwest facade to provide a direct and convenient access point for pedestrians arriving from the city center. Additionally, public functions such as a cafe or information center will be strategically located near this entrance to enhance visitor experience and encourage interaction. Car traffic, on the other hand, is concentrated on the eastern edge of the site. This strategic location has been chosen for the ambulance entrance to ensure efficient access, minimizing response times for emergencies. Separating car and pedestrian traffic flow points not only enhances safety but also creates a more pedestrian-friendly environment within the development. Finally, wind direction has played a crucial role in shaping the building's physical form. Prevailing winds typically originate from the west. The proposed design incorporates a perpendicular mass to this direction, optimizing natural ventilation throughout the building. This approach not only reduces reliance on mechanical ventilation systems but also creates a more favorable environmental condition within the building, promoting occupant comfort and potentially reducing energy consumption.

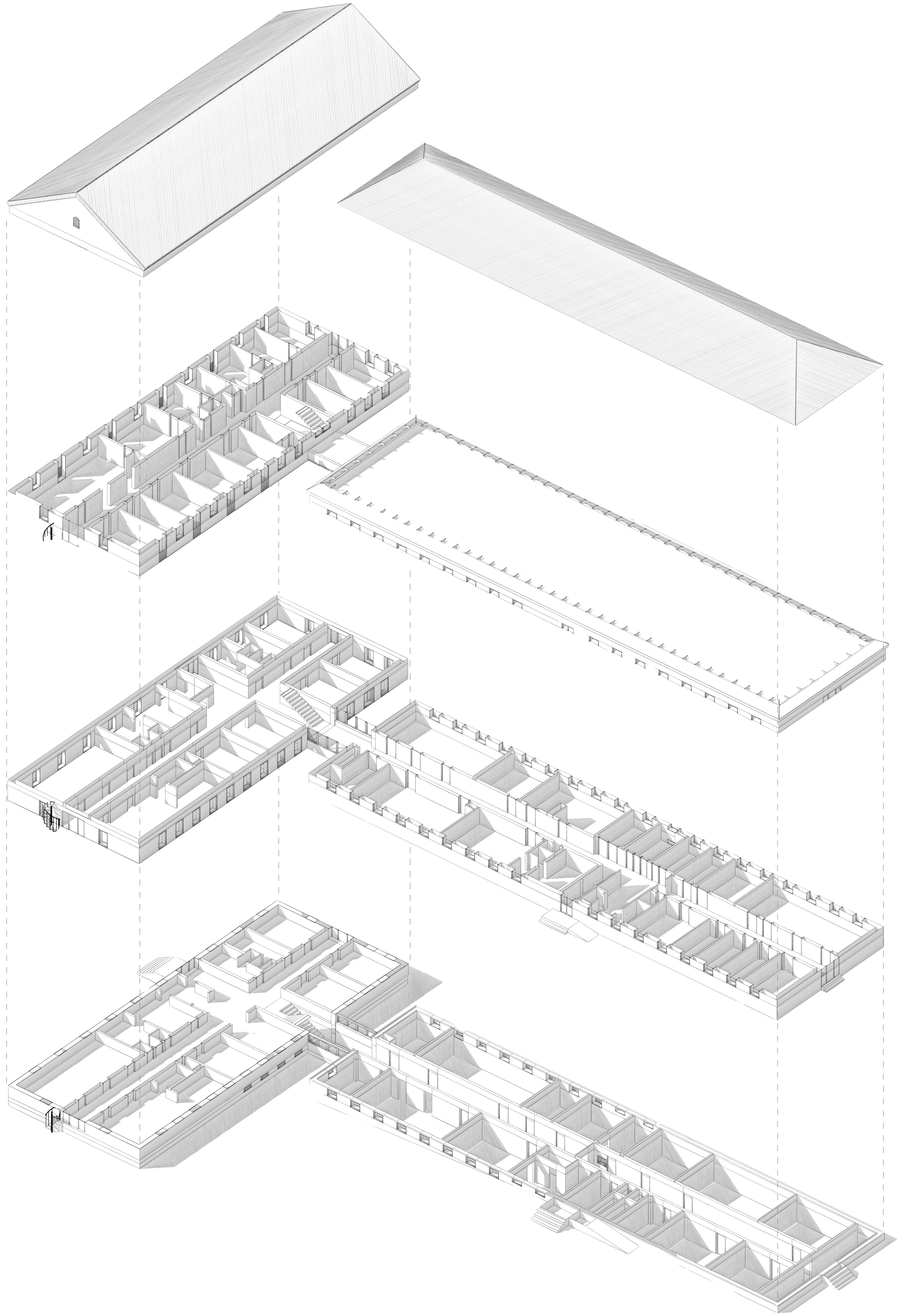


G. EXISTING BUILDING

The buildings on the site utilize a load-bearing wall system. Walls constructed from brick support the exterior and corridor structures, eliminating the need for internal columns. Basement walls are likely constructed from concrete, while the floors consist of concrete slabs. These buildings feature "kallvindar" design, a Swedish term for an uninsulated attic. In this design, insulation is placed within the top floor slab rather than directly within the roof itself. These structures share a common architectural aesthetic. Straight gabled roofs adorned with red tiles crown the buildings, while the facades are finished with a sand-colored plaster. The current site regulations establish a maximum allowable gross building area of 2,500 square meters.

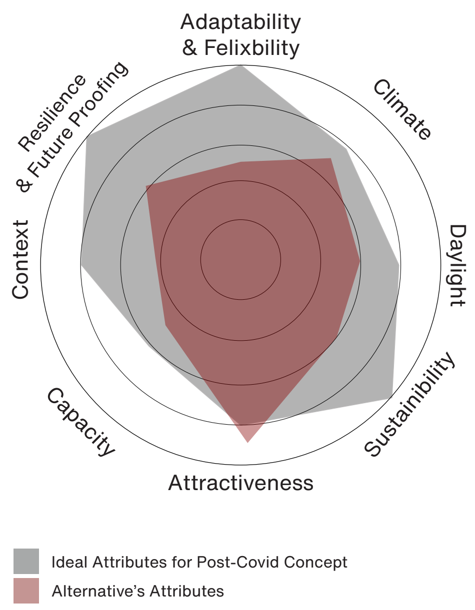


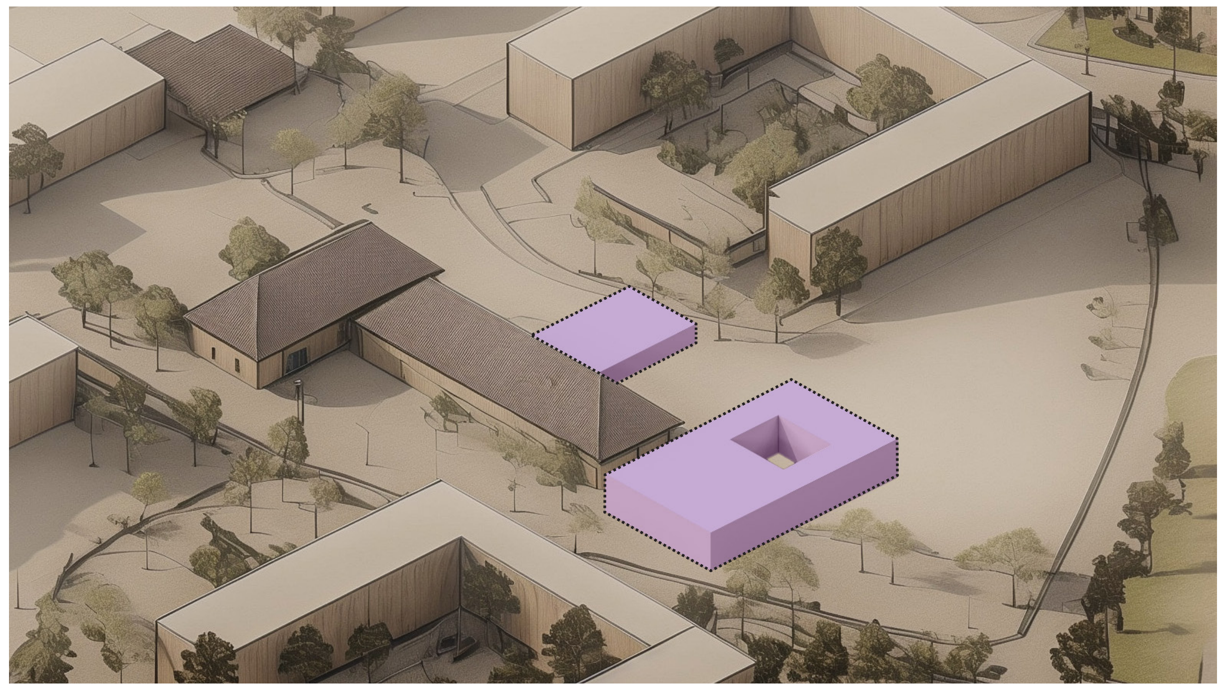


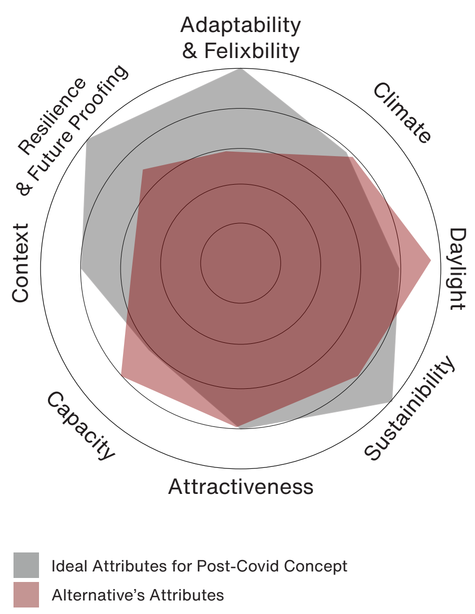


H. VOLUME ANALYSIS

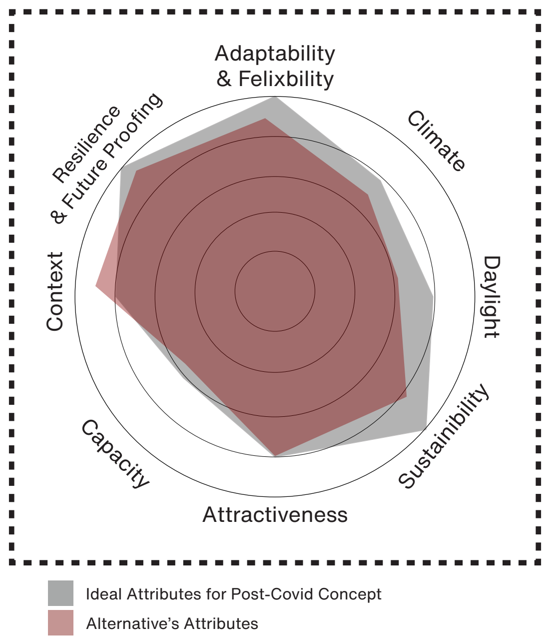
To increase the sustainability, the project prioritized the preservation of existing volumes. These existing buildings were then redesigned to accommodate the new functionalities of the primary care center. To address the need for additional space, an extension was planned. Several design language options were explored for this new volume, ranging from bold architectural statements to more conservative approaches. A meticulous evaluation was conducted for each option, employing a SWOT analysis framework to weigh the advantages and disadvantages. This analysis considered a comprehensive set of criteria. These included how well the design could adapt to future changes, its response to the local climate, optimization of natural light, and its overall sustainability. The aesthetic integration with the surroundings, capacity to meet spatial needs, respect for the existing context, resilience to challenges, and ability to serve the primary care center in the long term were all carefully evaluated. By carefully considering these various factors, the project was able to select the most suitable design language for the new volume, ensuring that it met the functional needs of the primary care center while adhering to the principles of sustainability. The chosen option emerged as the most favorable solution due to its exceptional adaptability and flexibility. This characteristic, alongside its inherent resilience and future-proofing qualities, aligns perfectly with the core principles of successful post-covid design. Furthermore, the design's strong connection to the surrounding context reinforces its viability as the optimal choice for this proposal.

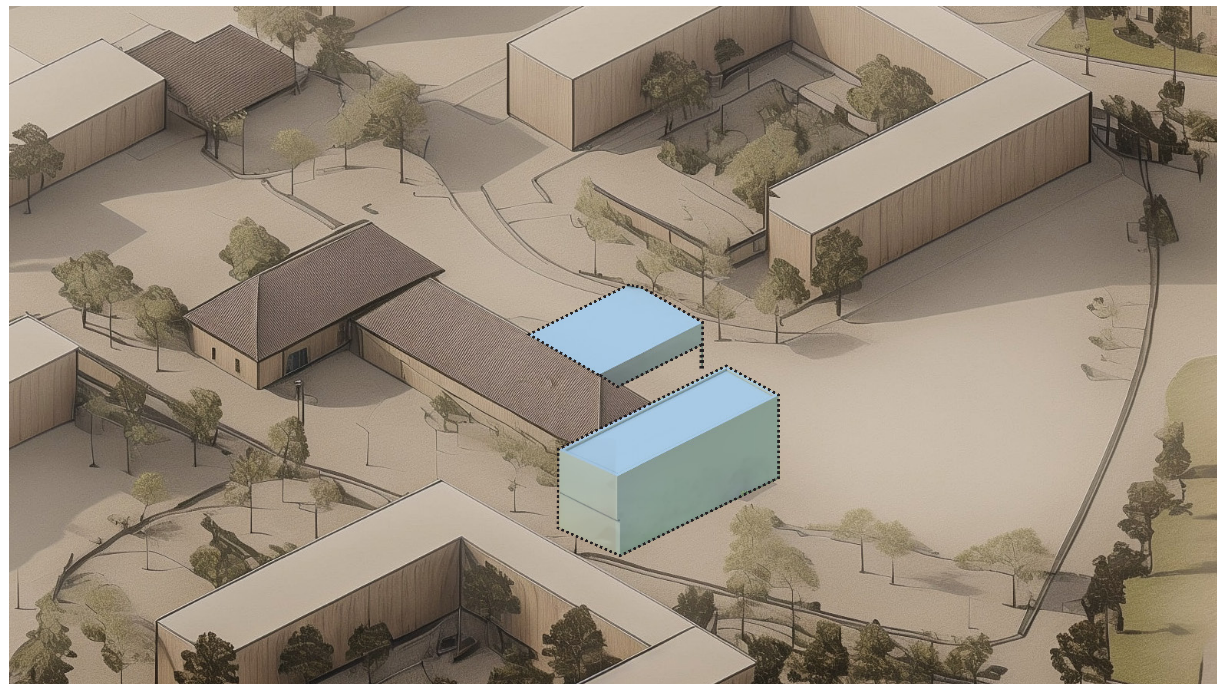


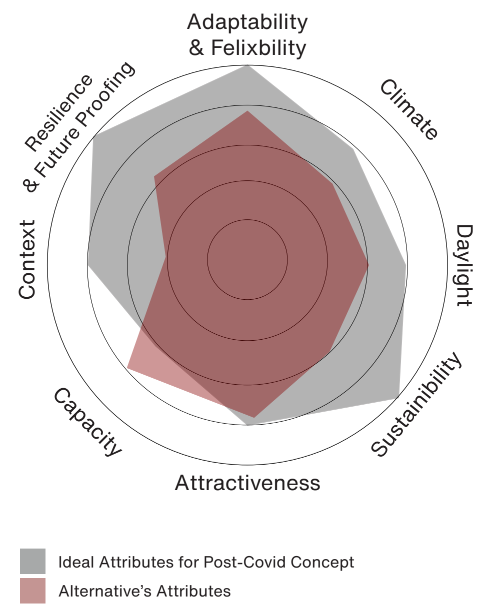


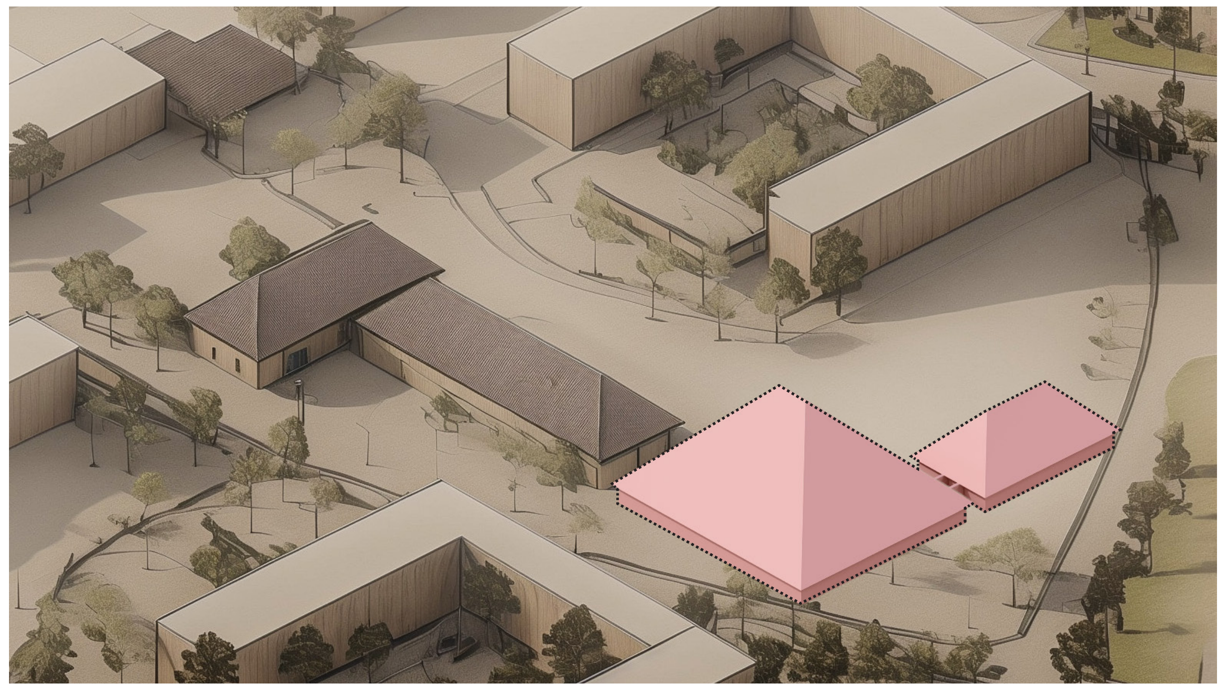


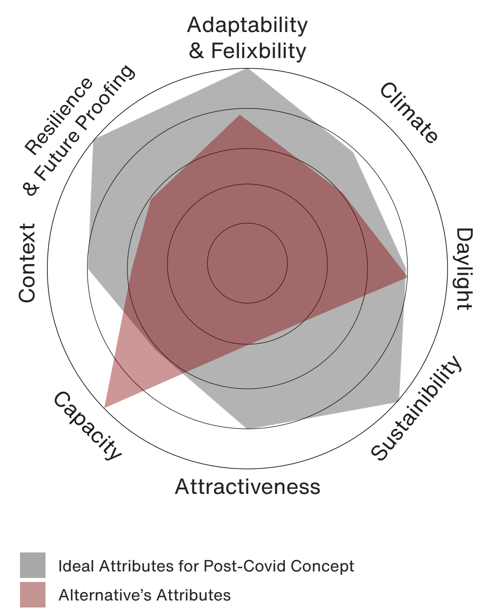
Most Compatible

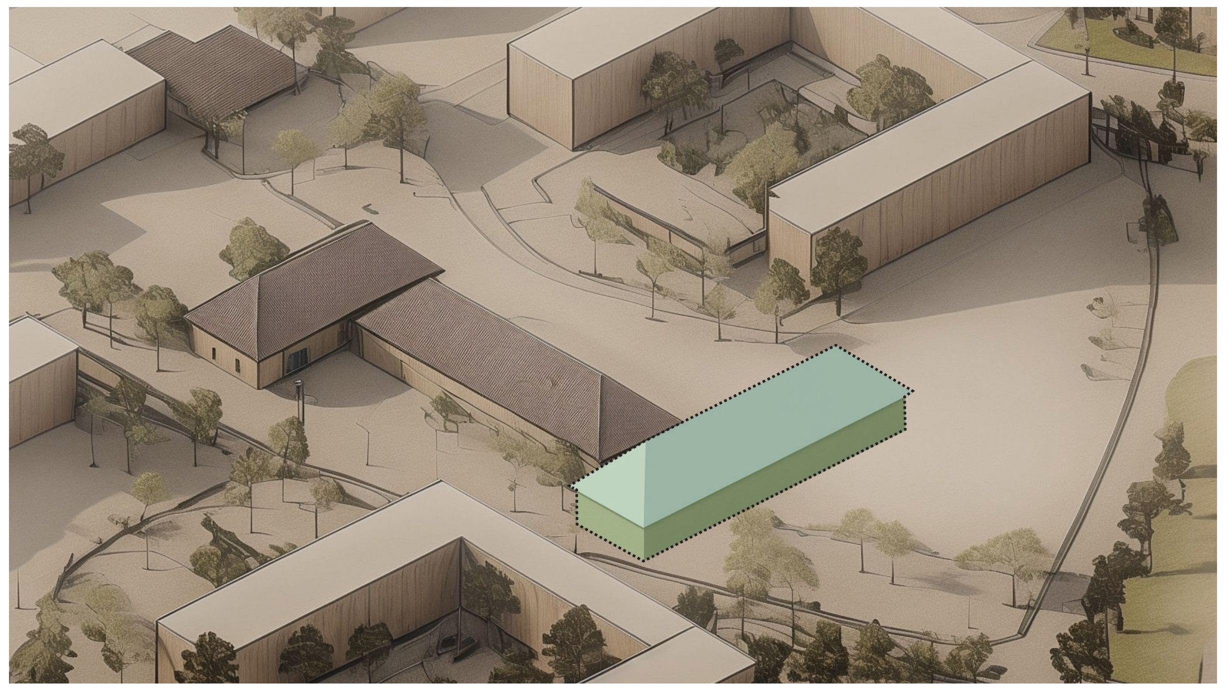


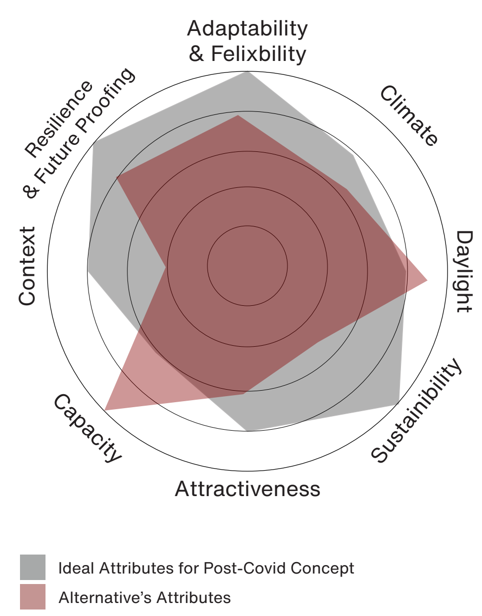






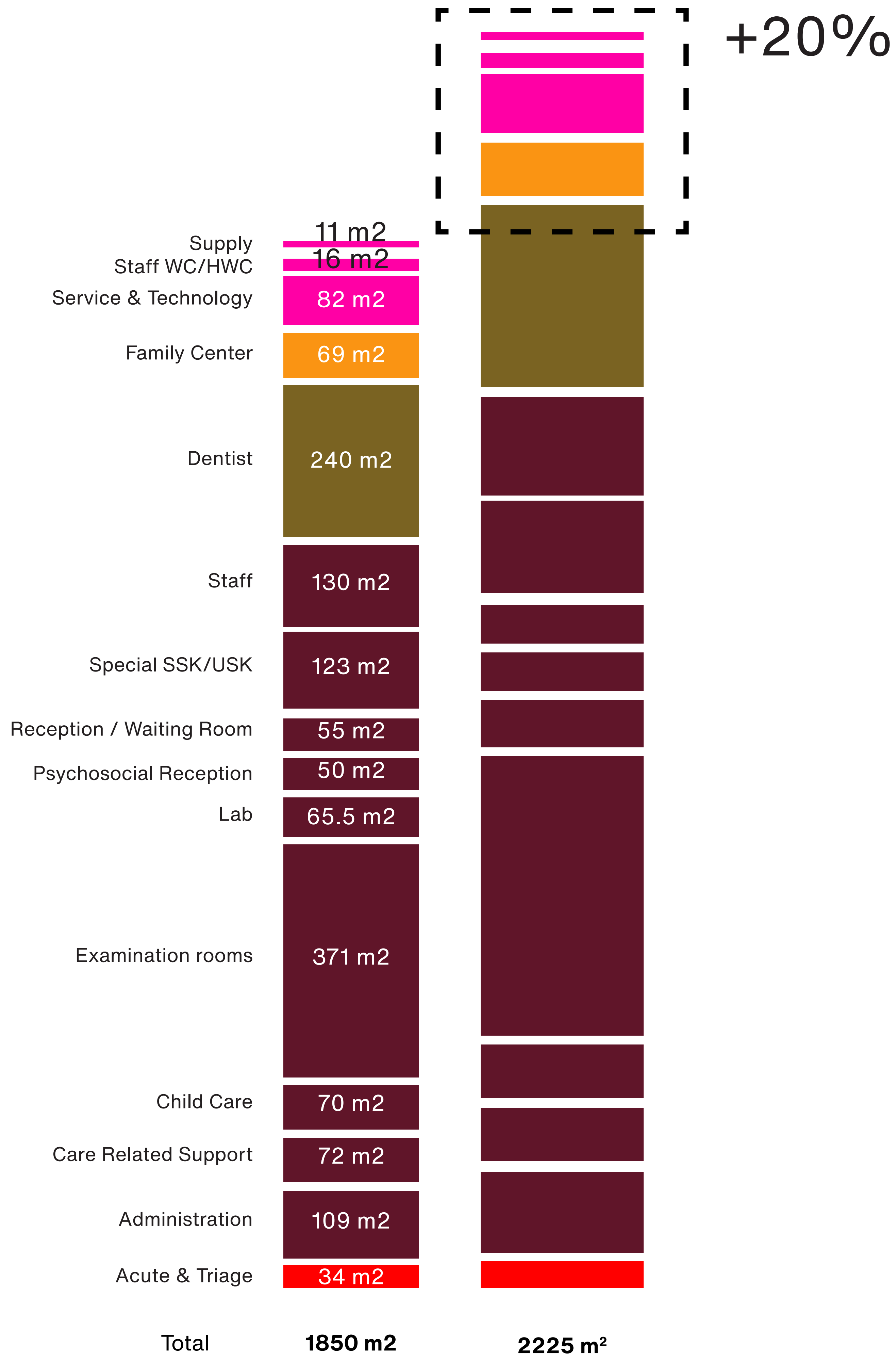






I. PROGRAM

In the post-pandemic era, primary care centers require an increased focus on flexibility to adapt to evolving needs. Compact spaces pose a greater risk of infection control challenges, while biophilic design principles, which can enhance patient well-being, often necessitate more square footage. Additionally, the potential integration of new public health functions, the need for dedicated telemedicine spaces, and the possibility of expanding triage and acute care areas all necessitate either a larger footprint or highly adaptable design solutions. Furthermore, ensuring clear separation of patient flows within the facility is crucial for infection control and overall patient experience. By prioritizing these considerations, the design can effectively accommodate a wider range of needs and future-proof the primary care center for continued success.



J. SUSTAINIBILITY CONSIDERATIONS

This proposal aims for sustainability, aligning with the UN's 2030 Agenda for Sustainable Development, particularly goal 11: Sustainable Cities and Communities. To minimize environmental impact, the design prioritizes the renovation of an existing building, avoiding unnecessary demolition. Modifications focus on interior layouts, window placements, and the roof to accommodate the new post-pandemic function and enhance space flexibility. This approach not only conserves resources but also reduces construction waste. Furthermore, the design prioritizes a healthy and energy-efficient indoor environment. To achieve this, a sustainable solution called Seasonal Thermal Energy Storage (STES) is implemented for the HVAC system. This system leverages the building's natural topography and slope to guide water to cisterns located near the building. By utilizing STES, the design minimizes electricity consumption for heating and cooling, promoting energy efficiency. This not only reduces reliance on fossil fuels but also contributes to a healthier planet for future generations.

Internal Walls *(Replaced)*

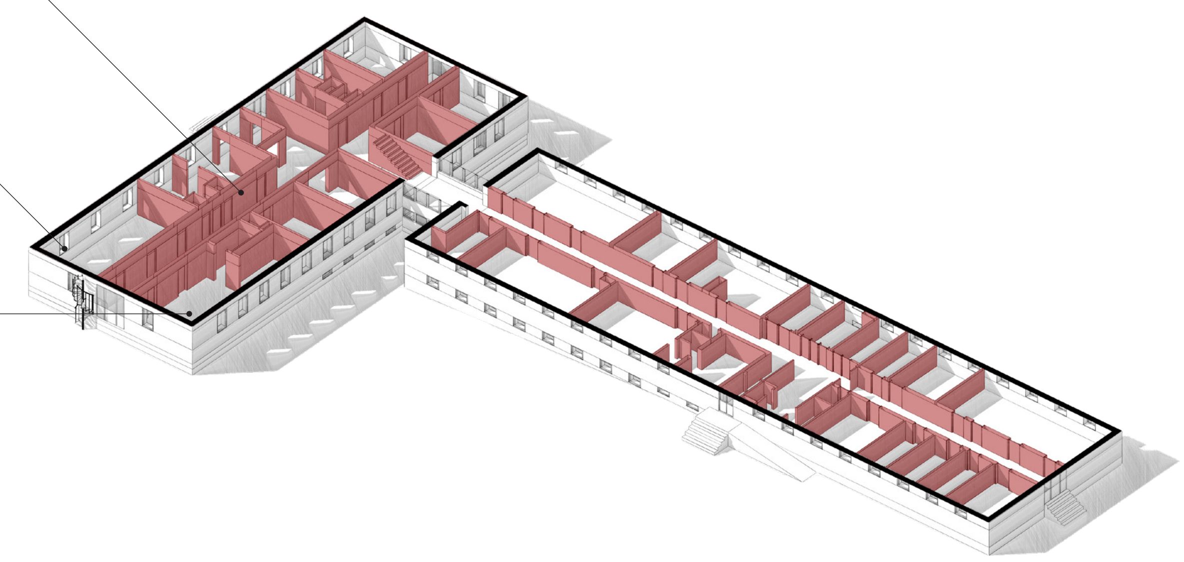
To facilitate the creation of flexible examination rooms that meet both Swedish standards and the post-pandemic need for adaptable spaces, the proposal calls for a new interior grid system. This necessitates the replacement of existing internal walls, allowing for a more versatile and future-proof layout.

External Walls

The exterior wall and all it's components remain unchanged.

Slabs

Slabs also remain unchanged.

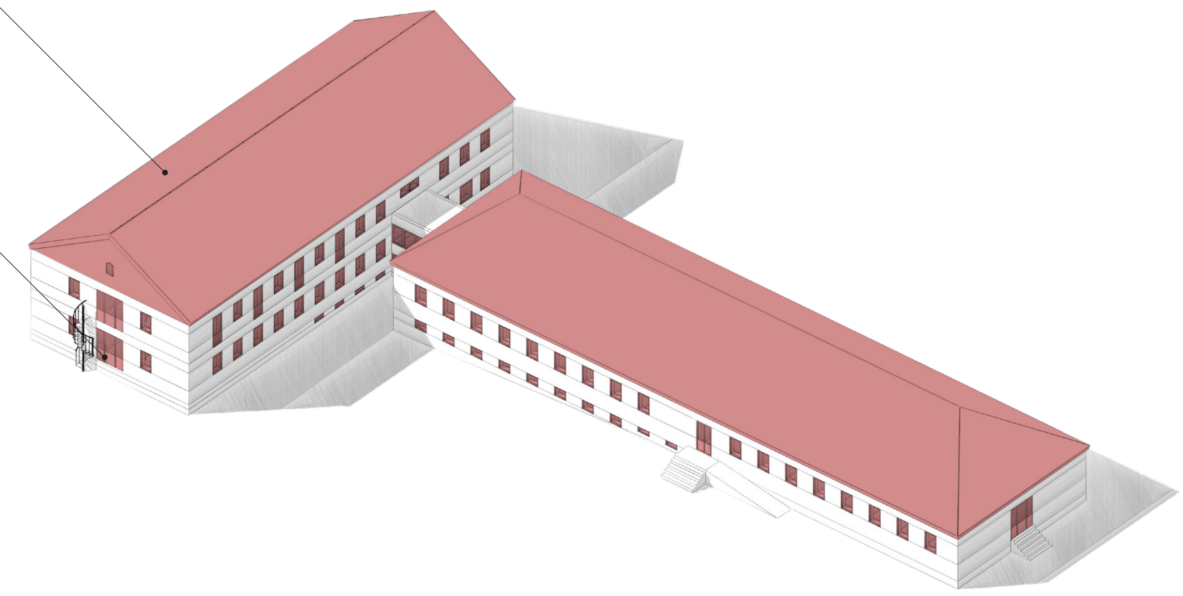


Roof *(Replaced)*

The existing building's low-sloped roof creates limited usable space underneath. To maximize the building's potential and enhance its aesthetics, the design proposes new roof structures that will provide more headroom and allow for functional use of the previously wasted space.

Openings *(Replaced)*

The existing window locations don't align with the new structural grid designed to optimize the building's adaptability and accommodate the post-pandemic concept. To address this, the proposal introduces new openings in the facade, creating a more flexible layout that supports the evolving needs of the space.



Ground Heat Exchange

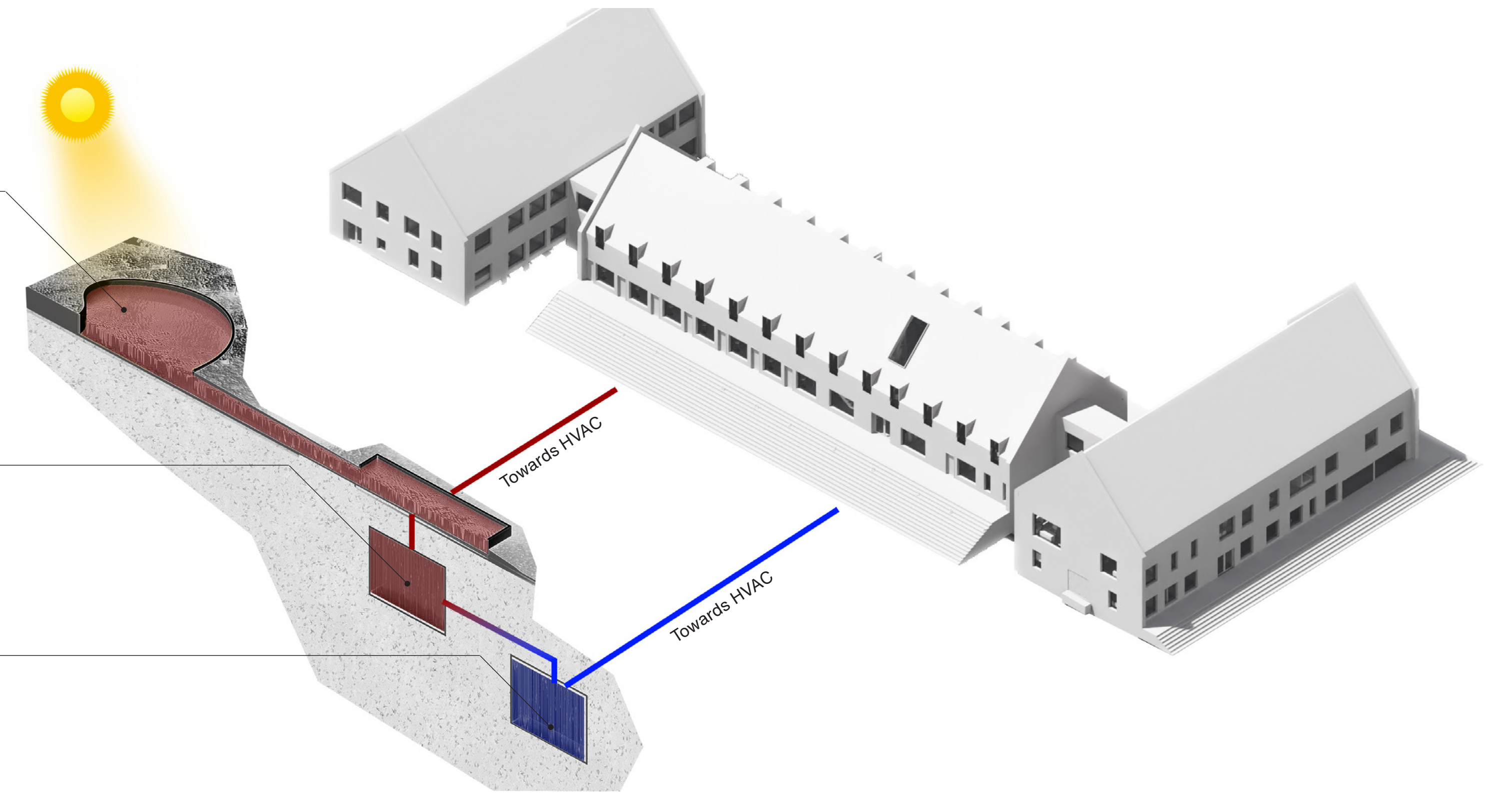
GHE utilizes the relatively constant temperature of the earth below the surface. In winter, a GHE system extracts heat from the ground to warm buildings. Conversely, in summer, it can transfer heat from the building into the ground for storage and later retrieval for cooling.

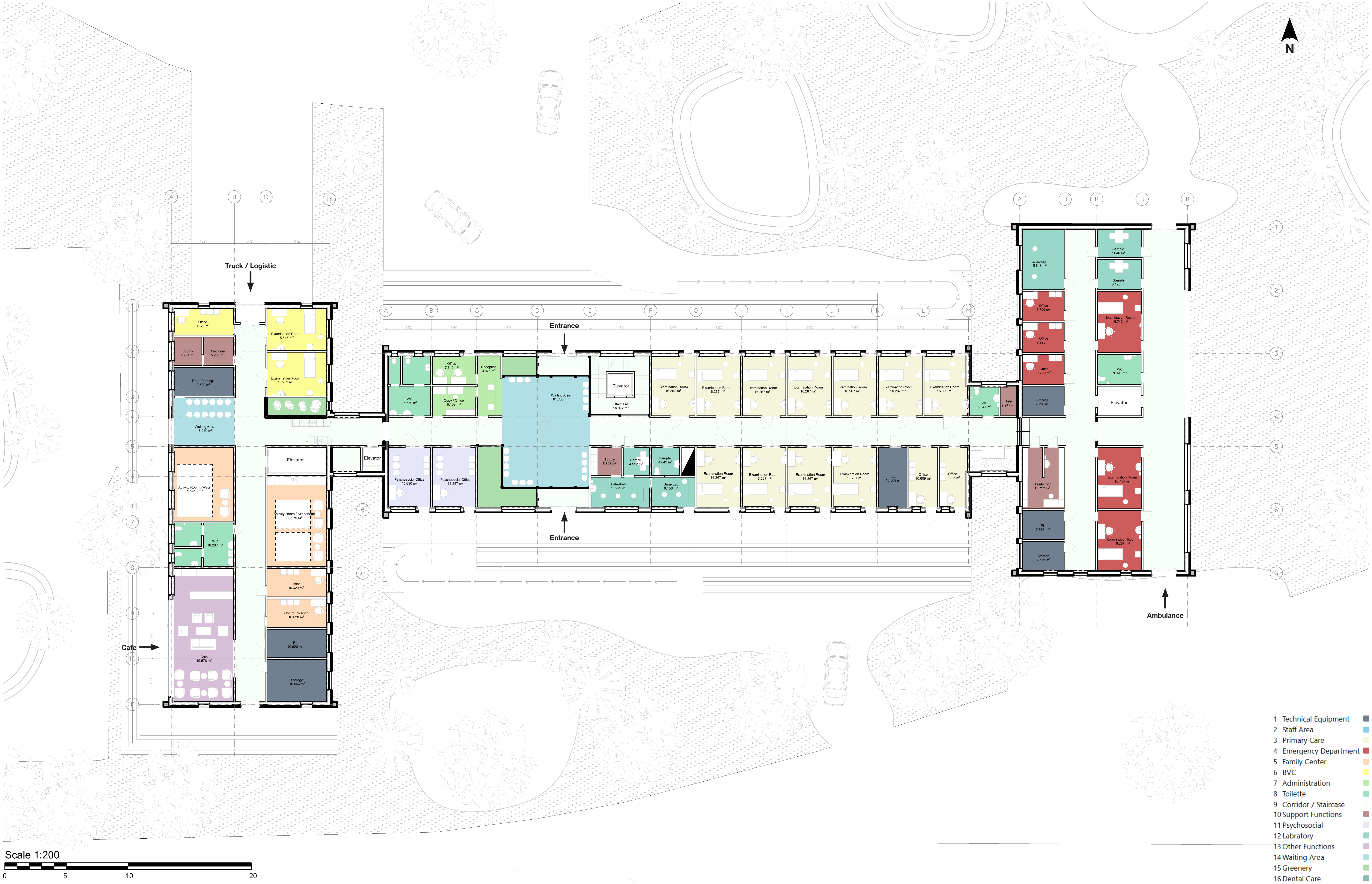
Warm Cistern

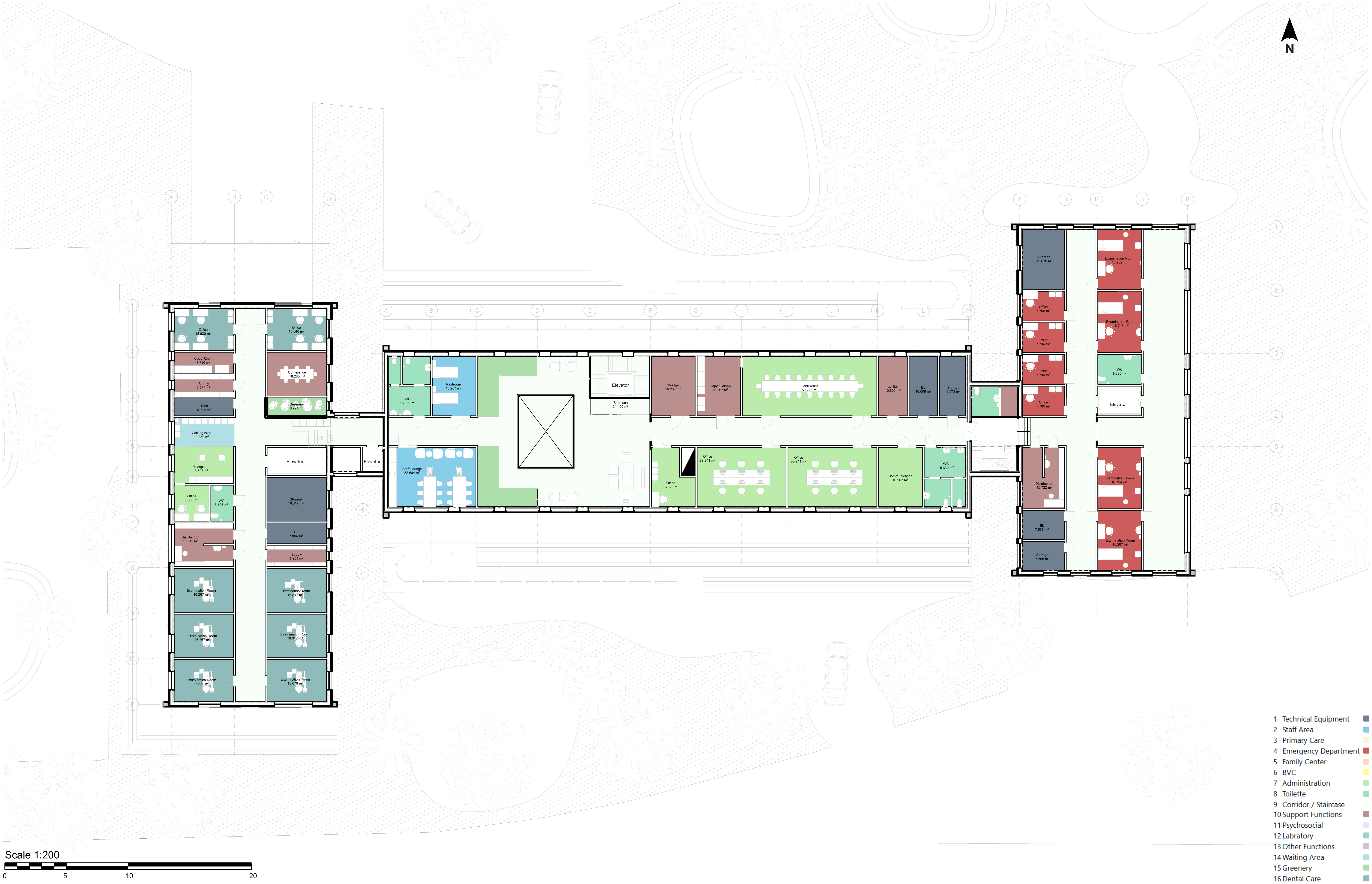
The warm cistern store the heated water extracted from the ground during summer. This warm water can then be used for building heating needs later in the year.

Cold Cistern

The cisterns hold chilled water obtained during winter. This cool water can then be used for building air conditioning or cooling purposes later in the summer.




N
Truck / Logistic
Entrance
Entrance
Ambulance
Cafe
Elevator
Scale 1:200
0
5
10
20
1 Technical Equipment
2 Staff Area
3 Primary Care
4 Emergency Department
5 Family Center
6 BVC
7 Administration
8 Toilette
9 Corridor / Staircase
10 Support Functions
11 Psychosocial
12 Labratory
13 Other Functions
14 Waiting Area
15 Greenery
16 Dental Care



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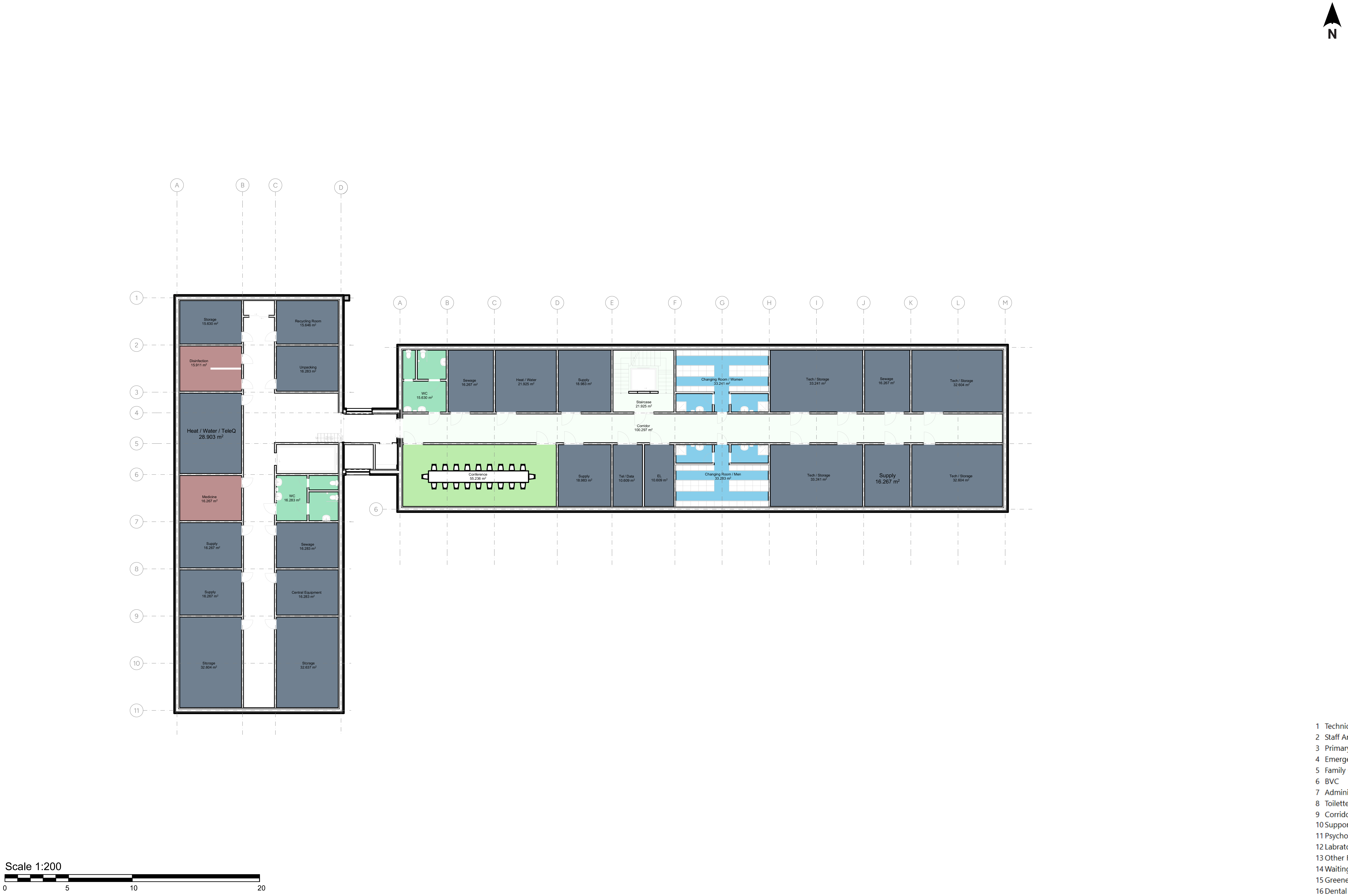

1 Technical Equipment
2 Staff Area
3 Primary Care
4 Emergency Department
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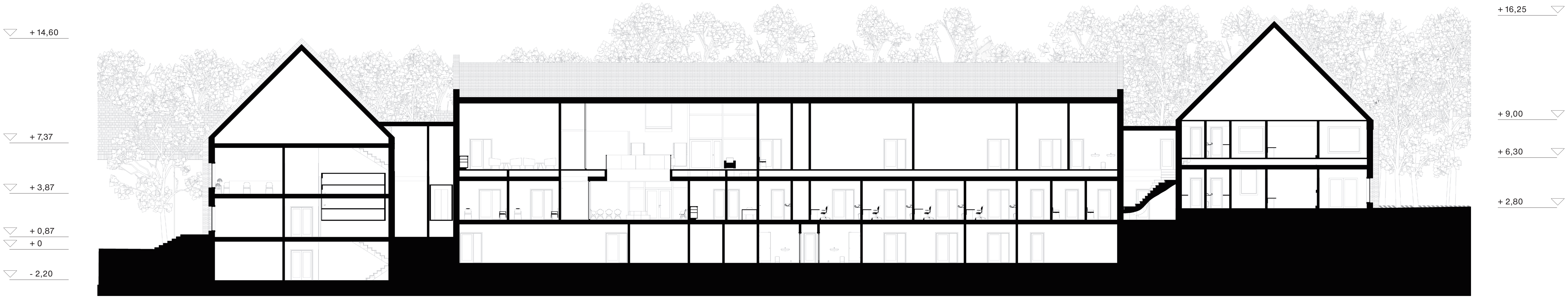

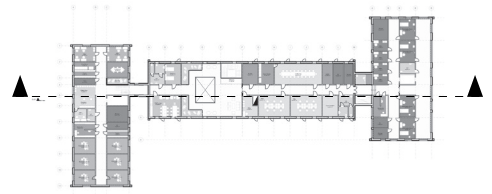

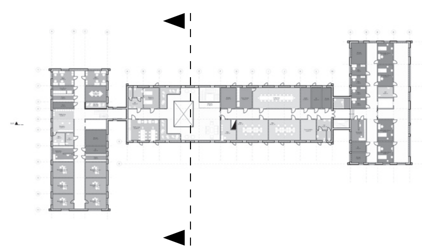

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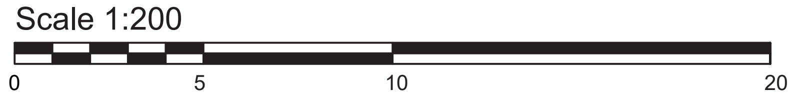
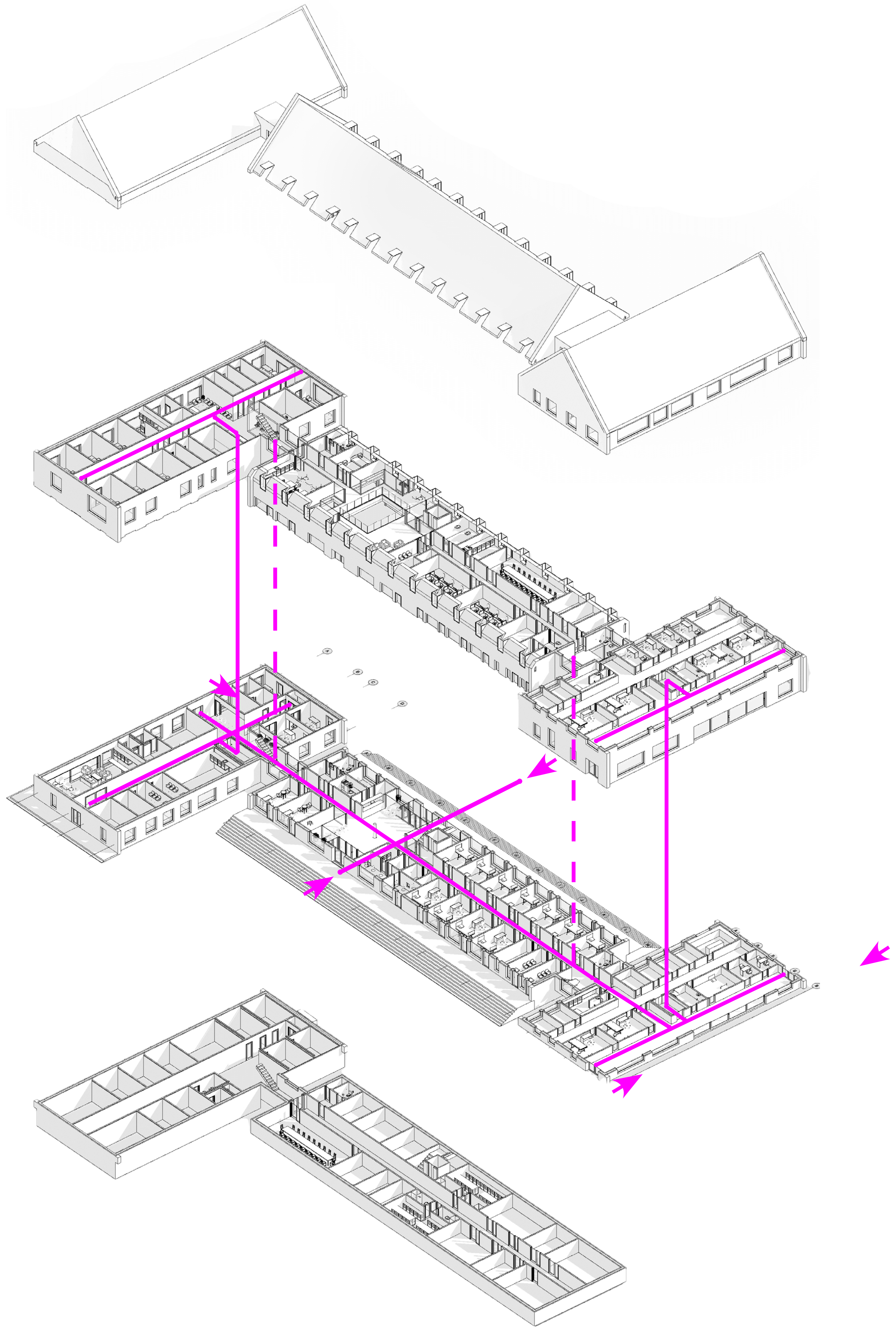
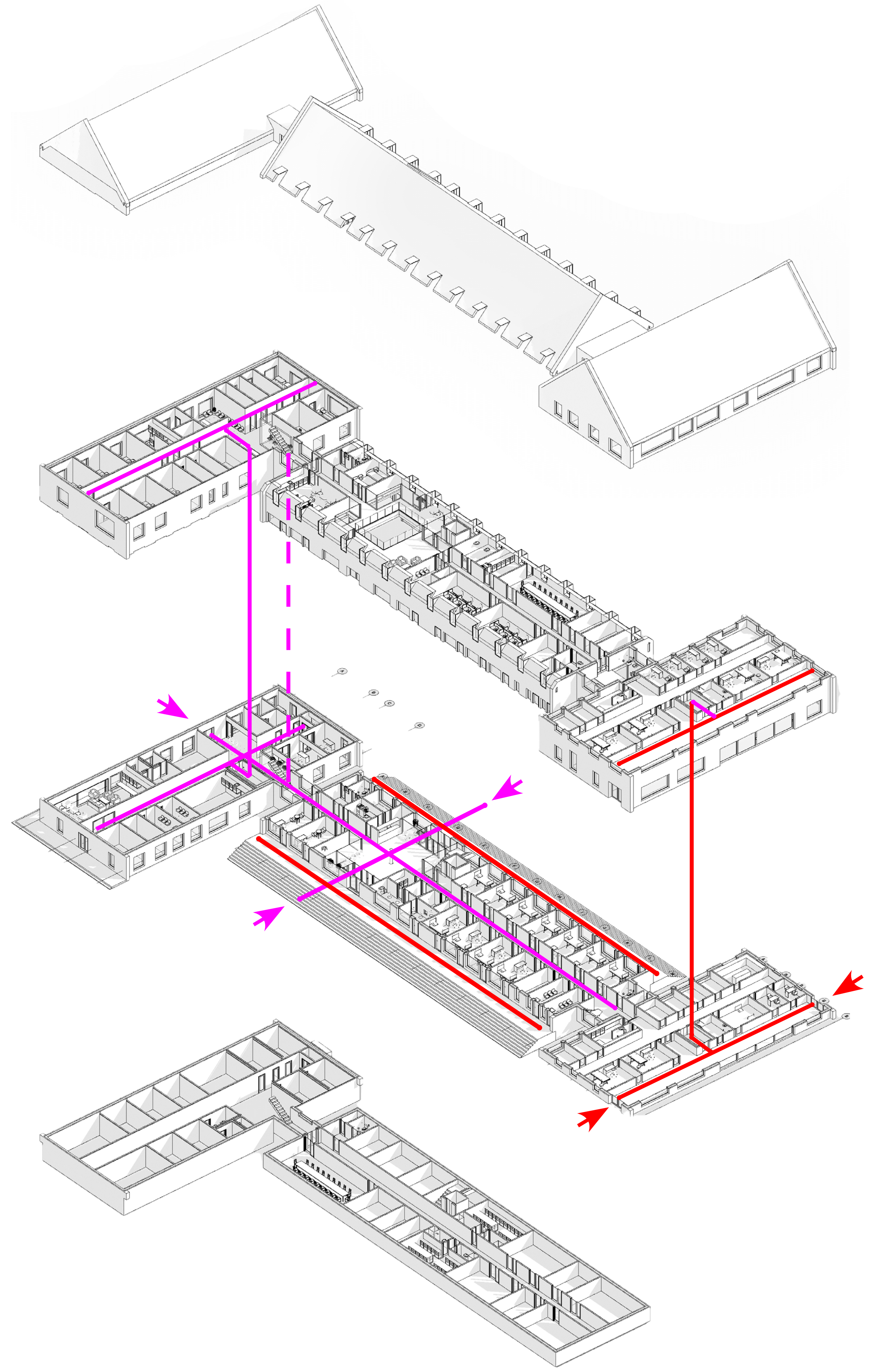


PATIENT FLOW - NON PANDEMIC



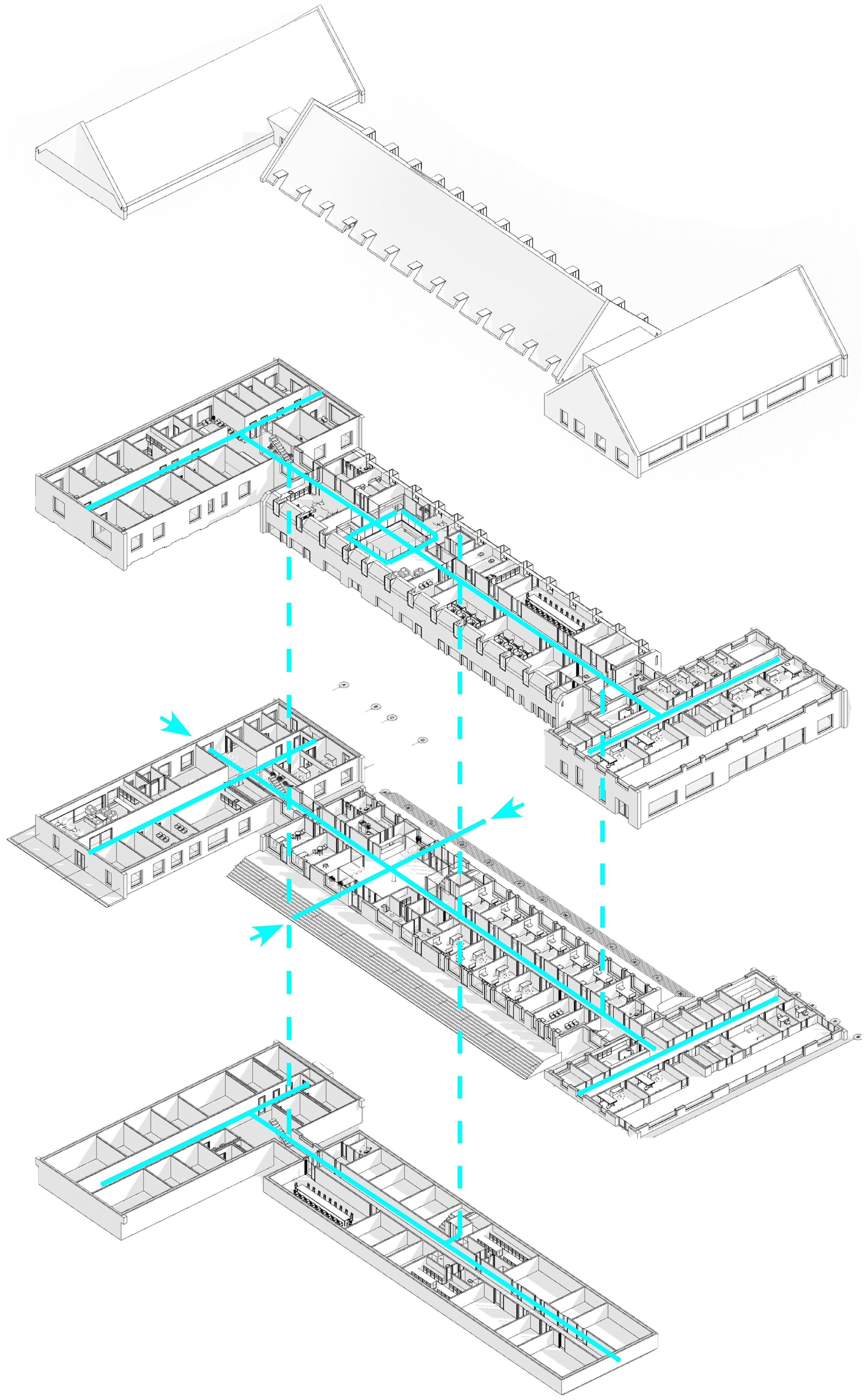
ELEVATOR
STAIRCASE
SUSPECTED PATIENT

PATIENT FLOW - PANDEMIC

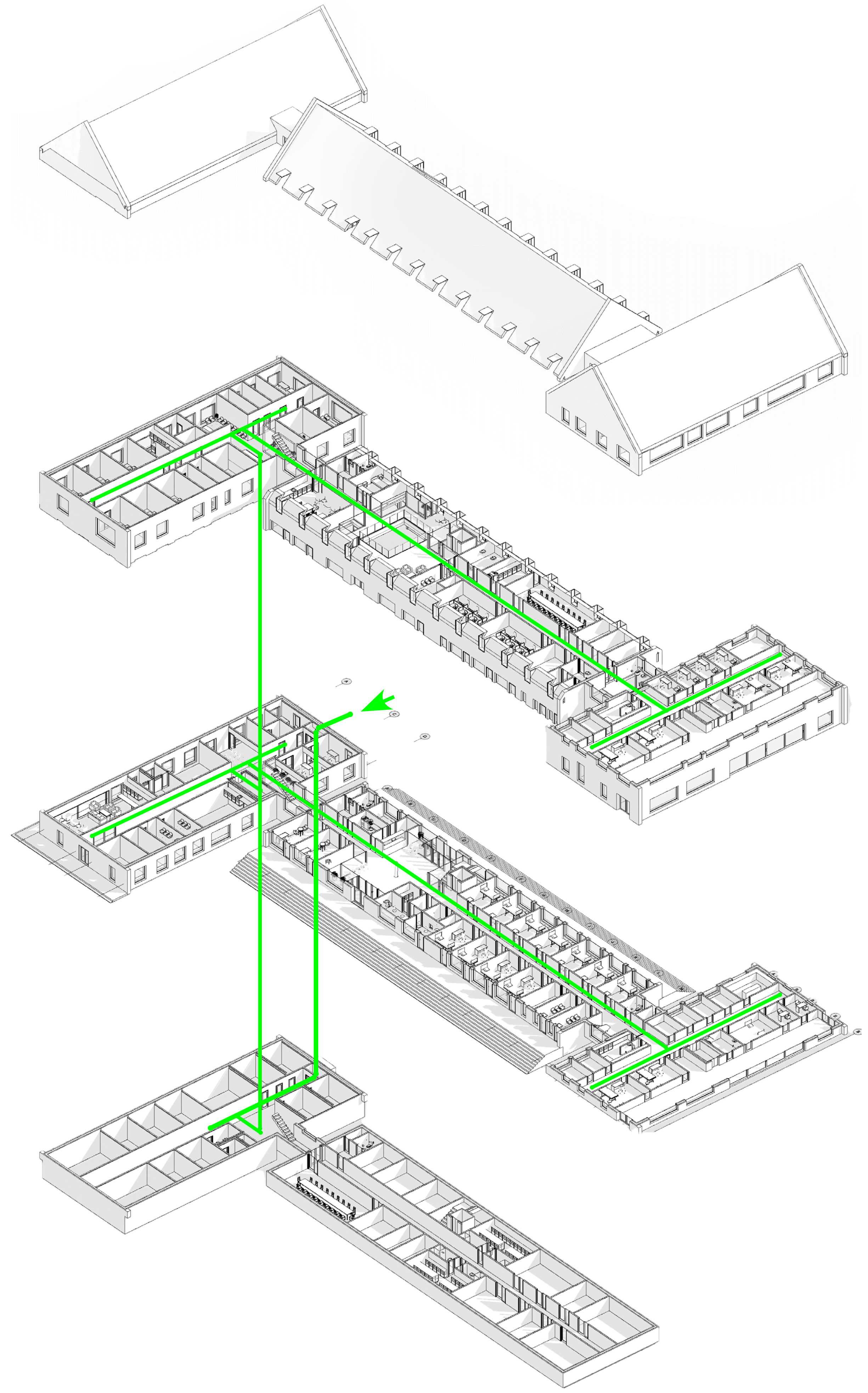


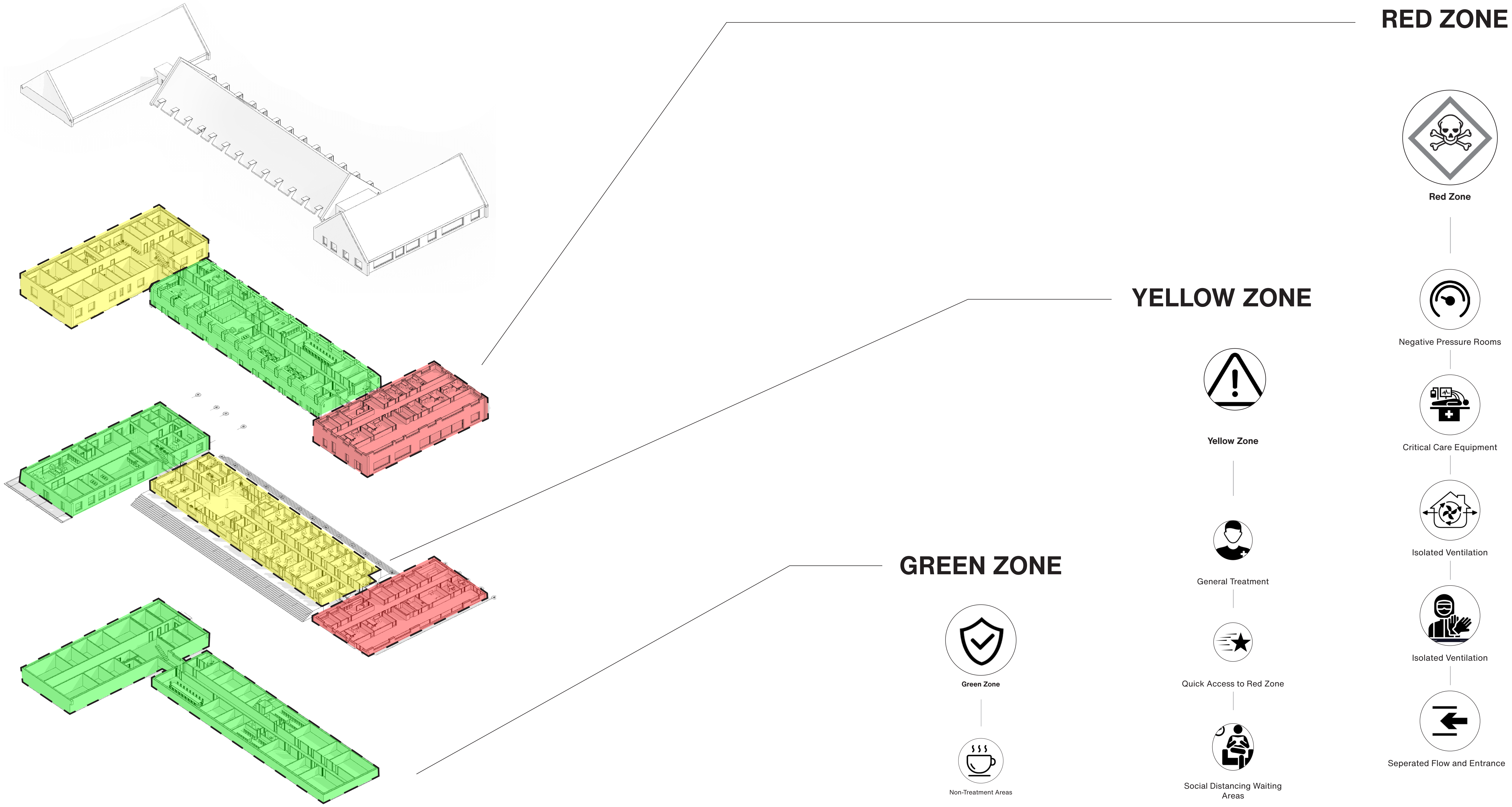
ELEVATOR
STAIRCASE
SUSPECTED PATIENT

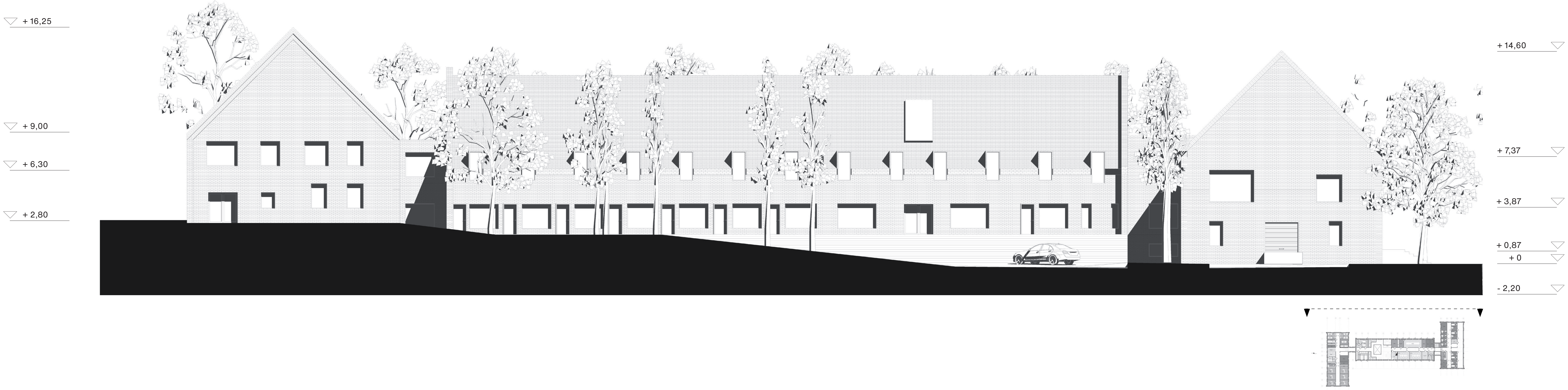
STAFF



GOODS



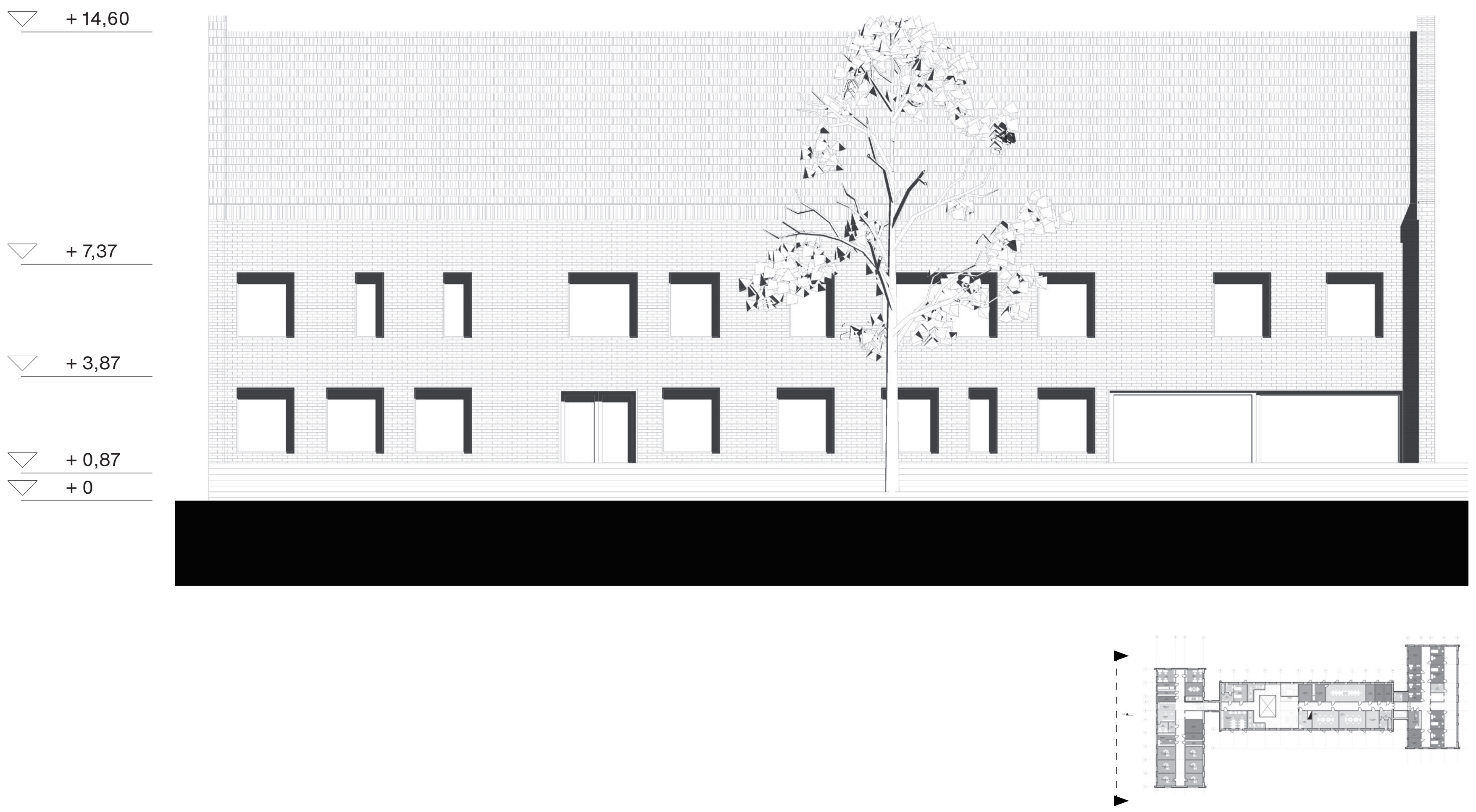

RED ZONE
Red Zone
Negative Pressure Rooms
Critical Care Equipment
Isolated Ventilation
Isolated Ventilation
Seperated Flow and Entrance
YELLOW ZONE
Yellow Zone
General Treatment
Quick Access to Red Zone
Social Distancing Waiting Areas
GREEN ZONE
Green Zone
Non-Treatment Areas

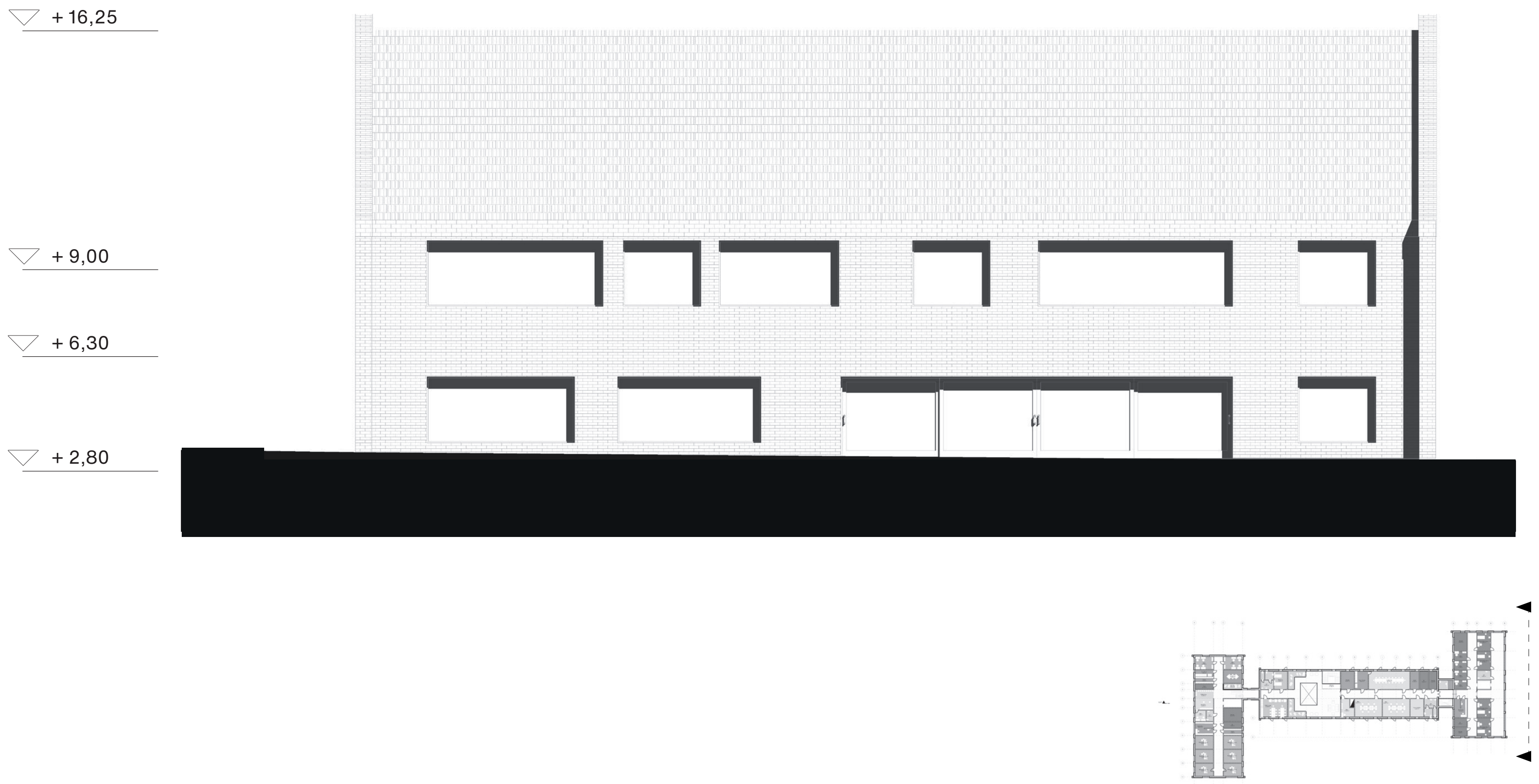


Scale 1:200

0 5 10 20

T. ELEVATION / EAST & WEST





IV.
APPENDIX

A. REFERENCES

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2023