THE HEALING GARAGE

What is the future of the hospital ?

Sarah Sioufi

American University of Beirut

HEALTHCARE INFRASTRUCTURE AND ARTIFICIAL INTELLIGENCE

Architectural speculations about future typologies

By
Sarah Sioufi

Bachelor of Architecture
(BArch)

Department of Architecture and Design

Maroun Semaan Faculty of Engineering and Architecture
(MSFEA)

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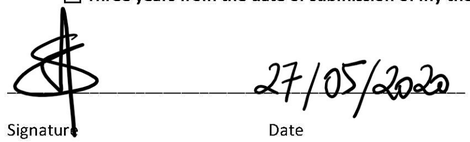

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HEALTHCARE INFRASTRUCTURE AND ARTIFICIAL INTELLIGENCE
ARCHITECTURAL SPECULATIONS ABOUT FUTURE TYPOLOGIES

by
SARAH SIOUFI

ARCH 508/509– FINAL YEAR THESIS I & II
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ADVISOR: Robert Saliba

Approved by Thesis Advisor:

[Signature]

Robert Saliba, Professor

Department of Architecture and Design

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IN-TRO-DUC-TION

THE HEALING GARAGE

HOW DOES AI IMPLICATE THE HOSPITAL TYPOLOGY OF THE FUTURE?

Since the beginning of times, humans have been faced with illness and injuries, and since then there were institutions that were here to help others heal and get better. Healthcare institutions draws back to more than 1000 years BCE, and since then humanity has witnessed many variations of the Healthcare architecture. Looking at the different typologies of "hospitals" throughout history and studying their relation, chronology and differences while studying in parallel the timeline of medical discoveries, a pattern can be discerned: Every time a medical breakthrough happens a change of typology follows.

Putting that pattern in effect it is important to look at the medical advances and discoveries happening now to be able to design and imagine the hospital of the future. There are several emerging technologies that will drastically affect the medical field, nevertheless the one which has already started and will have a huge effect on medicine is Artificial Intelligence. Why look at emerged technologies and not technologies being implemented nowadays in hospitals? Because every time of the hospitals designed for a certain technology is built, it is already outdated due to a new discovery. Therefore, the hospital of the future, or may I say the future of the hospital has to be based on transformability, adaptability, structure and infrastructure in order to be able to adapt and adopt to the emerging discoveries that will once again impose new requirements. A flexible and fast-pace typology that will be able to keep up with the discovery field.

Projecting 50 years forward, the world would have changed and evolved significantly, and an adequate institution will have to be created to be able to take care of that future population. Artificial Intelligence won't only have an important consequence on the way people are diagnosed, treated, intervened on and healed, but also on the architecture typology and the spatial needs of the healthcare institution. According to many reliable sources about half of the 28 million human death in 2015 (52%) were related to medical Emergencies (John Hopkins medicine). The world's aging population is also to be taken into consideration since the ratio of chronical diseases will increase and therefore increase the importance of emergency medicine in order to maintain the aging population healthy. Nevertheless, it is also important to take into consideration the periods of war, revolution, movements, epidemics, fire, mass shootings... in which emergency medicine is crucial to allow the population to overcome these occurrences.

Narrowing it down to the field of emergency medicine, the first step to be taken is learning how does the Emergency Department work. Taking several case studies, the program distribution as well as their proportion of the total area can be determined, and be key elements in understanding what are the need for an Emergency hospital to run, even though it is going to be implemented with Artificial Intelligence, there are some components of the present day ED that are critical to keep. An essay published in the New York Times on the 16th of December 2019 tells the diary doctor on the overnight shift in the Emergency Department. What stands out is the importance of diagnosis and deciphering little details which can save a life (which will be the job of AI) and the importance of the follow up of patients, which can even be more important than the actual doctor's intervention. A shocking number taken from this essay is that almost 10% of patient dispatched from the emergency department will come back in the three following days.

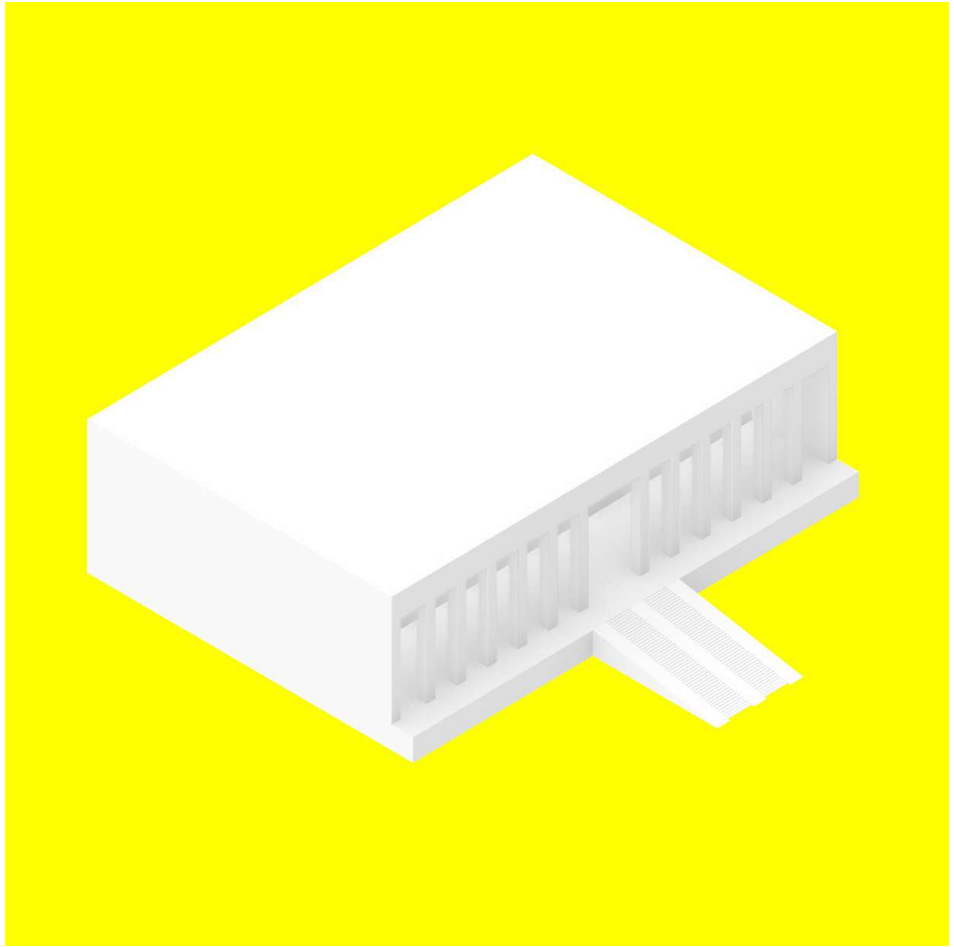
This information emphasizes on the importance of wellness and recovery to complete the full cycle of health of the patient, the Emergencies must not only be able to intervene on patients treatment time in the fastest way possible but also to make sure they are staying healthy and following their needs and prescriptions after that. A wellness element has to then be added to the recipe of the new Hospital typology, and which will make this time not play a secondary role similarly to the hospitals which are running nowadays, but have an equal if not more important role than the intervention.

The future of the hospital is therefore the combination of an AI (artificial intelligence) activated emergency intervention module and a wellness and recovery module, therefore breaking away from the strict hospital typology and reimagining it in order to be more efficient and more human. The mix of these two antipodes will also be a catalyzer in changing the aspect and the feeling generated by going to the Emergencies by creating a peaceful Eden which is only fueled by the will to heal.

THE HOSPI-TAL TY-POLOGY TIME-LINE

THE HOSPITAL TYPOLOGY TIMELINE

The first step of designing and imagining the hospital typology of the future is looking at past typologies. Going back to the first recorded healthcare institution in ancient Egypt, this section consists of a timeline of the key hospital typologies throughout history. The timeline is divided into six main periods that spread between 1290 BCE and today, and highlights with the main medical or technological discoveries that are responsible for the change of typology in that period.
The first period is from 1290 BCE to 100 AD and mainly consisted of the healthcare typology being based on rooms not the full architectural scopes, therefore there was several typed of rooms that were part of the healing process and were laid out in several ways. Galen's contribution to anatomy, physiology and pharmacology in 160 was the turning point which ended this typological period.
The second period spreads between 350 and 1740, in this era hospitals are mainly affiliated to religious institutions, either churches or mosques, and consisted of an annex to the religious building which was a large room with beds that the sick would share. This typology was not very efficient noting that people use to contaminate each other. There were two tuning points in this case in 1796 and 1841.
The third period is the first in which architecture has a role and something to offer, the ward or pavilion model consisted of different pavilions in order to separate people with different diseases and it focused a lot on lighting and cross ventilation. This typology was used between 1865 and 1901.
The three following periods came after the first skyscraper, they were focused first on a stacking model, then with more machines needed the podium typology emerged followed by the typology we know nowadays the campus hospitals.

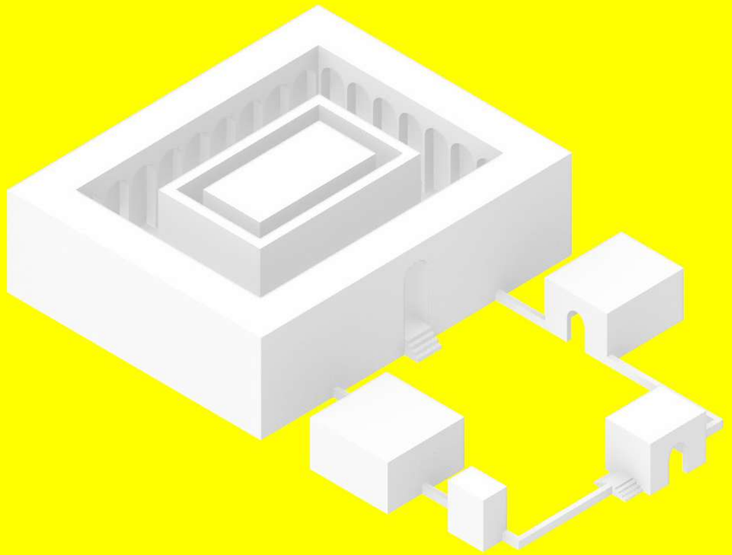


TEMPLE OF SETY I

Ancient Egypt

Temple in acient Egypt dedicated to Sety, which had several rooms dedicated to “healing” which was mostly spiritual at the time.
The rooms consisted of statues of the gods to which the ill had to pray in order to get better since in that time an illness was equivalent to being punished by the gods.

1290 BCE

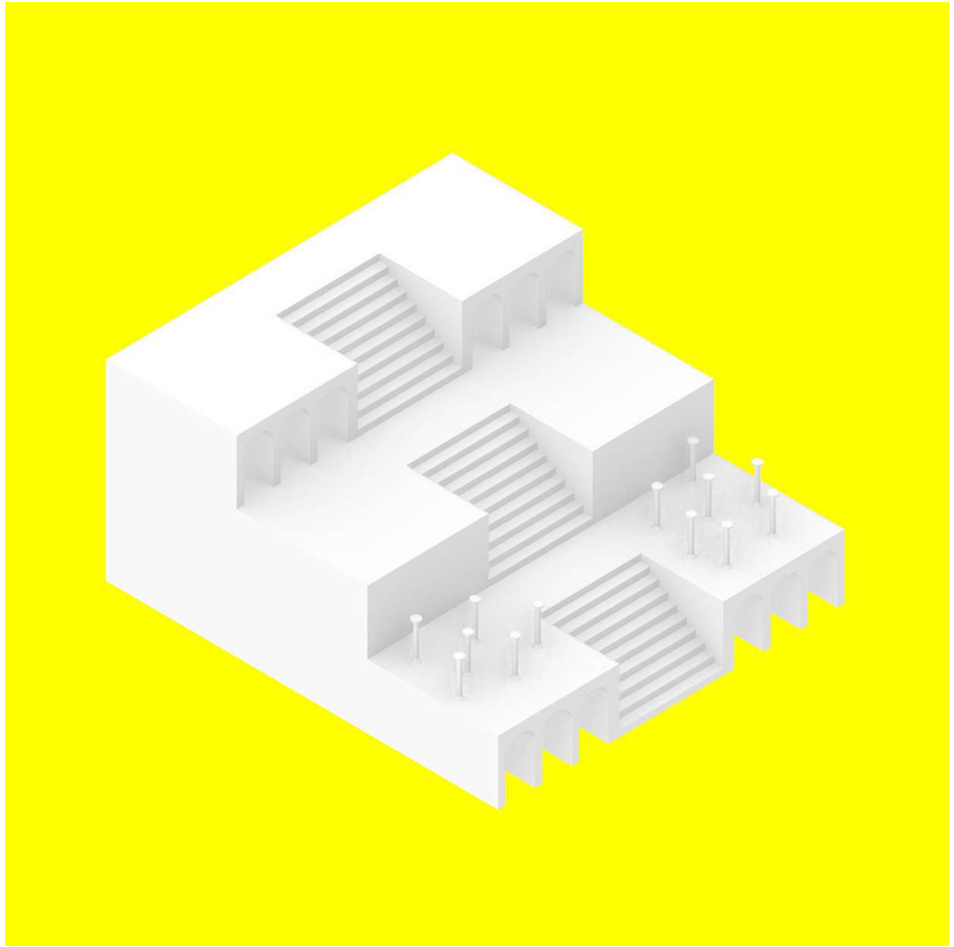


MIHINTALE

Sri Lanka

Known as the oldest hospital in the world the mihintale hospital is situated at the bottom of the sacred moutain of mihintale in Sri lanka, the hospital consited of rooms spread around a central “clinic”

400 BCE

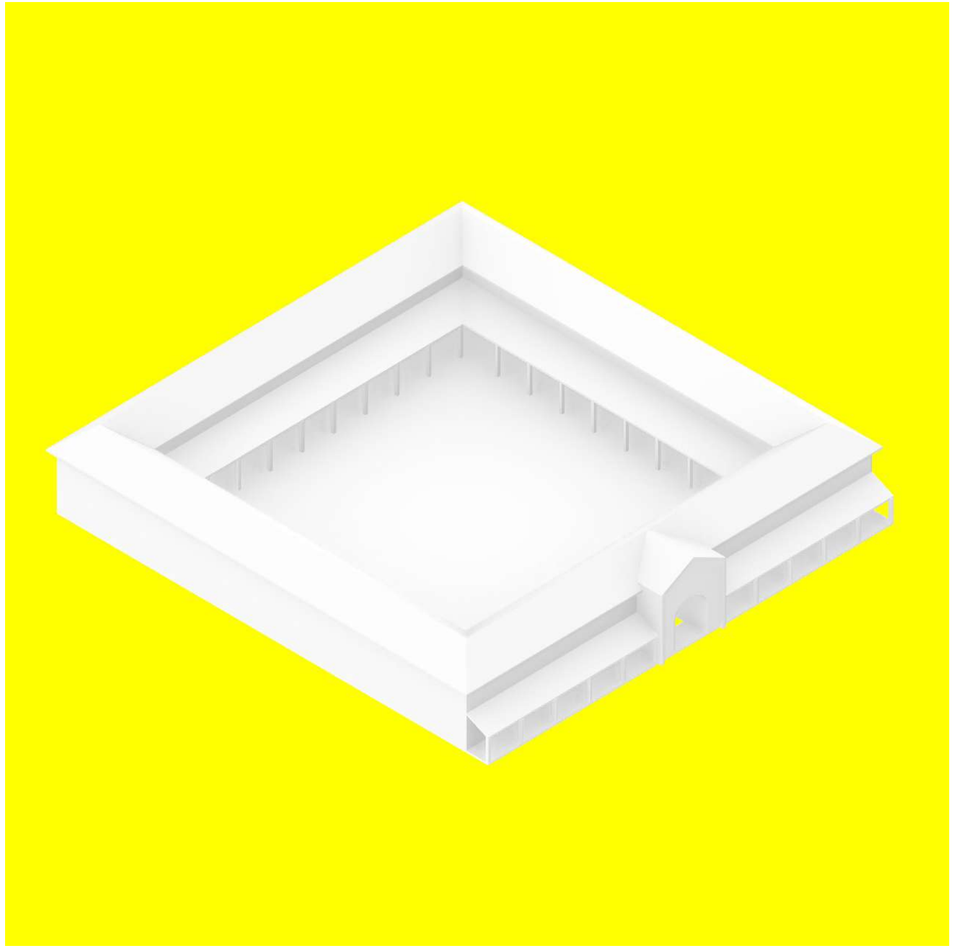


350 BCE

ASCLEPEION

Acient Greece

The Asclepeion doesn't have a fixed outer architecture, it is also based on room modules. In this case there are 3 types of rooms which are the 3 steps to recovery, the first being a sleeping room mostly enclosed with no daylight, a room for exercising and a third room to get a snake bite administrated. Therefore, different combinations of these rooms exist.



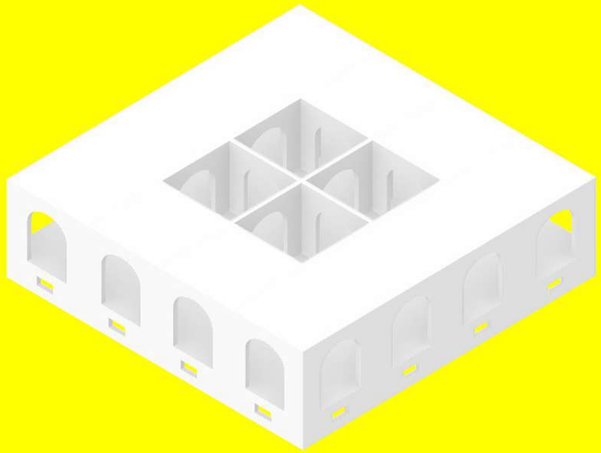
100

THE VALETUDINARIUM

Roman Empire

The valetudinarium was a hospital for the roman empire's army, especially when they go fight outside of the republic of Rome, it had to be able to receive a big number of soldiers. Galen the father of anatomy was a physician in the valetudinarium before his discovery that changed medicine.

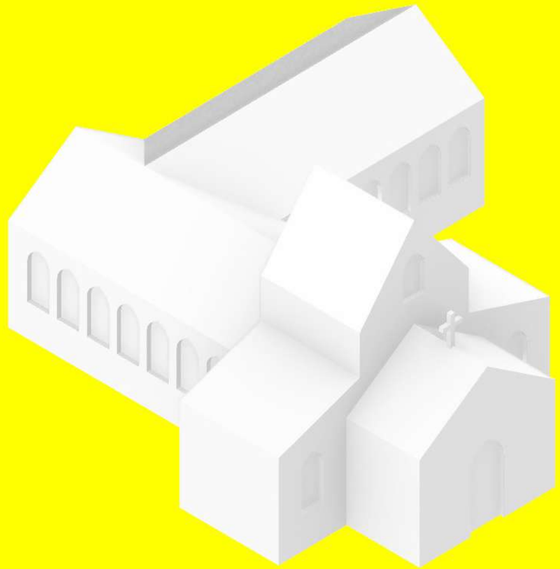
160 : Galen's contribution to anatomy, physiology, and pharmacology



BYZANTINE HOSPITAL

Turkey

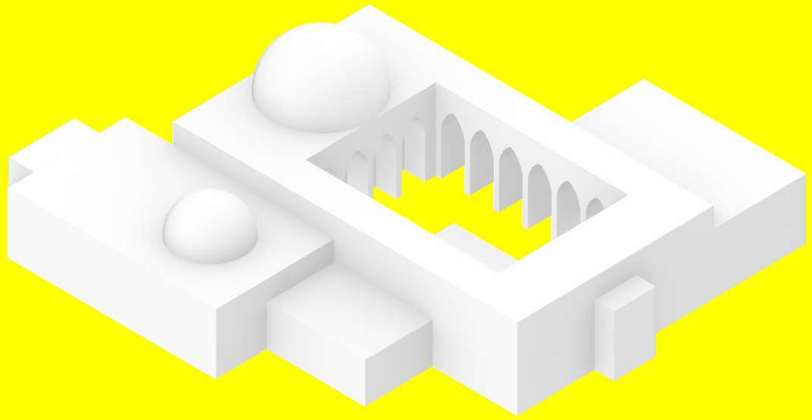
Being built at the turning point between the two eras (prior and after Galen's discovery) of typologies the hospital was not yet affiliated to a religious institution but was built by the church to help soldiers.



HOTEL DIEU DE PARIS

France

The hotel Dieu de Paris is the oldest hospital still in use even after burning to the ground it has been rebuilt and continues to run as a hospital. It was affiliated to the cathedral in Paris, and consisted of an open space with beds which could receive up to 250 ill, even if they had to be 3 in the same bed. This was an enormous problem since the death rate of the hospital was of 25% because of cross contamination of patients.

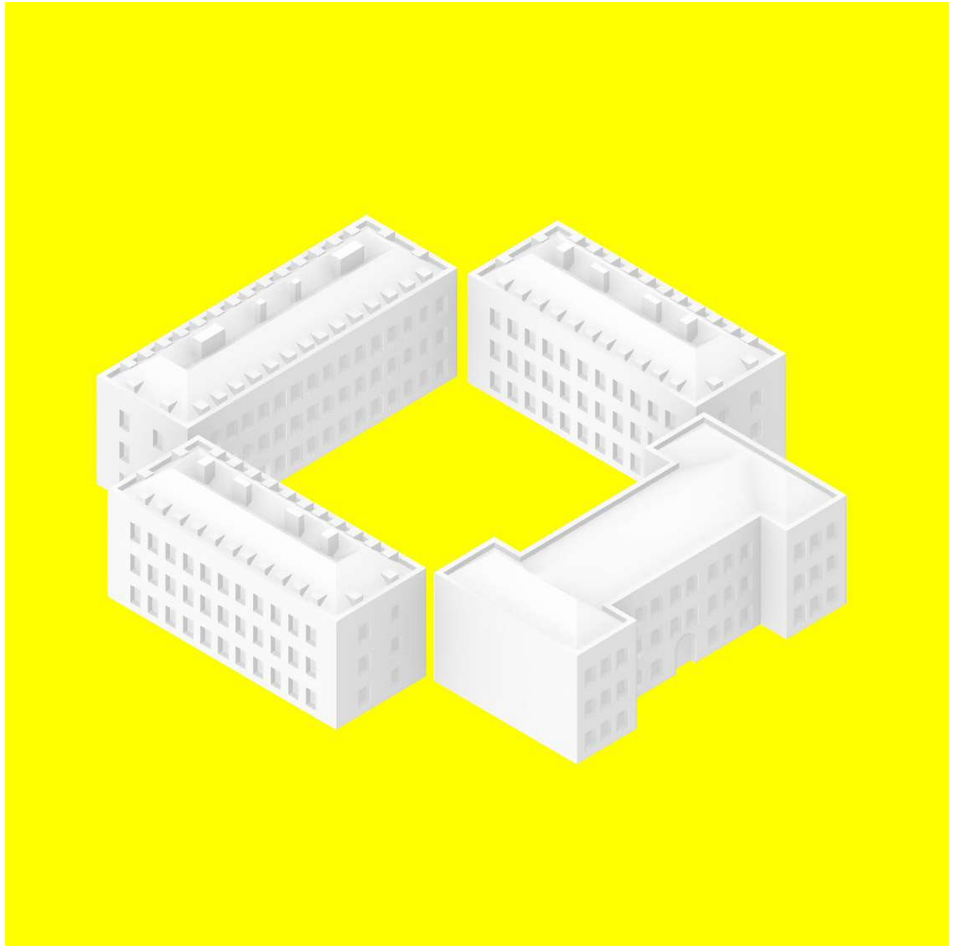


1354

BIMARISTAN ARGUN

Syria

Bimaristan Argun was a hospital in Aleppo, it was the annex of the mosque, and was considered as a laic hospital that was open to all the religions in order to offer help. The rooms were laid around a central fountain which also acts as a light well



1740

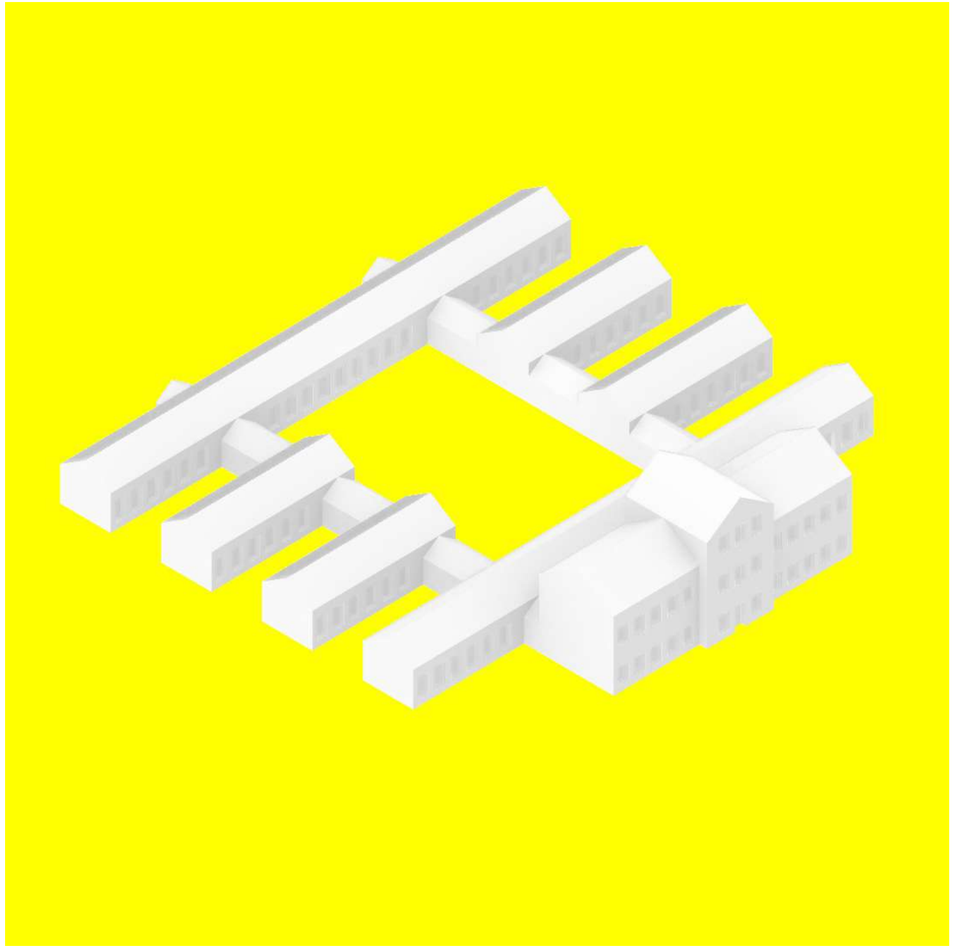
ST. BARTHOLOMEW'S HOSPITAL

London, UK

This hospital was known to being the first hopsital of that period not to be affiliated for religious institution, Placed in the center of London and having several buildings this hospital was serving a large number of patients.

1796: Edward Jenner discovers a method now known as vaccination

1841: Sir Humphry Davy discovers anesthesia

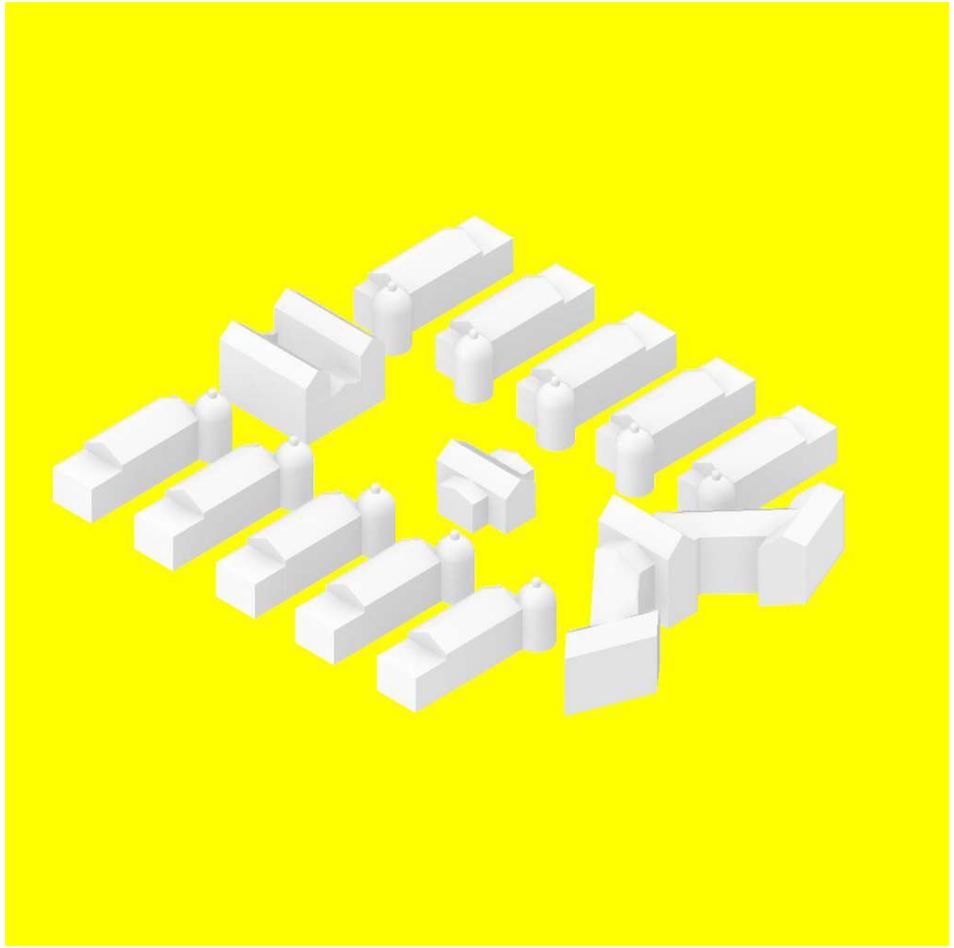


1865

ROYAL HERBERT HOSPITAL

London, UK

The ward system typology had different variations, in this case we can see several wards all interconnected with galleries around a common open space in the middle. The buildings are laid out this way in order to favor sunlight in the wards as well as ventilation to reduce the chances of stagnating bacteria



1901

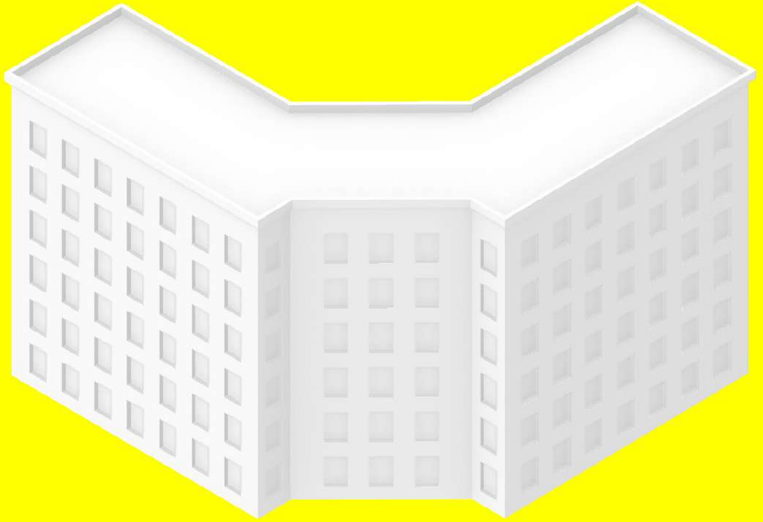
SANT PAU HOSPITAL

Barcelona, Spain

The Sant Pau hospital is a variation of the ward system also known as the pavilion system, the buildings don't seem interconnected, they are not directly, but there is an underground network of corridors that link all the pavilions' entrances. The aim of this typology is again to separate the ill and to promote a start of wellness in hopitals.

1900: The use of XRays (discovered in 1895) is essential for clinical care

1903: Invention of the Electrocardiogram by Dr. Willem Einthoven

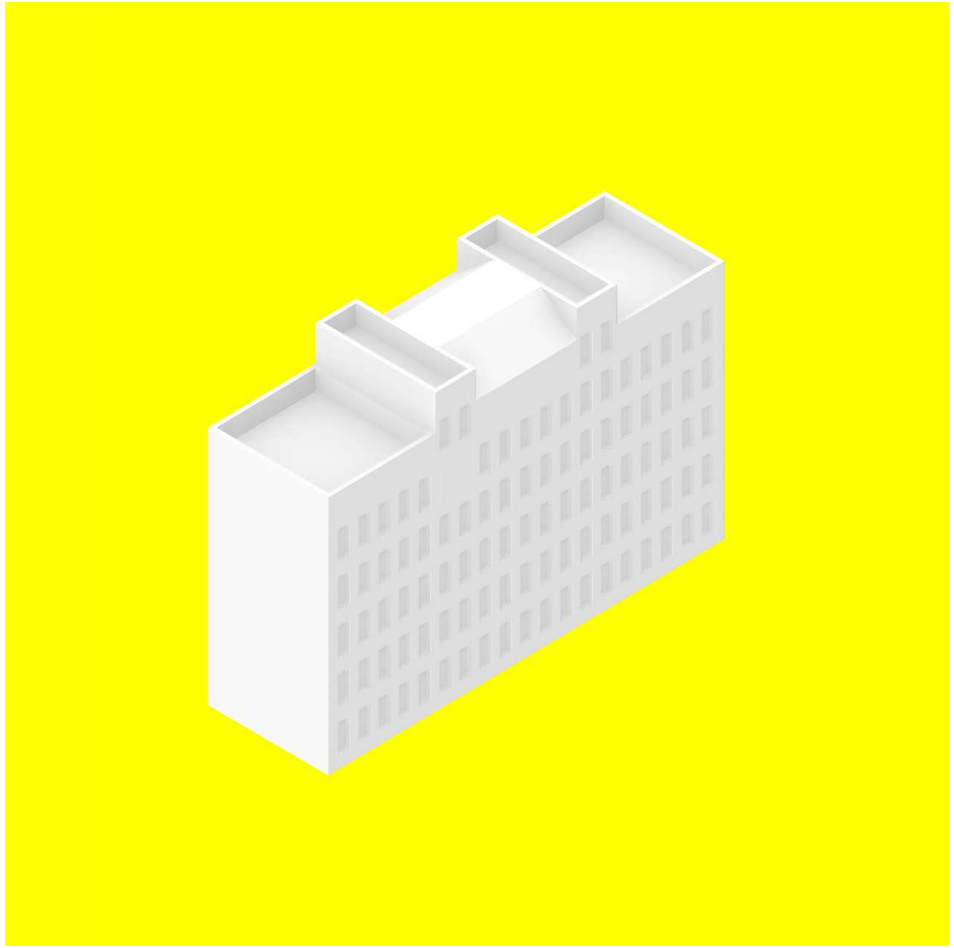


MICHEAL REESE HOSPITAL

Chicago, US

Known as one of the first skyscraper hospitals, this typology consisted of stacking the different buildings previously being considered wards and creating a vertical hospital

1910



1922

JAMAICA HOSPITAL

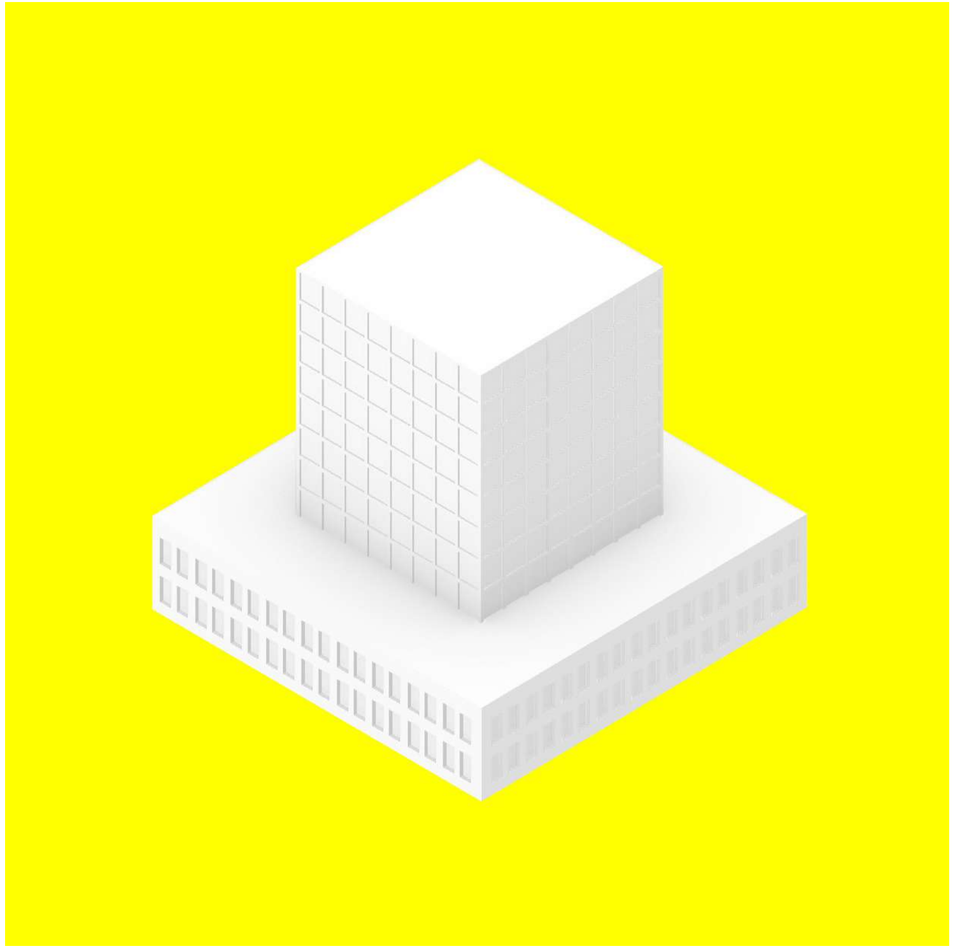
New York, US

An important feature was the central core which would connect the whole building vertically and facilitate the circulation of patients as well as doctors. In this case it is easy to determine that the building had two cores and therefore more efficiency

1924: Dr. Hans Berger of Germany recorded the first human electroencephalogram

1943: Willem J. Kolff,built the first dialysis machine

1947: First cardiac defibrillation success in clinical application

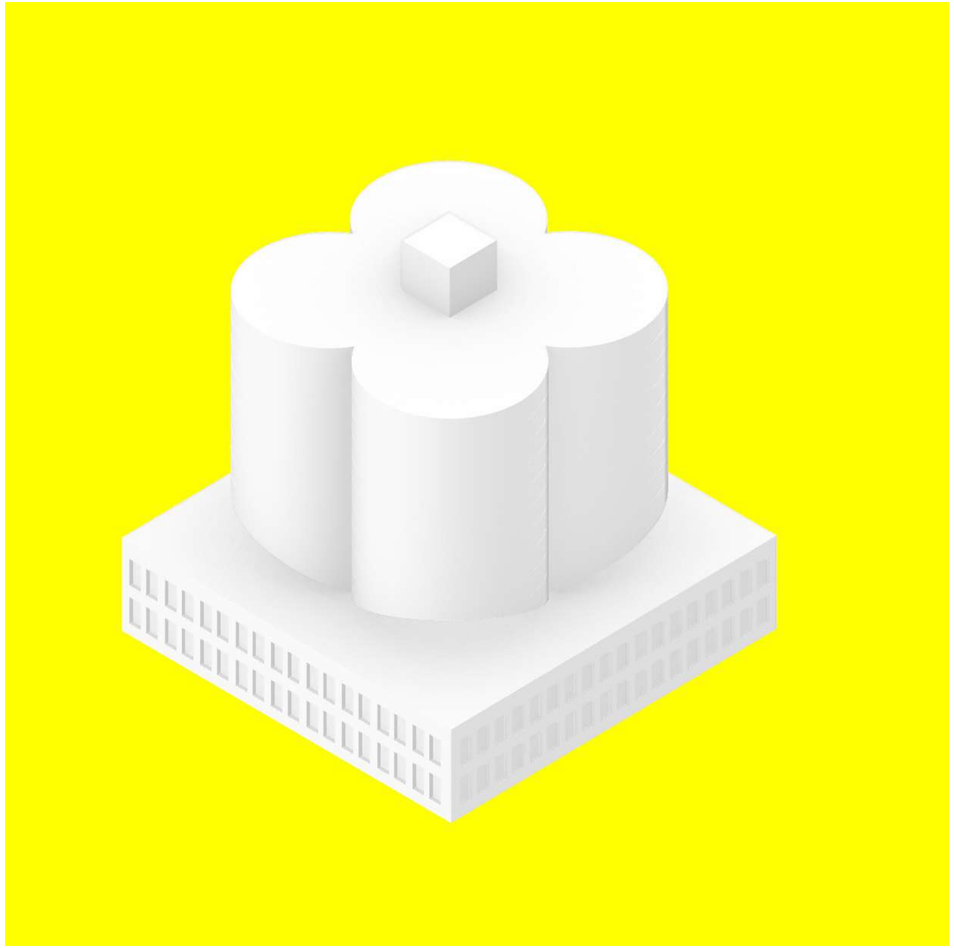


HYGEIA HOSPITAL

Greece

With the discovery of many new machines that were enormous at the time the podium typology was the most efficient way to merge the bulk of the machines on the bottom part and the patient's care and rooms on the upper part also being served vertically

1975



1975

PRENTICE WOMEN'S HOSPITAL

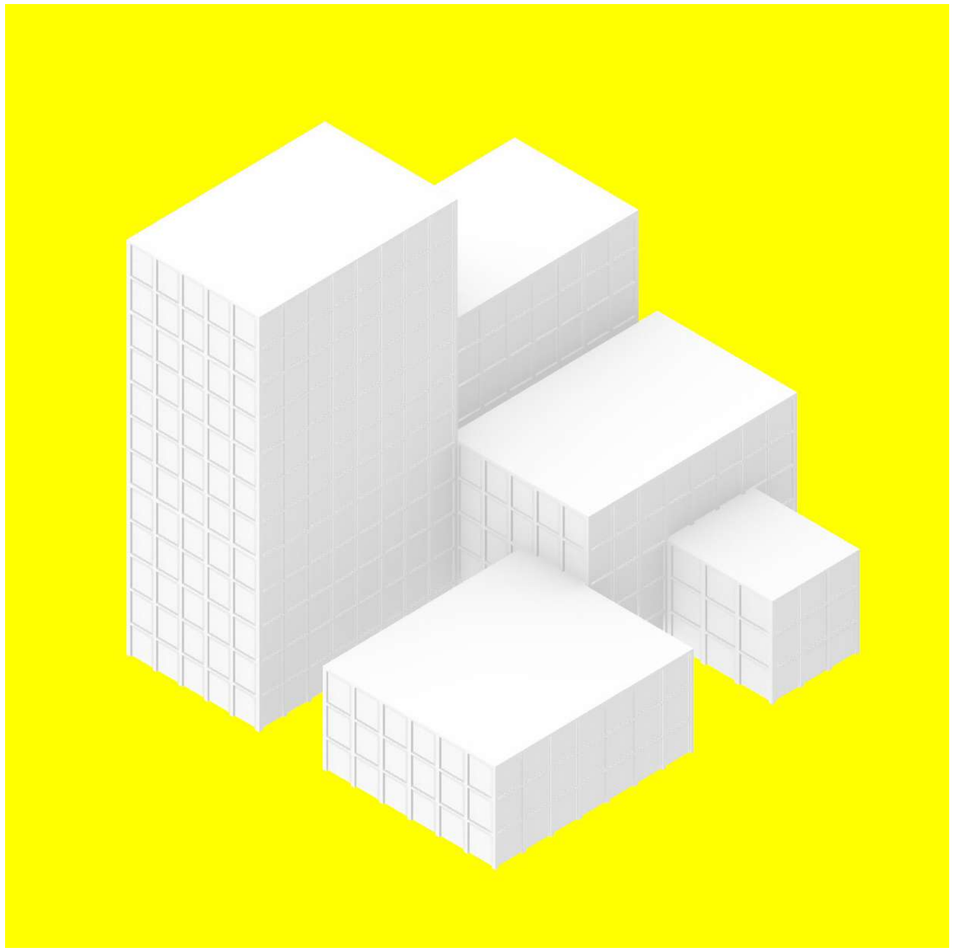
Chicago, US

This hospital was considered an icon of the podium typology and had to be destroyed after many medical discoveries because it was not equipped with the space of material required to host these new technologies. The destruction process of a hospital is very meticulous in order not to contaminate the whole city with the bacteria present in the structure of the building once destroyed. And this is one of the reasons for the next typology which consists of adding building instead of destroying

1971: CT scanner developed by Dr. Godfrey Hounsfield

1978: Dr. Raymond V. Damadian dicovered M.R.I.

1992: Dr. Leroy E. Hood invented an automated DNA sequencing technique

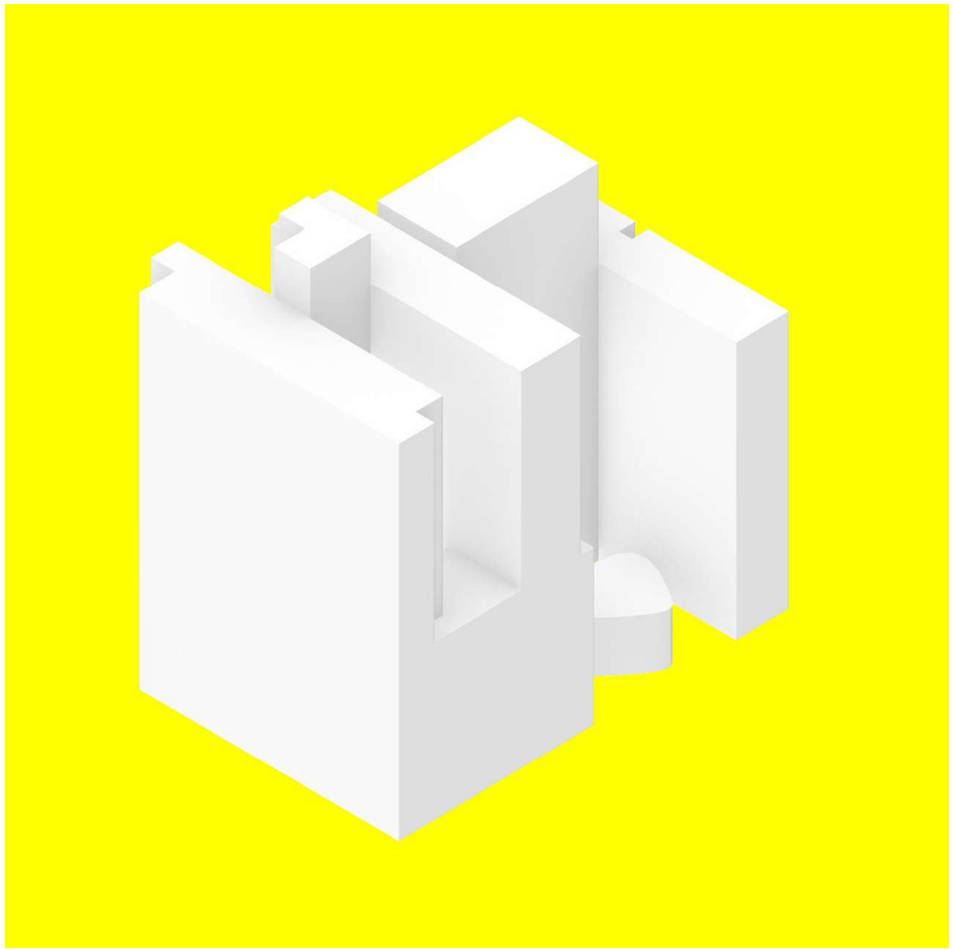


AUBMC

Lebanon

The construction of AUBMC started in the early 20th century and is still on-going, a new building was inaugurated just this year and a new one is being built at the moment, this typology consists of adding to the existing hospital building in order to create a hospital campus

1902 +



2017

CENTRE HOSPITALIER DE L'UNIVERSITE DE MONTREAL

Chicago, US

This campus also follows the same typology but taken further by directly building a whole campus of hospital with common spaces at the bottom which include social interaction. But the drawback of this typology is that it is not possible to add buildings eventually space will start being an issue, therefore the hospital of the future has to be a hybrid which can adapt to the changes rather than either destroy or add

AI IMPLICATES HOSPITAL TYPOLOGY OF THE FUTURE

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Artificial intelligence is playing a major role in the medical field, even though it is not applied in a lot of hospitals and healthcare institutions the tests made came back with result that could promote a better future. AI will not affect the medical field on two levels, as applied medicine, and implicating hospital design and especially the Emergency Department. Starting with the core of emergency: diagnosis. There are several steps to be followed in order to guess the diagnosis of a patient admitted to the hospital of the emergency department, the patient has to first undergo an imaging process or physical tests, that will have to then be shown to the first physician that has to study them, who will then give them to another professional that will also study the results to then be transmitted to the patient. This process with the pressure present on the emergency department can take 4 hours or more which can be life threatening for the patient that is waiting for their diagnosis. This same process takes 5 minutes by artificial intelligence data analyses, which can save lives especially people with life threatening situations in which the first 8 minutes are the most important.

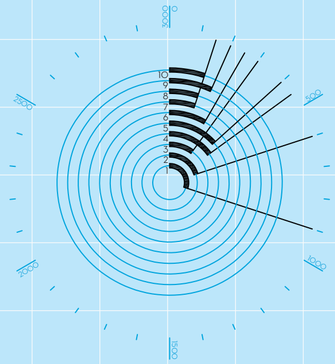
Doctors are mostly willing to let Artificial Intelligence take over the field in order to have faster and more precise diagnosis, as well as interventions, surgeries... the technology is still not fully developed and a problem that will have to be faced by the developers is expanding their data which is now mainly based on European people, and it is know that different races are exposed to different chances to getting certain diseased.

AI won't only have an effect on how patients are healed but also on the space and architecture of the hospital, several programs can be omitted or reduced to maximize the patient spaces, which can be no bigger than a fully equipped technological capsule which can act as an imaging machine to generate the diagnosis or to intervene on the patients who need surgery.

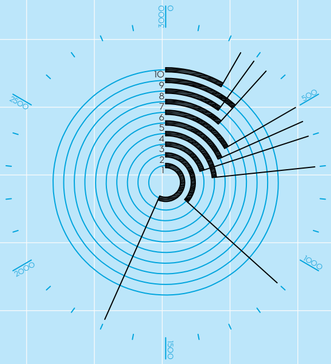
The technologies and discoveries are part of a very fast-pace model which is not the case of architecture, therefore a challenge will be designing a fast-paced architecture that will be able to follow up, adopt and adapt to the changes.

TOP 10 Disease types diagnosed by AI

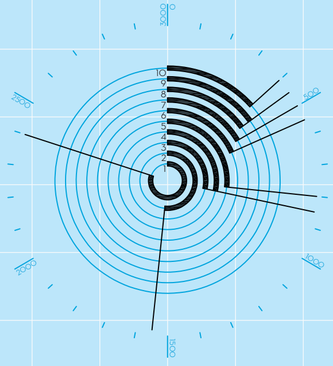
2013



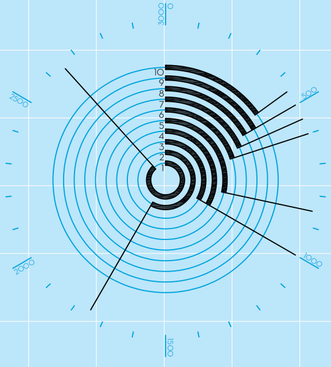
2014



2015



2016



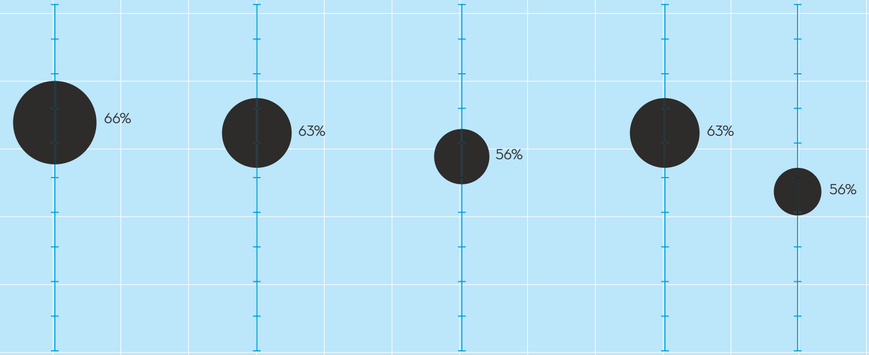
Source: "Artificial Intelligence in Healthcare: Past, Present and Future." Stroke and Vascular Neurology

Legend ▲

1. Neoplasms
2. Nervous
3. Cardiovascular
4. Urogenital
5. Pregnancy
6. Digestive
7. Respiratory
8. Skin
9. Endocrine
10. Nutritional

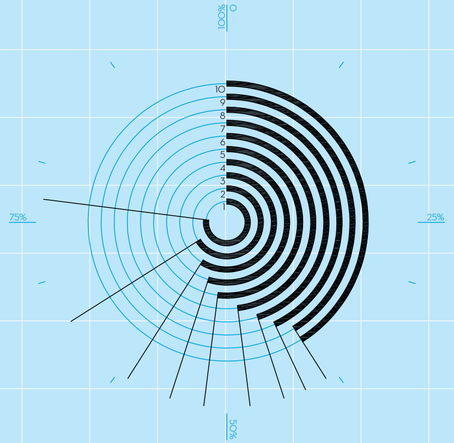
HOW DOES AI & EMERGING TECHNOLOGIES IMPLICATE THE HOSPITAL TYPOLOGY OF THE FUTURE?

Chronic health conditions expected to benefit most from AI



Source: "3 Charts Show Where Artificial Intelligence is Making an Impact in Healthcare Right Now." Healthcare IT News

AI use cases survey



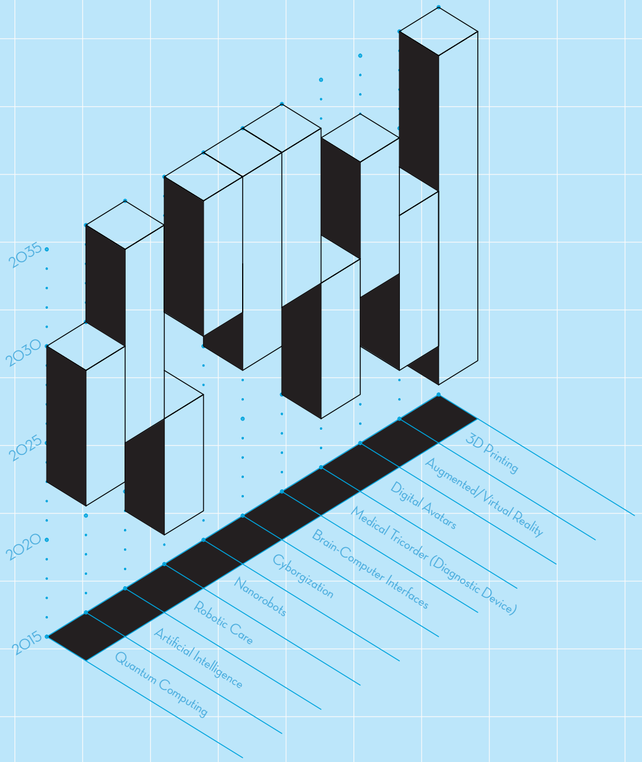
Legend ▲

1. Supporting clinical decision making
2. Extracting meaning from big data
3. Resolving operational ineffi ciencies
4. Enabling earlier diagnosis of disease
5. Enabling popular health management
6. Optimizing administration/ clinical workflows
7. Increasing patient engage ment
8. Advancing patient behavior change
9. Advancing personalized medication
10. Improving data integration from connected devices

Source: "3 Charts Show Where Artificial Intelligence is Making an Impact in Healthcare Right Now." Healthcare IT News

"Artificial intelligence **simplifies** the lives of patients, doctors and hospital administrators by performing tasks that are typically done by humans, but in **less time** and at a **fraction of the cost.** "

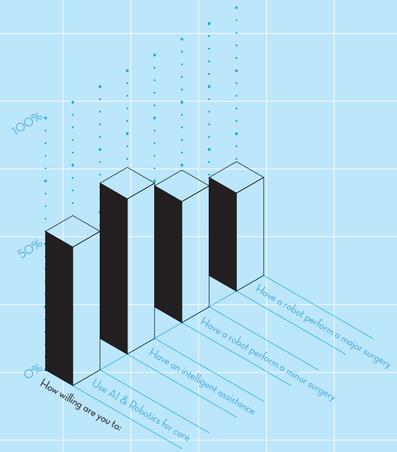
Top 10 technologies that will transform the healthcare industry

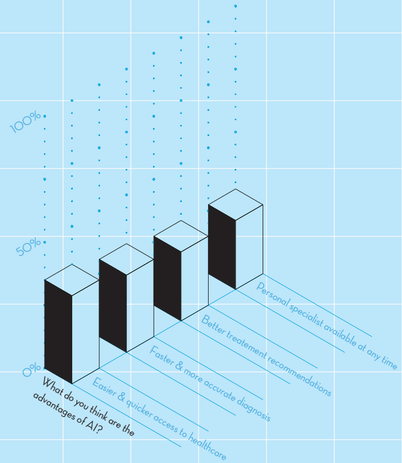


Source: Das, Reenita. "Ten Top Technologies That Will Transform The Healthcare Industry." Forbes

HOW DOES AI & EMERGING TECHNOLOGIES IMPLICATE THE HOSPITAL TYPOLOGY OF THE FUTURE?

Survey in the EMEA* region about AI and its impact on healthcare





Source: Williams, Brian. "Enabling Better Healthcare with Artificial Intelligence." Next In Tech
*EMEA : Europe and Middle East Area
*SMAC : Social, Mobile, Analytics and Cloud

94%

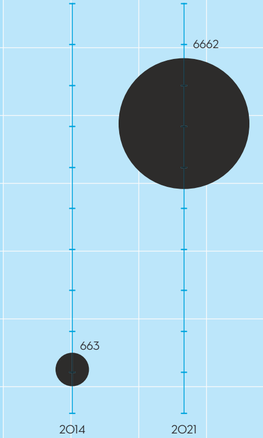
of healthcare executives report that the pace of innovation in their organization has accelerated over the past three years due to emerging technologies.

80%

of healthcare executives agree SMAC* has moved beyond adoption silos to become part of the core technology foundation for their organization.

Source: Accenture | New Insights. Tangible Outcomes. New Applied Now

AI market for healthcare applications (in millions)



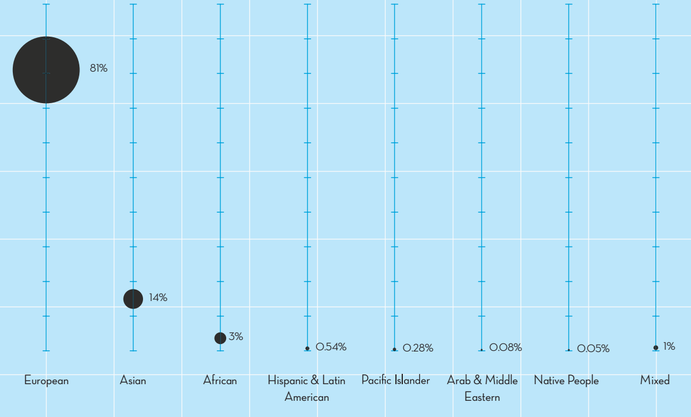
Source: "Five Distinct Trends Are Converging to Determine How Artificial Intelligence (AI) and Robotics Will Define New Health," PwC

Share of samples in genetic studies, by ancestry

"A person's body-hair type can skew an AI's assessment of whether or not he or she has skin cancer."

Source: Gershgorn, Dave. "If AI is Going to Be the World's Doctor, It Needs Better Textbooks." Quartz

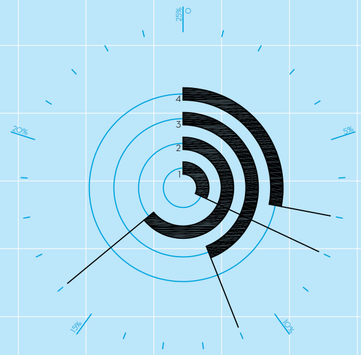
2016 2 511 studies



Source: Elijah. "Little Progress is Being Made to Improve Diversity in Genomics." Atlas, 2 Sept. 2018

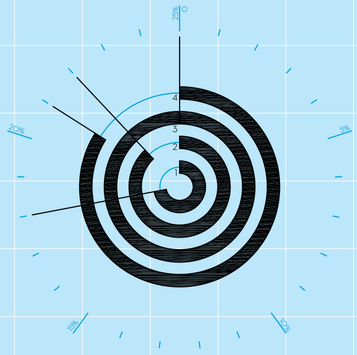
WHAT ARE THE DRAWBACKS OF AI & EMERGING TECHNOLOGIES?

Breast cancer five-year mortality rate



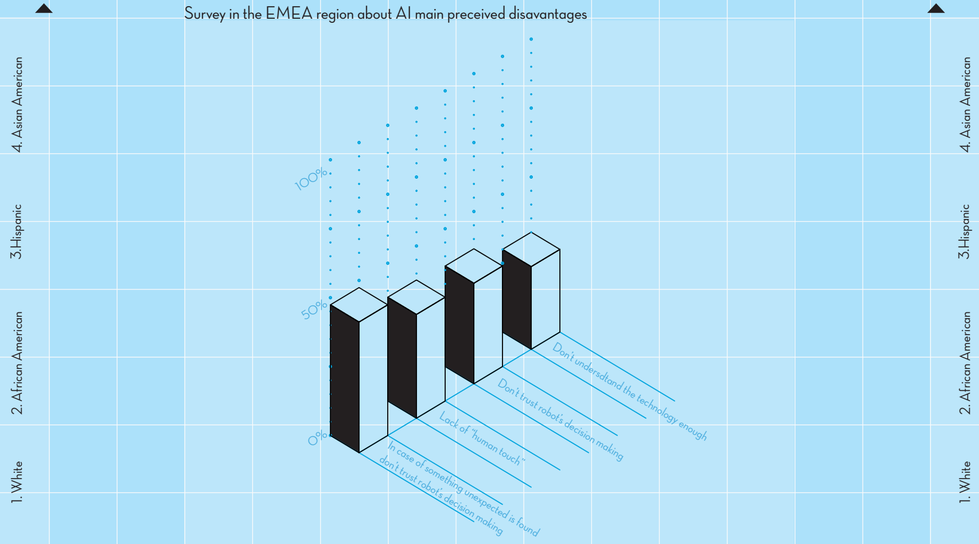
Source: Gershgorn, Dave. "If AI is Going to Be the World's Doctor, It Needs Better Textbooks." Quartz

Colorectum cancer five-year mortality rate



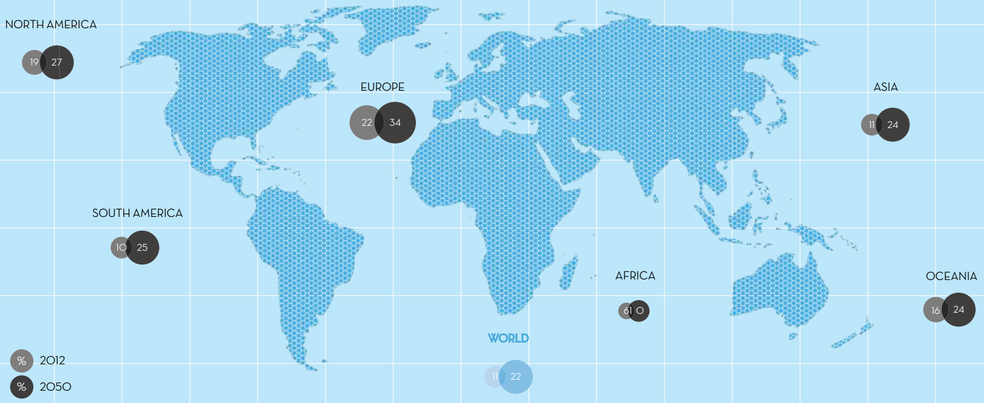
Source: Gershgorn, Dave. "If AI is Going to Be the World's Doctor, It Needs Better Textbooks." Quartz

Survey in the EMEA region about AI main preceived disavantages



Source: Williams, Brian. "Enabling Better Healthcare with Artificial Intelligence." Next In Tech

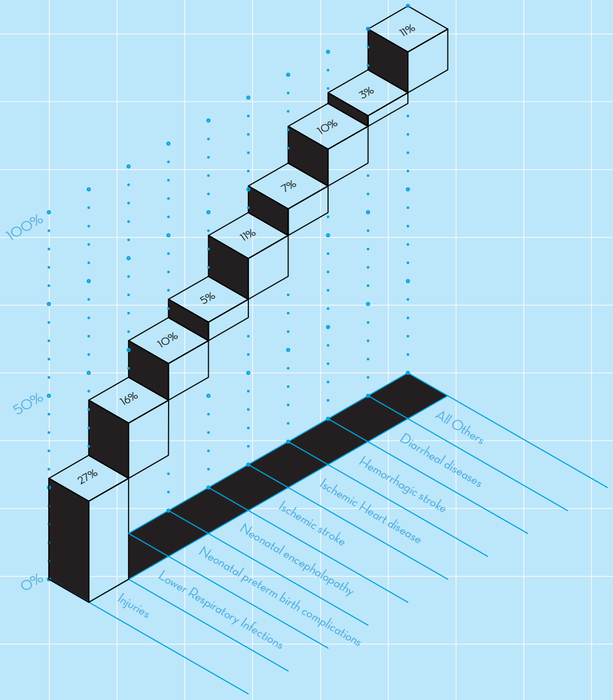
World Population aged 60 or over



Source: genderedinnovations.stanford.edu

FROM THE EMERGENCY DEPARTEMENT TO AN EMERGENCY HOSPITAL

Top 10 Emergency Medical Diseases in the middle eastern region



Source: "Global, Regional and National Burden of Emergency Medical Diseases Using Specific Emergency Disease Indicators: Analysis of the 2015 Global Burden of Disease Study." BMJ Global Health

In Lebanon

15.2%

of patients are transported by Emergency Medical Services (EMS) agencies

55.2%

of stroke patients arriving **late** to the Emergency Department

Source: American University of Beirut, K2P Policy Brief Strengthening Emergency Medical Services in Lebanon

51%

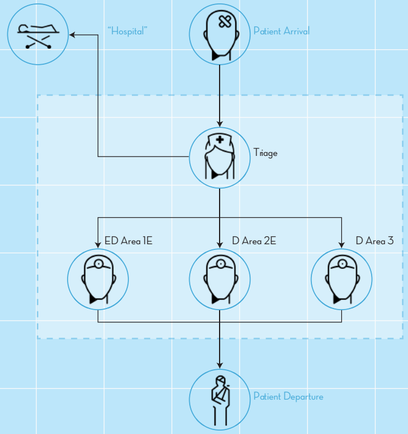
of the percentage of total deaths in 2015 were due to Emergengy Medicine Diseases.

42%

of the percentage of total Disability-Adjusted Life Year (DALY) in 2015 were due to Emergengy Medicine Diseases.

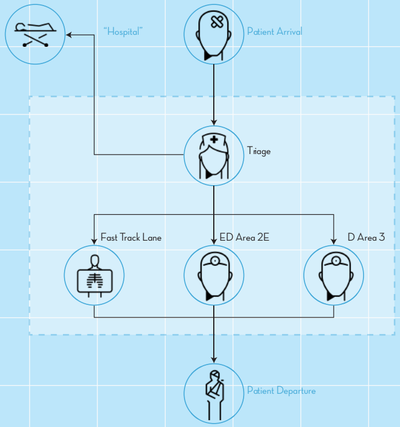
Source: "Global, Regional and National Burden of Emergency Medical Diseases Using Specific Emergency Disease Indicators: Analysis of the 2015 Global Burden of Disease Study." BMJ Global Health

Triage model



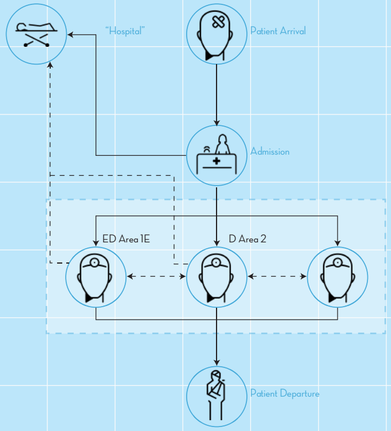
Source: "Designing Patient Flow in Emergency Departments." ResearchGate

Fast-track model



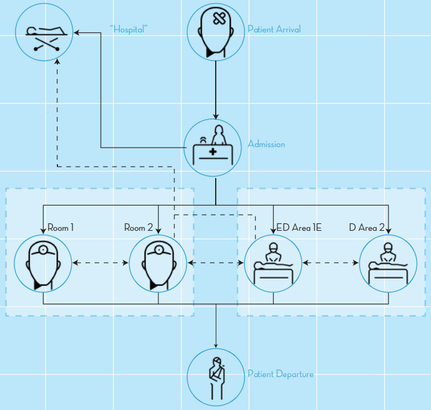
Source: "Designing Patient Flow in Emergency Departments." ResearchGate

Illness-based model



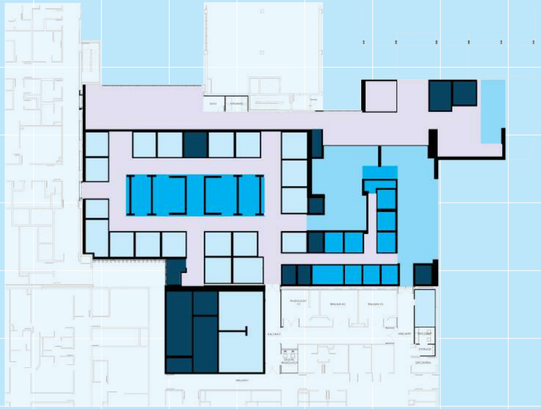
Source: "Designing Patient Flow in Emergency Departments." ResearchGate

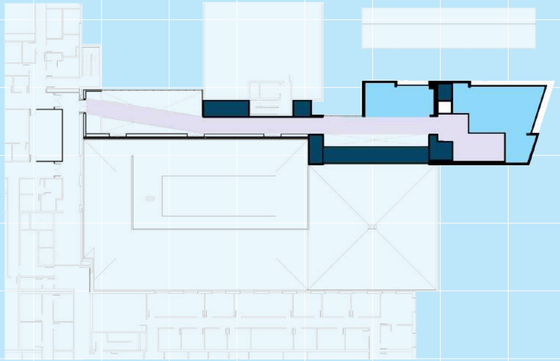
Walking-acute model



Source: "Designing Patient Flow in Emergency Departments." ResearchGate

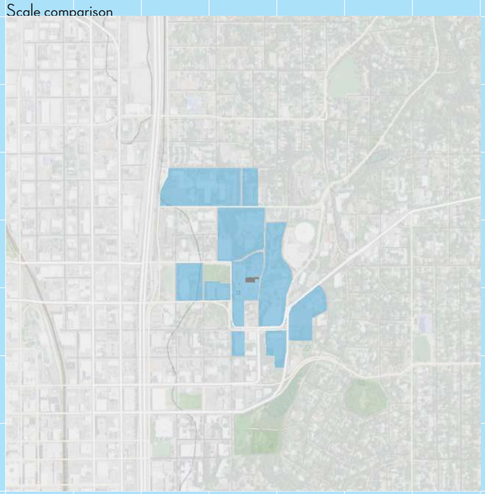
Providence Sacred Heart Medical Center Pediatric ED





Source: Architectmagazine.com, https://www.architectmagazine.com/project-gallery/providence-sacred-heart-medical-center-pediatric-emergency-department_o

Scale comparison



Legend

- Circulation
- Staff Spaces
- Patient Care
- Wating & Family
- Services

Proportions

- 36 %
- 10 %
- 18 %
- 21 %
- 15 %

Specs

Location:	Spokane, Washington
Emergency Area :	242 m2
ER to hospital ratio :	**1 %**
ER Beds:	18
Total Beds:	**644**

Emergency medicine being responsible for **50%** of yearly deaths, creating an **emergency hospital** that focuses on treating emergencies is necessary.

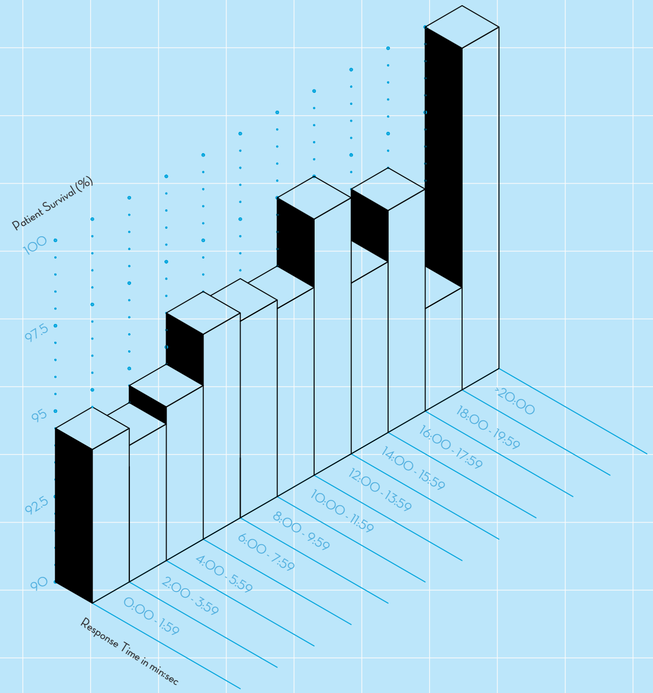
It qualifies of **"human garage"** and consists of **"fixing"** patients in the shortest time possible, and this is where **AI** comes in and reduces **waiting time** drastically as well as optimize **diagnosis and intervention.**

WHAT ARE THE NEEDS FOR AN AI IMPLEMENTED EMERGENCY HOSPITAL?

"Every 30 minutes of delay
results in a **7.5%** increased relative risk for 1-year mortality"

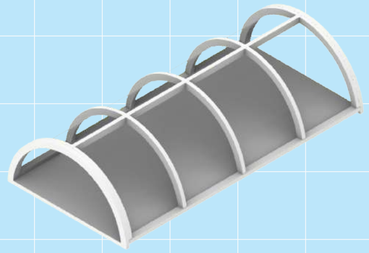
Source: De Luca, G., Suryapranata, H., Ottervanger, J. P., & Antman, E. M. (2004). Time delay to treatment and mortality in primary angioplasty for acute myocardial infarction every minute of delay counts. Circulation, 109(10), 1223-1225.

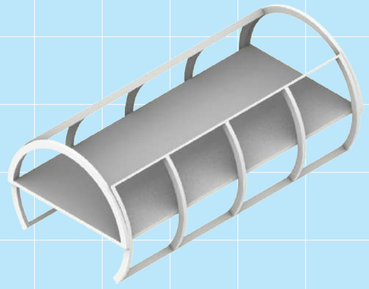
Patient Survival Vs. Ambulance Response Time



Source: Pons, P. T., & Markovchick, V. J. (2002). Eight minutes or less: does the ambulance response time guideline impact trauma patient outcome?. The Journal of emergency medicine, 23(1), 43-48.

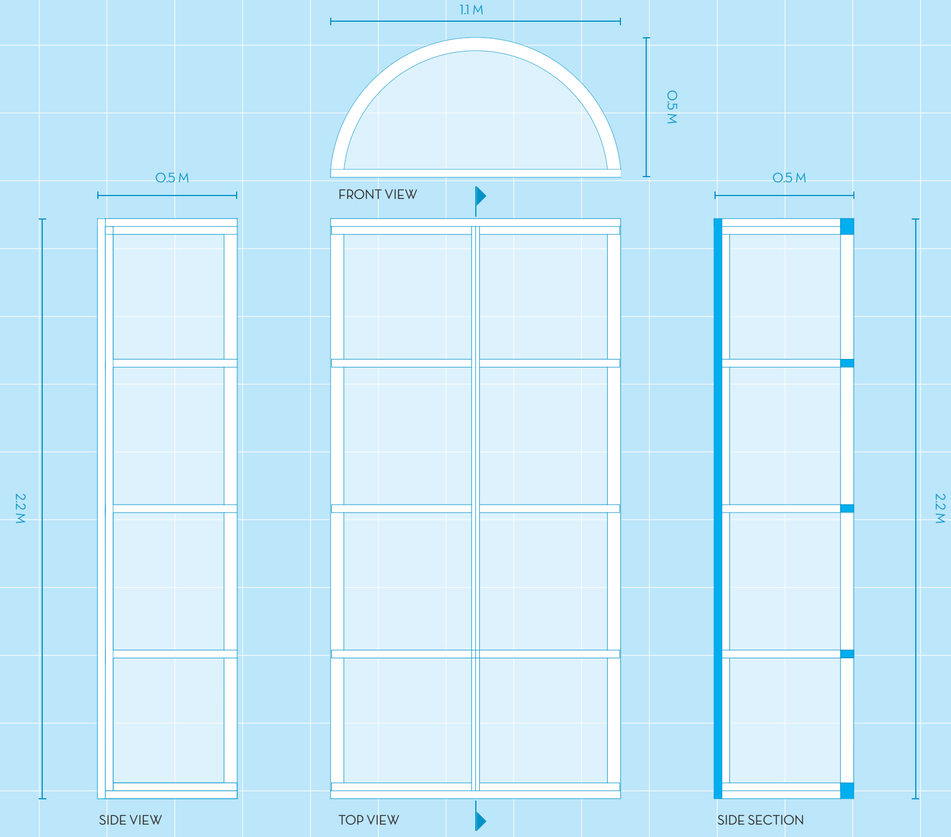
EMERGENCY MEDICINE SERVICE VEHICULE



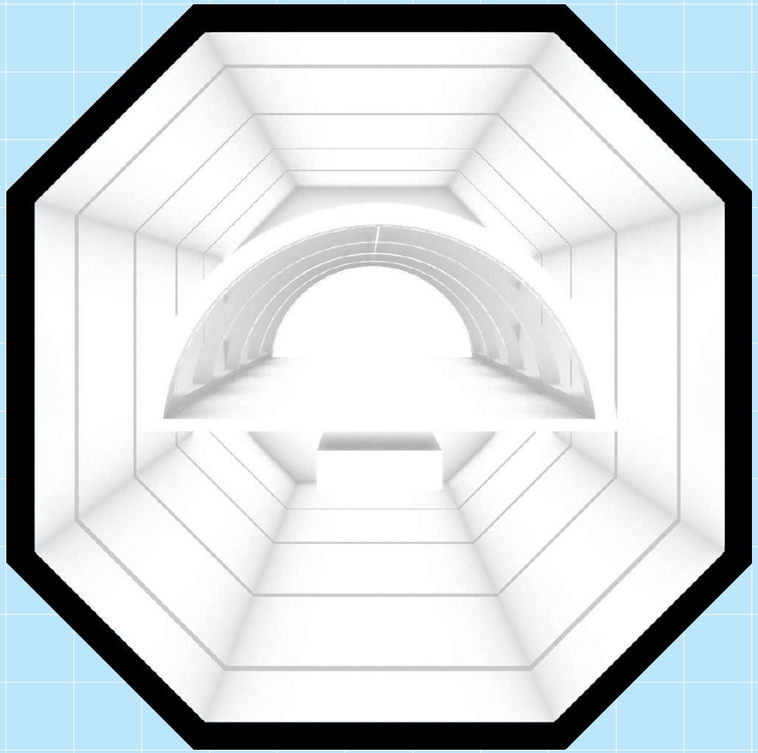


WHAT ARE THE NEEDS FOR AN AI IMPLEMENTED EMERGENCY HOSPITAL?

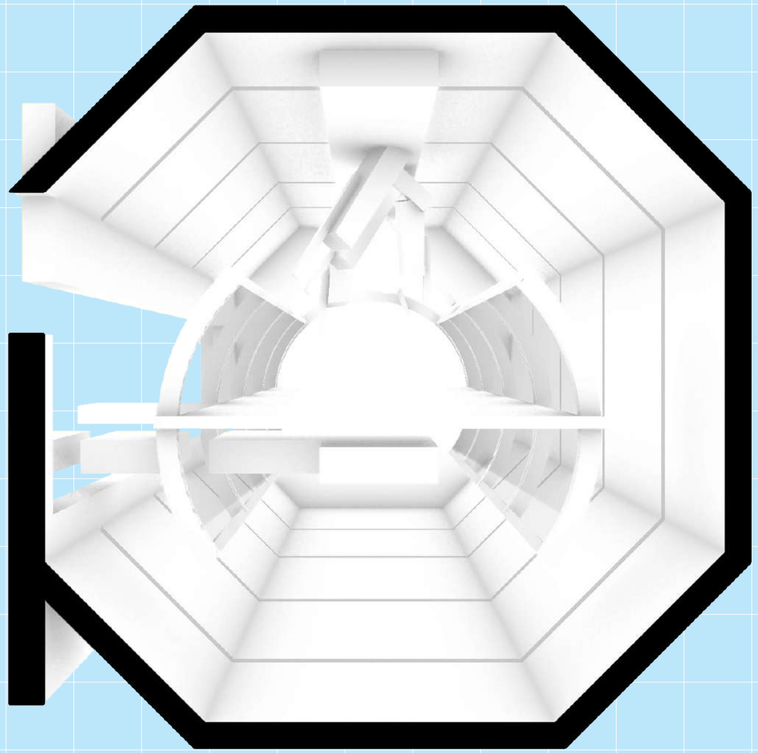
EMERGENCY MEDICINE SERVICE VEHICULE

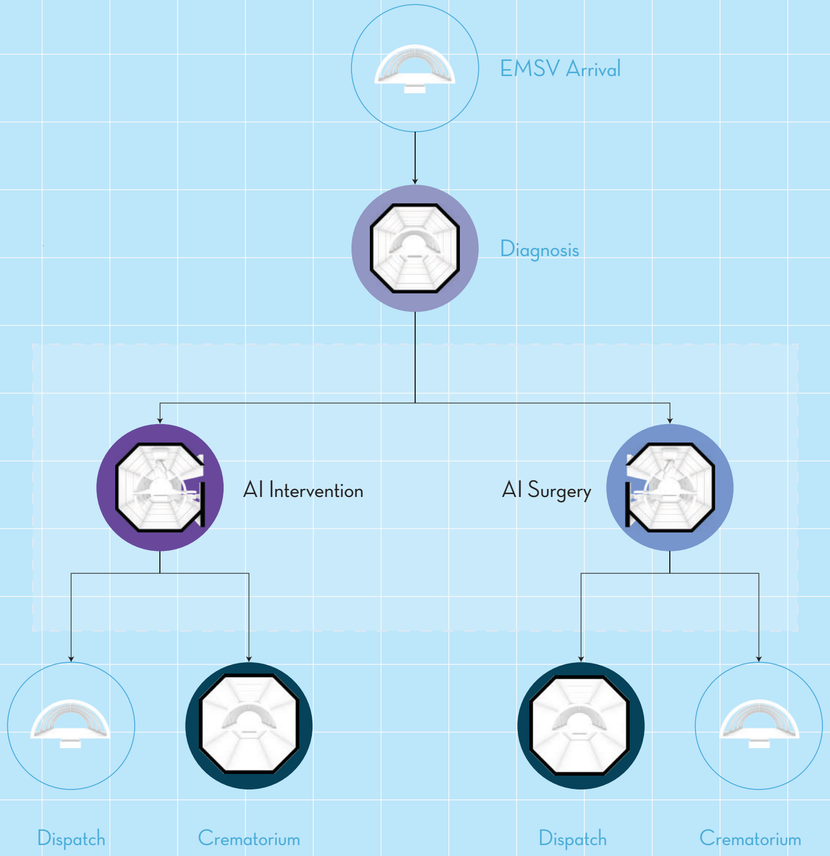


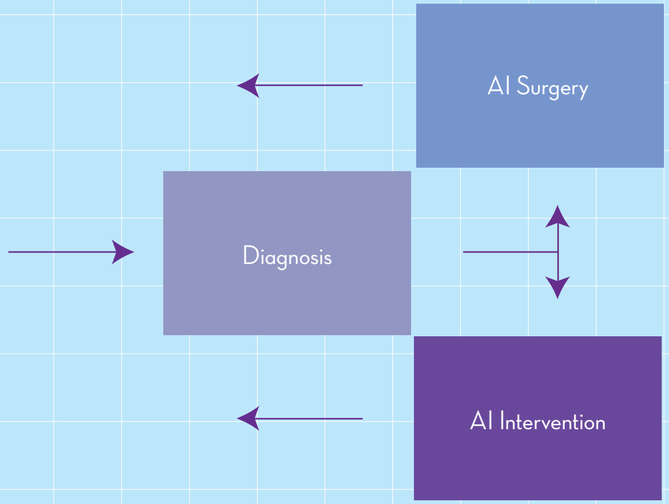
DIAGNOSIS AND **IMAGING** CAPSULE

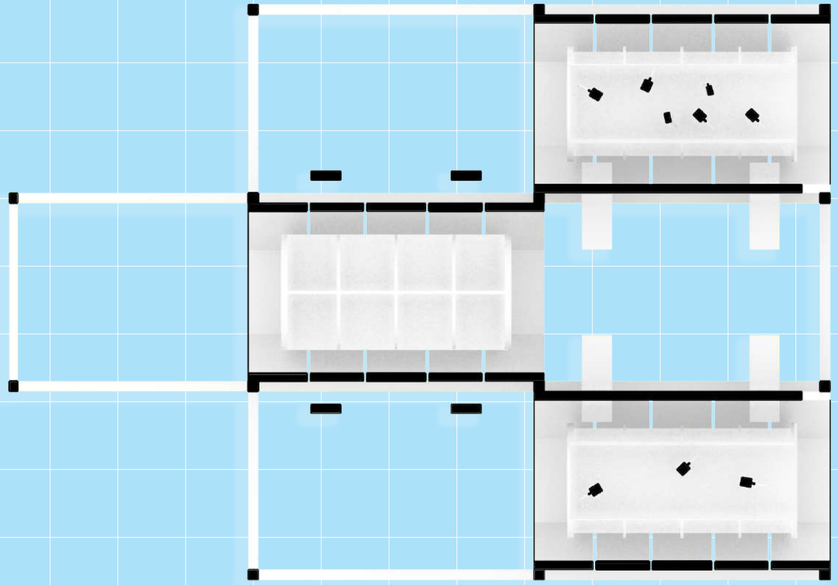


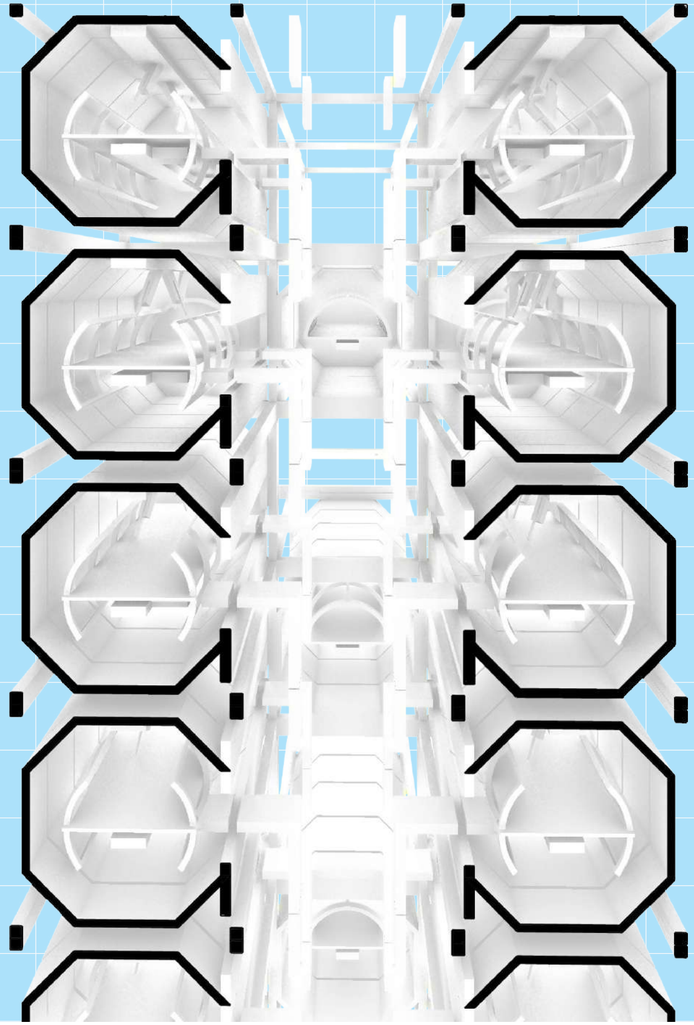
SURGERY AND **INTERVENTION** CAPSULE




EMSV Arrival
Diagnosis
AI Intervention
AI Surgery
Dispatch
Crematorium
Dispatch
Crematorium


AI Surgery
Diagnosis
AI Intervention





THE IMPORTANCE OF RECOVERY & WELL-BEING

THE IMPORTANCE OF RECOVERY & WELL-BEING

With AI taking over the emergency department and intervention spaces there is no placed left for humanity which is the most important component of healing, this is why it is crucial to include a wellness component to the very technological and cold AI component. Wellness is very important for both prevention and recovery, and it is important to take into consideration that no matter how small the intervention is the recovery is still a must.
Wellness focuses on 5 pillars that have to work together in order to keep the body in the right balance:

- Spiritual
- Physical
- Mental
- Emotional
- Social

In the medical field wellness is also starting to find its place but is still considered as "complementary", this is also a mindset that needs to be changed because wellness is as important as western medicine if not more important in order to heal people.
Based Candess M Campbell "Calling holistic medicine "alternative medicine" is no longer appropriate. The best approach now is "integrated medicine" in which we take the best of both worlds." Therefore, wellness modules have been added to the Kit is based on 3 main components:

- In
- Out
- About

In being the focus on their inner self though mediation of different activities to heal from the inside. Out being social interactions as a way to recovery, patients that are secluded from their society tend to have a harder time recovering than patients who still feel like a part of society. And finally About, which consists as architecture and design as a feature of recovery, many studies show that natural daylight as well as views and acoustics can have an impact on the recovery process of a patient. Adding the holistic and recovery component to the high-tech modules will include the humane factor it is lacking which is favorable to a more efficient healing of the patient.

The 5 pillars of holistic medecine and well-being

SPIRITUAL

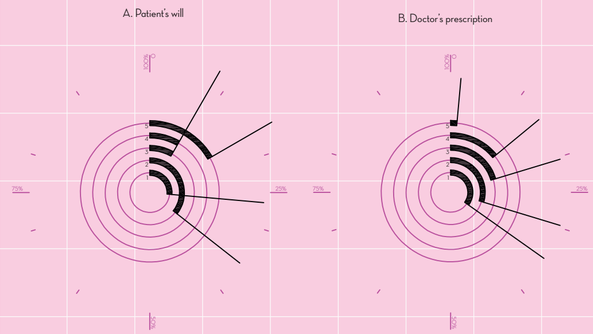
PHYSICAL

MENTAL

EMOTIONAL

SOCIAL

Will to use wellness



Source: "Figure 1: Utilization pattern of complementary and alternative medicine among doctors and patients."

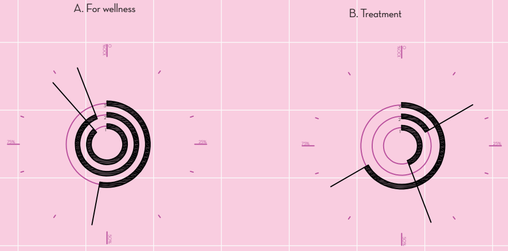
Legend ▲

1. Homeopathy
2. Ayurveda
3. Yoga
4. Home remedies
5. Unani

Legend ▼

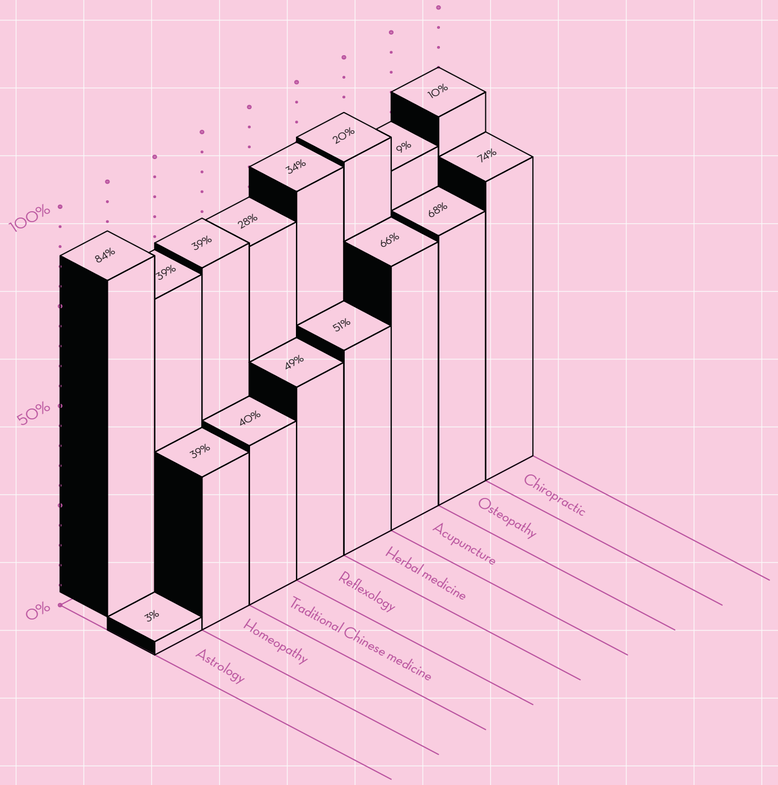
1. Natural products
2. Yoga
3. Spinal manipulation

Welness Vs. Treatment



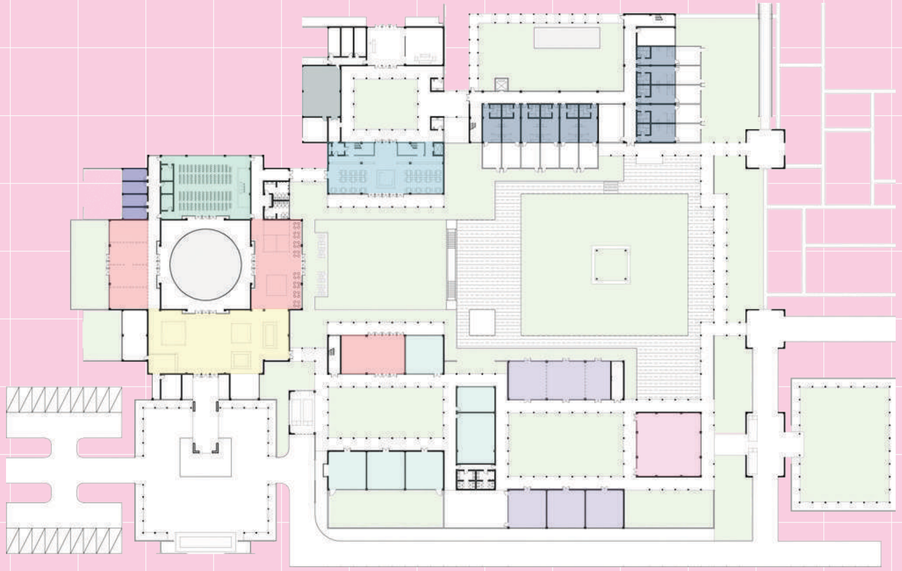
Source: cdn.ymaws.com/www.nationalwellness.org/resource/collection/6A5AC66C-4392-437O-BO4D-5OF67784BD47/4165-Harrington.pdf.

Survey of the efficiency of holistic medicine



Source: "Many Believe Alternative Medicines Are Effective." YouGov | What the World Thinks, 6 Mar. 2015

Weihai Hospital of Traditional Chinese Medicine



Source: "Weihai Hospital of Traditional Chinese Medicine / GLA." ArchDaily, ArchDaily, 29 July 2018, https://www.archdaily.com/898817/weihai-hospital-of-traditional-chinese-medicine-gla.

Legend

- Circulation
- Outdoor spaces
- Lobby
- Showroom
- Offices
- Multipurpose room
- Rehab & Nursing
- Classrooms
- Gymnasium
- Rooms
- Restaurant
- Kitchen

Proportions

80 %	2.8 %	
3.3 %	0.5 %	2 %
2.8 %	2.7 %	1.3 %
2.6 %	1.5 %	0.5 %

Specs

Location:	Weihai, China
rea :	7980 m2
In / Out ratio :	**25 %**
Shared Rooms:	11
Private Rooms:	**24**

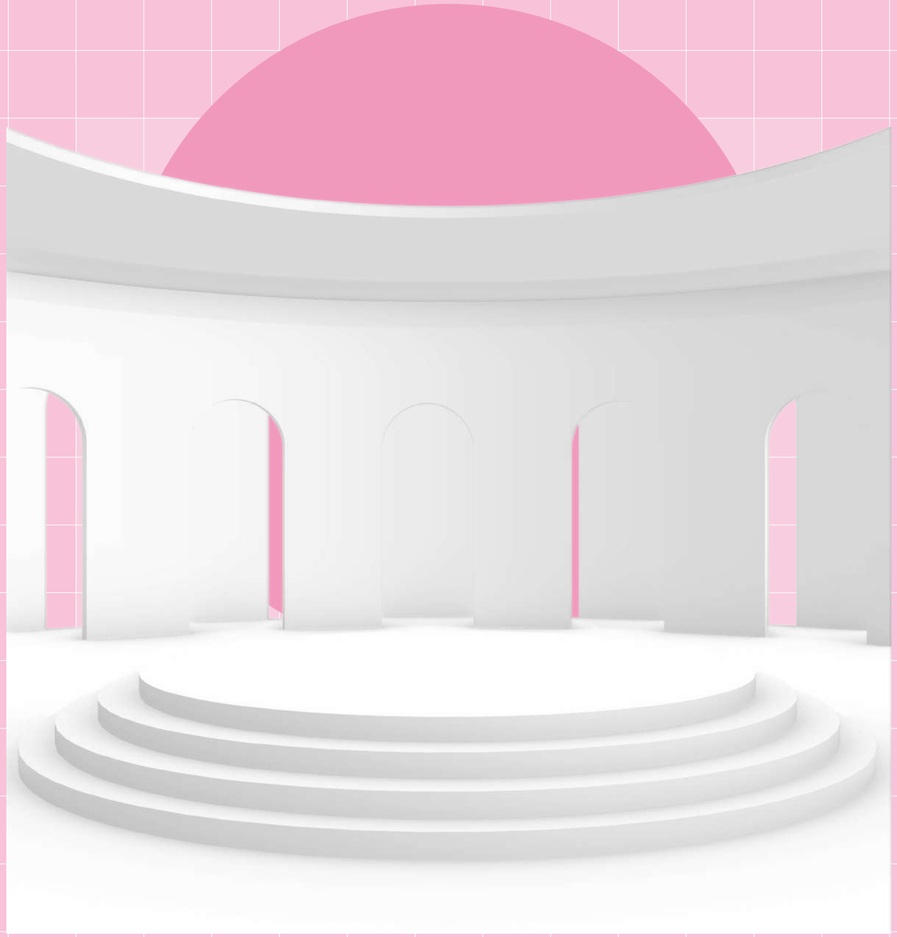
"The Combined impact of protocol and space design was a game-changer, one of the most effective ways to impact outcomes is to design an integrated cluster of architecture changes and care process changes"

Roger Ulrich

"Calling holistic medicine "alternative medicine" is no longer appropriate. The best approach now is "integrated medicine" in which we take the best of both worlds."

Candess M. Campbell

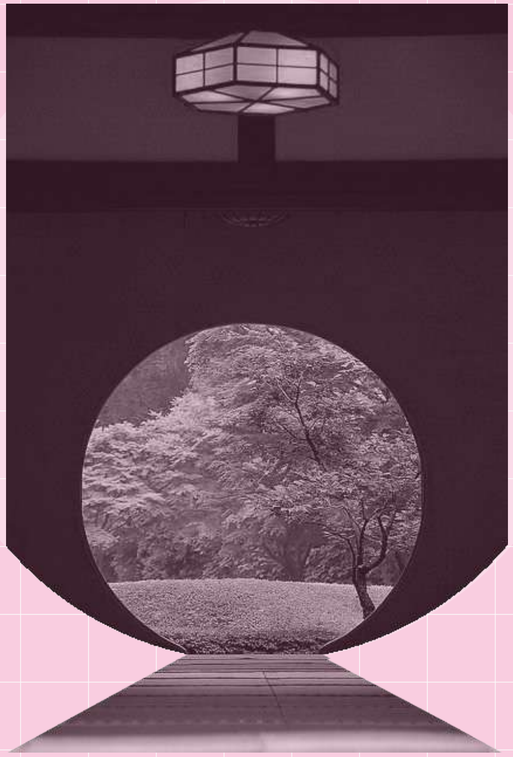
IN MEDITATION A FEATURE OF RECOVERY



OUT SOCIAL INTERACTION AS A FEATURE OF RECOVERY

DAYLIGHT

VIEW



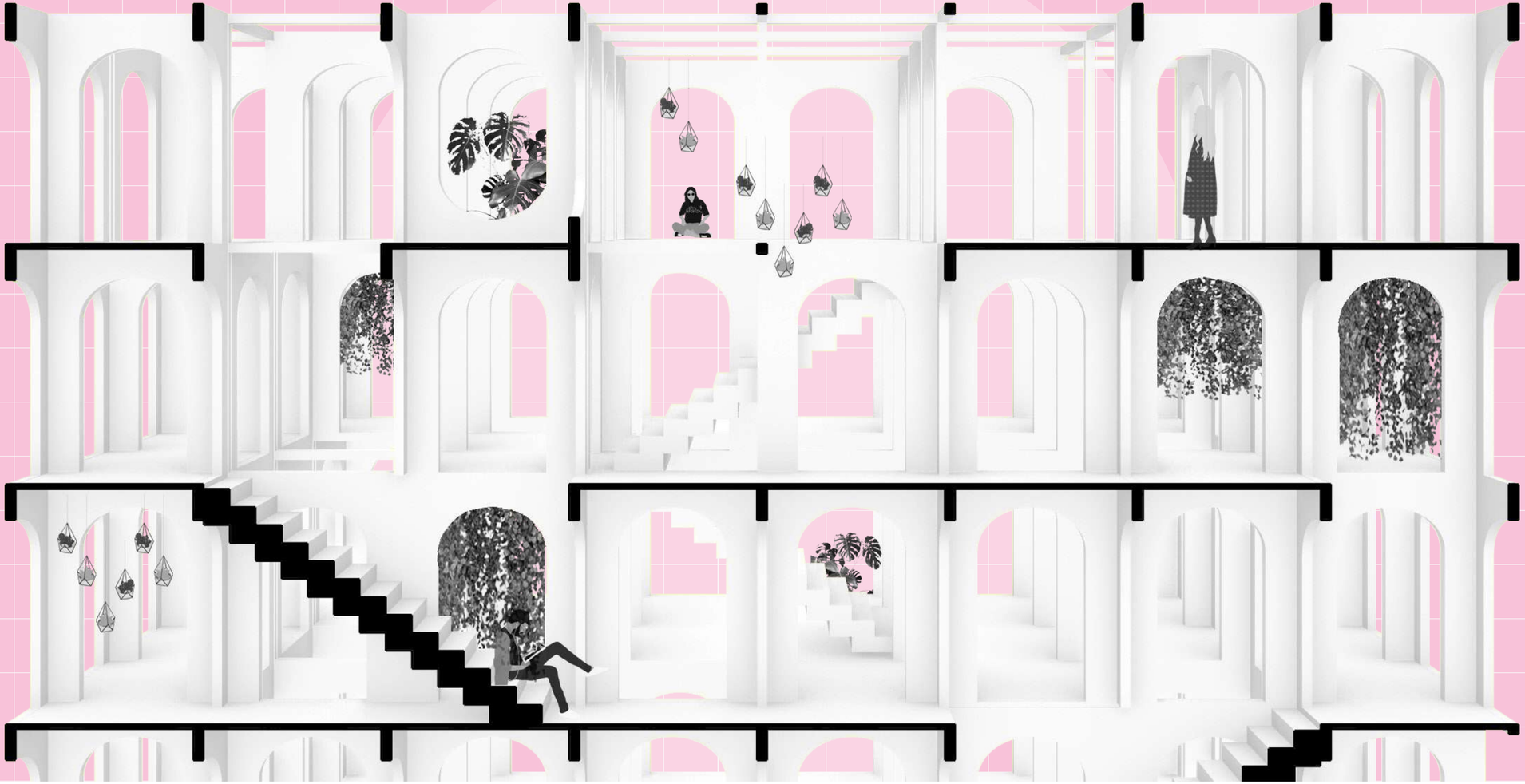
HEALING GARDENS

ACOUSTICS

COLOR

ABOUT ARCHITECTURE AS A FEATURE OF RECOVERY

WAYFINDING



THE EMER-GEN-CY HOSPI-TAL KIT

THE EMERGENCY HOSPITAL KIT

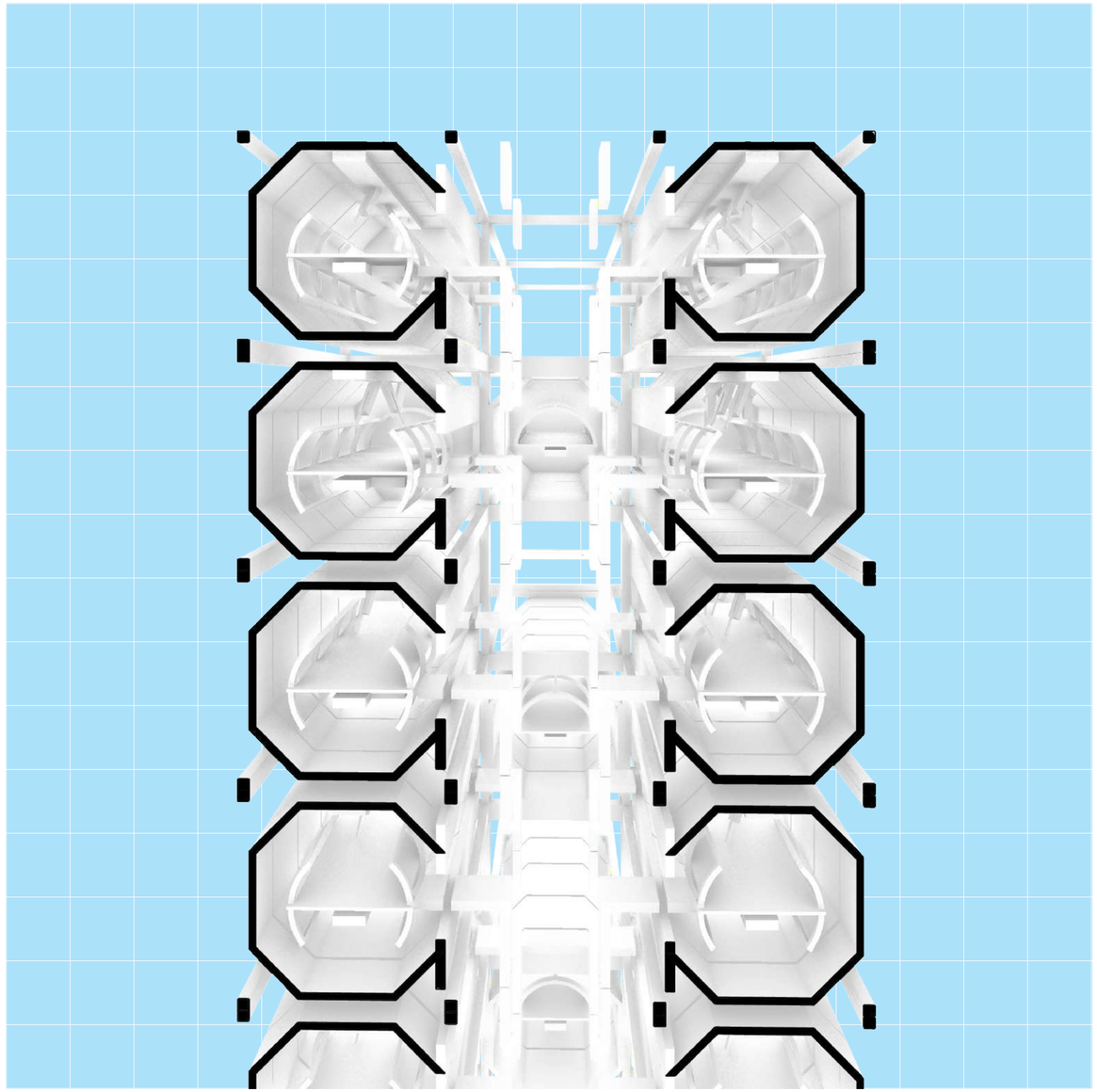
The challenge is to bring together the two antipodes of Artificial Intelligence and Wellness in order to create the hospital typology of the future, which will have the optimal balance in order to be the most efficient possible at healing people while still having a touch of humanity.

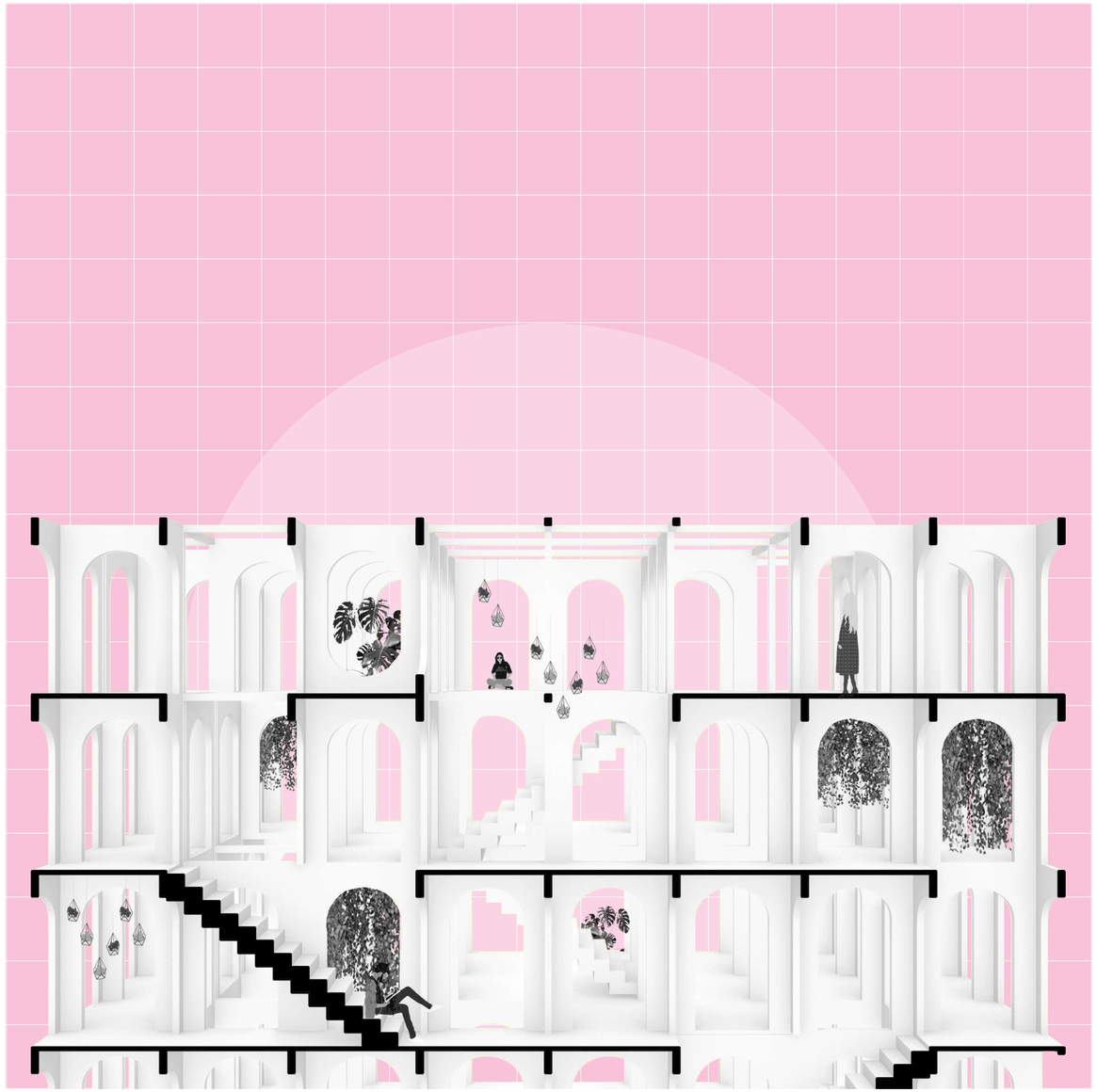
In this case the two components of the kit are codependent, you can't have one without the other, no intervention with wellness and recovery. Another challenge is breaking out of the strict and restrictive hospital typology.

Setting this Emergency Hospital in an urban setting was evident in order to be the most efficient possible since urban settings tend to have a larger population than secluded areas. In this section there are 3 proposed combinations of the Emergency Hospital Kit in order to adapt to any constraint that may be found in urban settings.

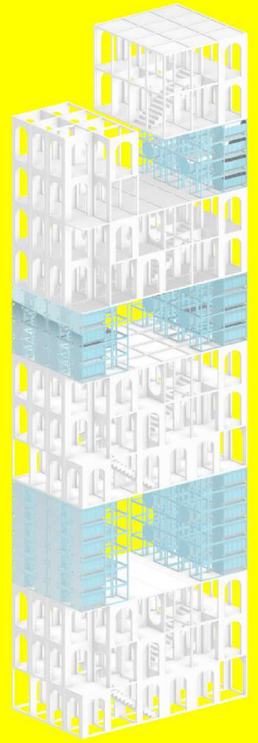
Therefore the Kit was created in order to challenge the "restrictive" and "strict" hospital typology, in order to reflect a fast paced typology, with is capable of adapt, transform, expand... at the same pace as the medical field, hence the introduction of modules which are in time become interchangeable.

THE HEALING GARAGE



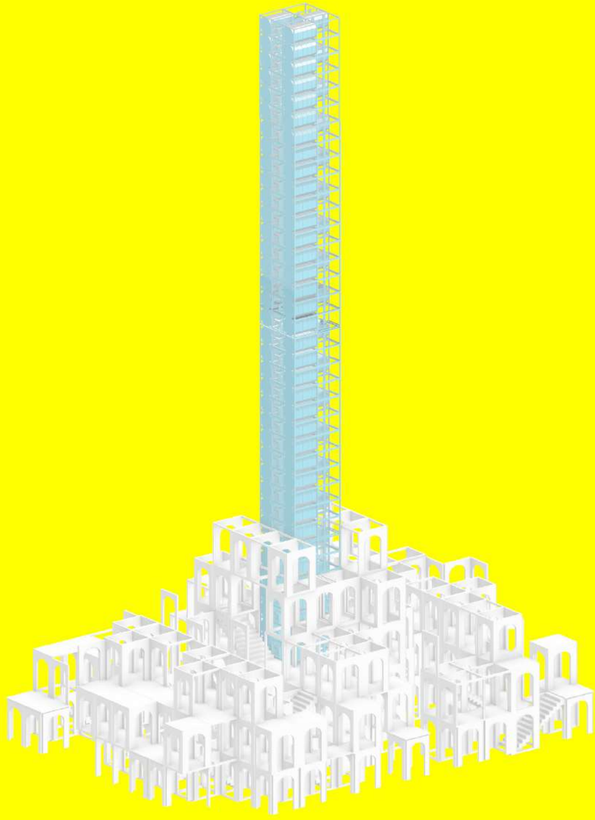


COMBI-NATION 1 : MINIMAL FOOT-PRINT STACK-ING



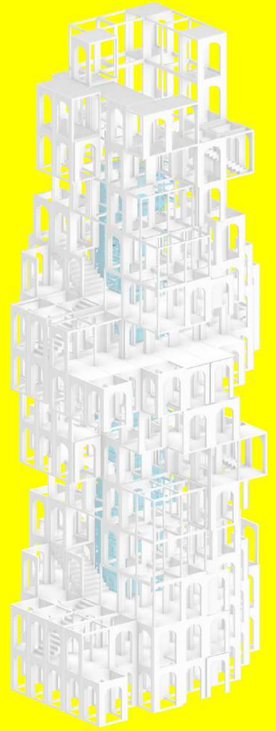
This first typology is an example of how the Kit can be assembled on a minimal footprint site, which in this case is bades on stacking the modules, alternating AI and recovery while creating punctures that will be used as drone landing areas.

COMBI-NATION 2 : THE PARK



This typology consists of taking advantage of the large site avaible for the project, the recovery modules are spread-out all over the site creating urban gardens and parks, while the AI core is as the center in order to feed the recovery modules.

COMBI-NATION 3 : THE UR-BAN JUN-GLE



This typology can be applied on any size site, it consists of merging the 2 modules, the A1 will then be the core of the project with the Recovery modules swirling around it, creating patches of floating vegetation in the city, hence its name: the urban jungle

THE VI-SION

THE VISION

The aim of this thesis is to create a kit that can be assembled in many ways hence a catalog of typologies. Typologies that will be able to adapt and adopt the medical advances of the upcoming years, as well as including the humane components in a crowded environment.
Looking at Beirut city, there are many emergency departments laid over the city, but the main problem that is being faced is getting there on time, since the traffic in the capital doesn't help. Therefore, implementing 3 emergency hospitals over the city is a way to cover all the areas of Beirut that are not equipped with emergency rooms. The implants will be acting as an acupuncture of the city, also healing the city not only the patients by acting as preventing engines and green pockets within this overcrowded non-green city.

The vision of the project is a haven in the middle of the buzzing city in which people will be welcome to exercise activities in order to prevent illnesses. Appearing as a Zen, green well in the city bathed with sunlight and natural ventilation creating an urban jungle that will perfectly merge with the intervention pods, which will create super high-tech punctures which will intervene on patients in the most effective and efficient way while their loved ones are waiting for them in the wellness modules. Consequently, the peaceful environment created will help reducing their level of anxiety while waiting for the patient to get to the recovery step.

Therefore, this new typology is not only and efficient product but mainly aims to ameliorate the emergency experience by creating an inviting adequate environment which is not secluded from the intervention areas, therefore no segregation between the sick and the healthy.

EMERGENCY DEPARTMENTS IN BEIRUT

Source: google maps

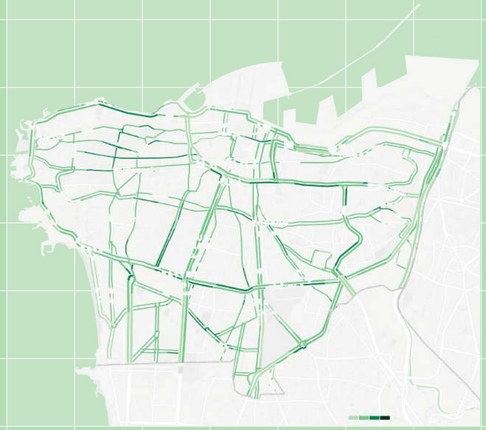
EMERGENCY WITH ADVANCED TRAUMA LIFE SUPPORT DOCTORS

Source: roads for life

BEIRUT TRAFFIC MAP

8 AM

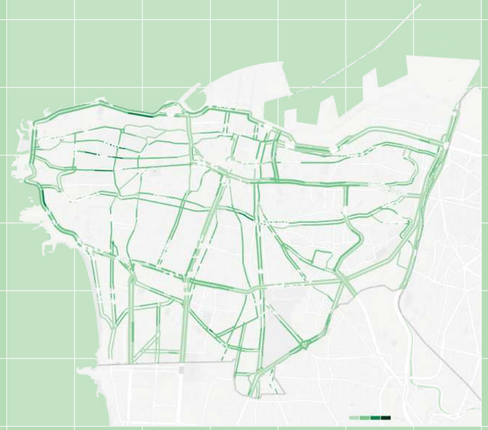
12 PM



BEIRUT TRAFFIC MAP

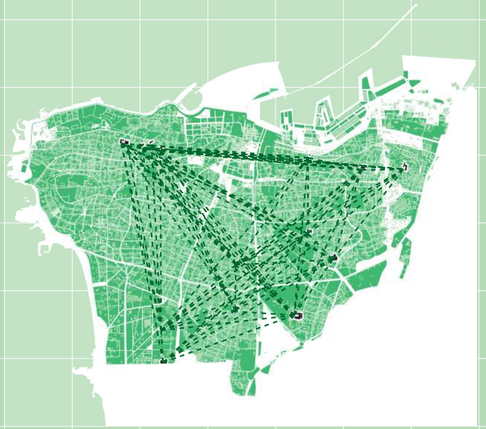
4 PM

8 PM

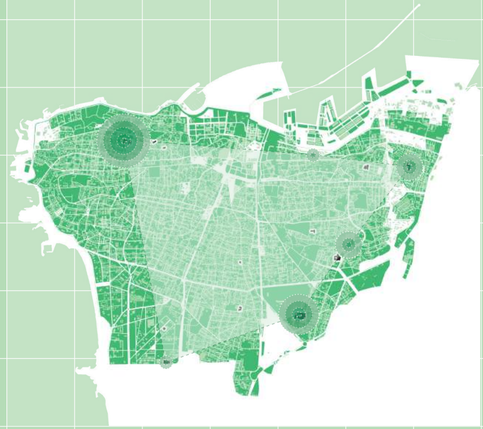


EMERGENCY DEPARTMENTS NETWORK & COVERAGE

ED NETWORK

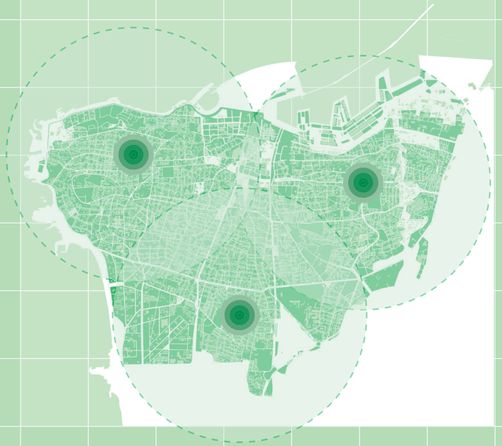


ED NETWORK COVERAGE & MAIN POLES



EMERGENCY HOSPITAL POTENTIL SITES

EH SITES AND COVERAGE



EH POTENTIAL SITES

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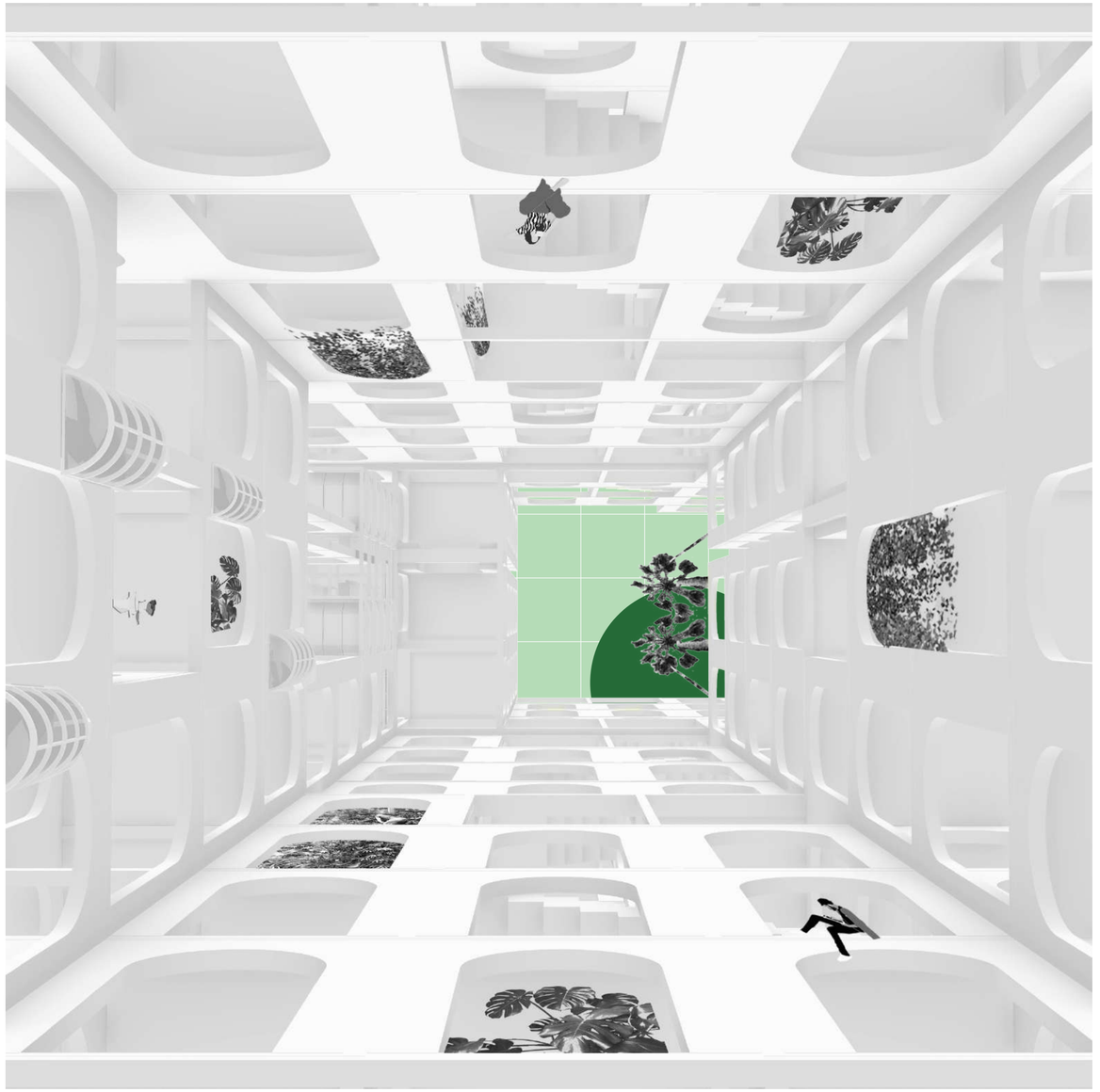
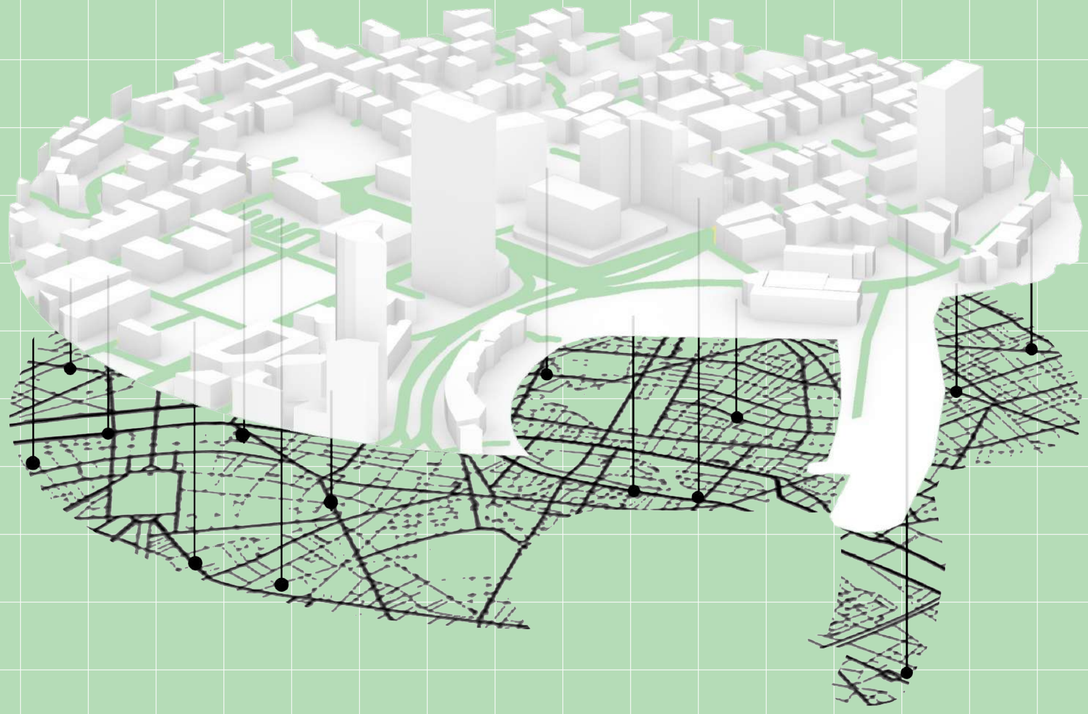
THE EMER-GENCY HOSPI-TAL VI-SON



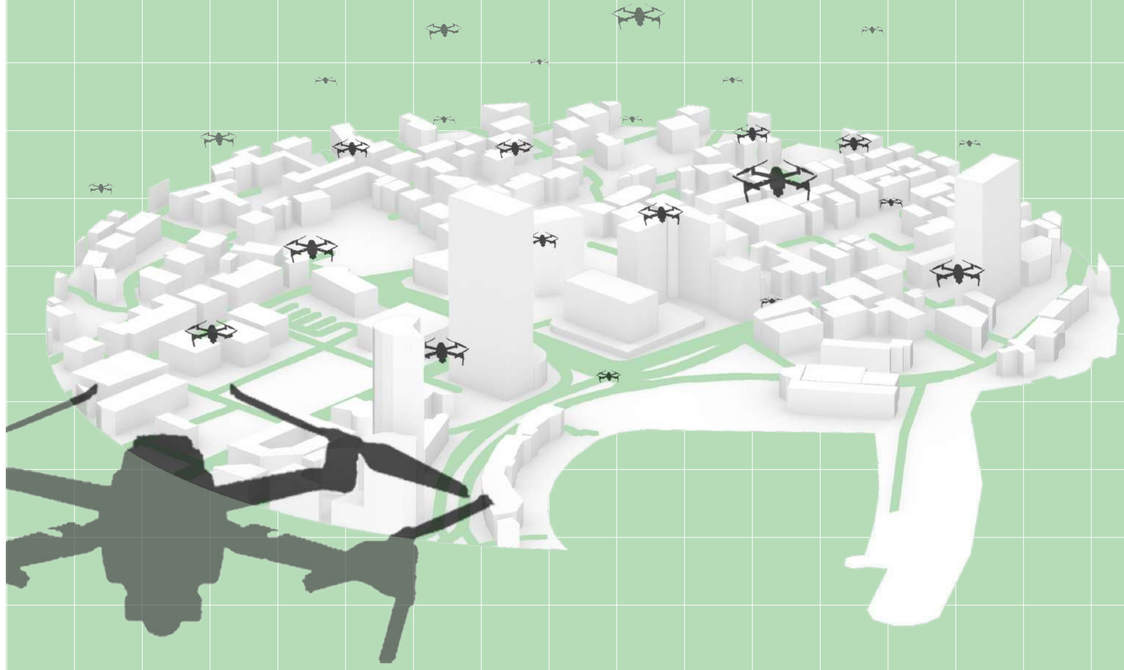
PROPOSED INFRASTRUCTURE 1

UNDERGROUND PIPE NETWORK



PROPOSED INFRASTRUCTURE 2

AERIAL DRONE NETWORK



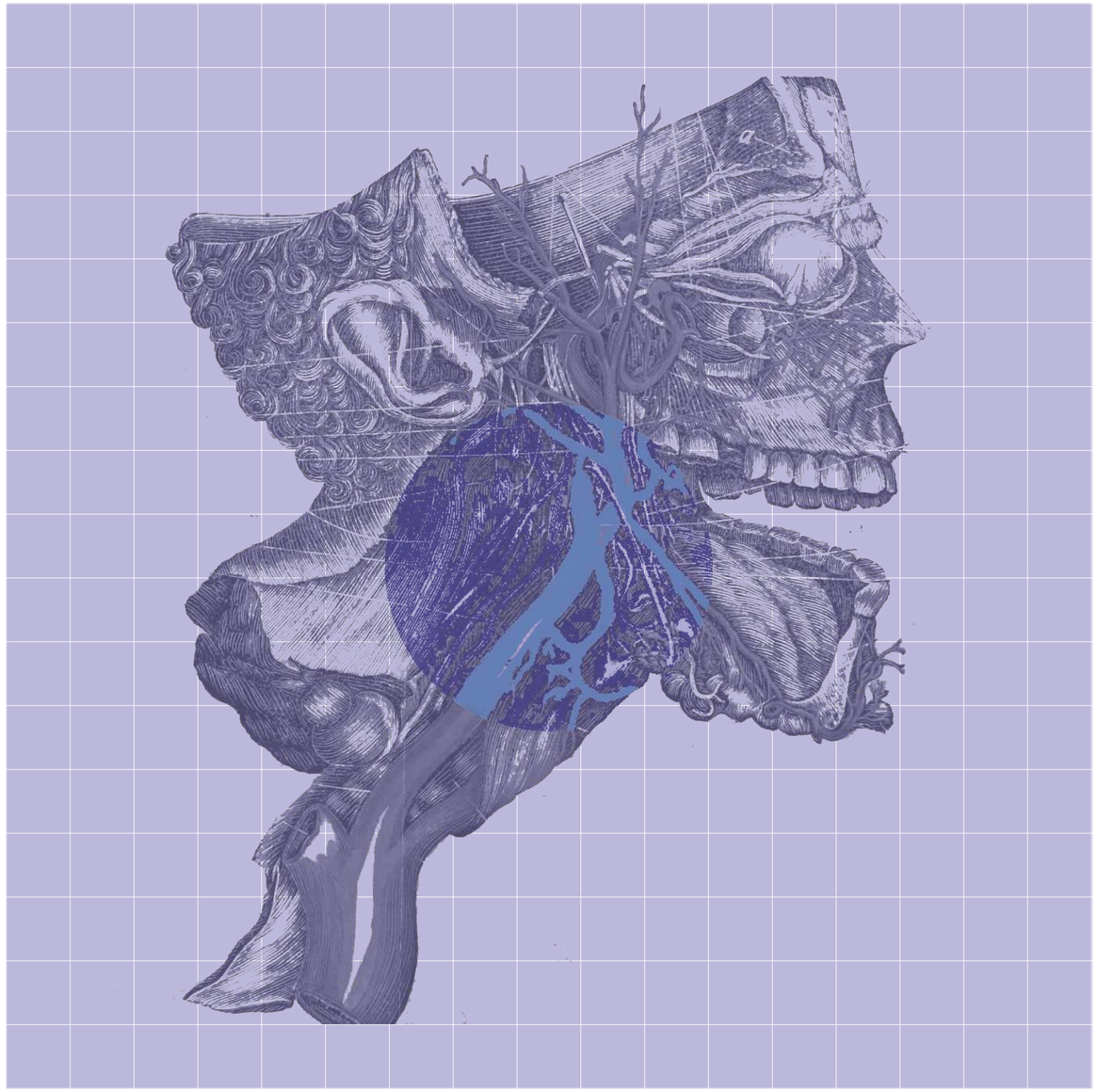
THE DE-SIGN STRAT-EGY

THE TOPIC

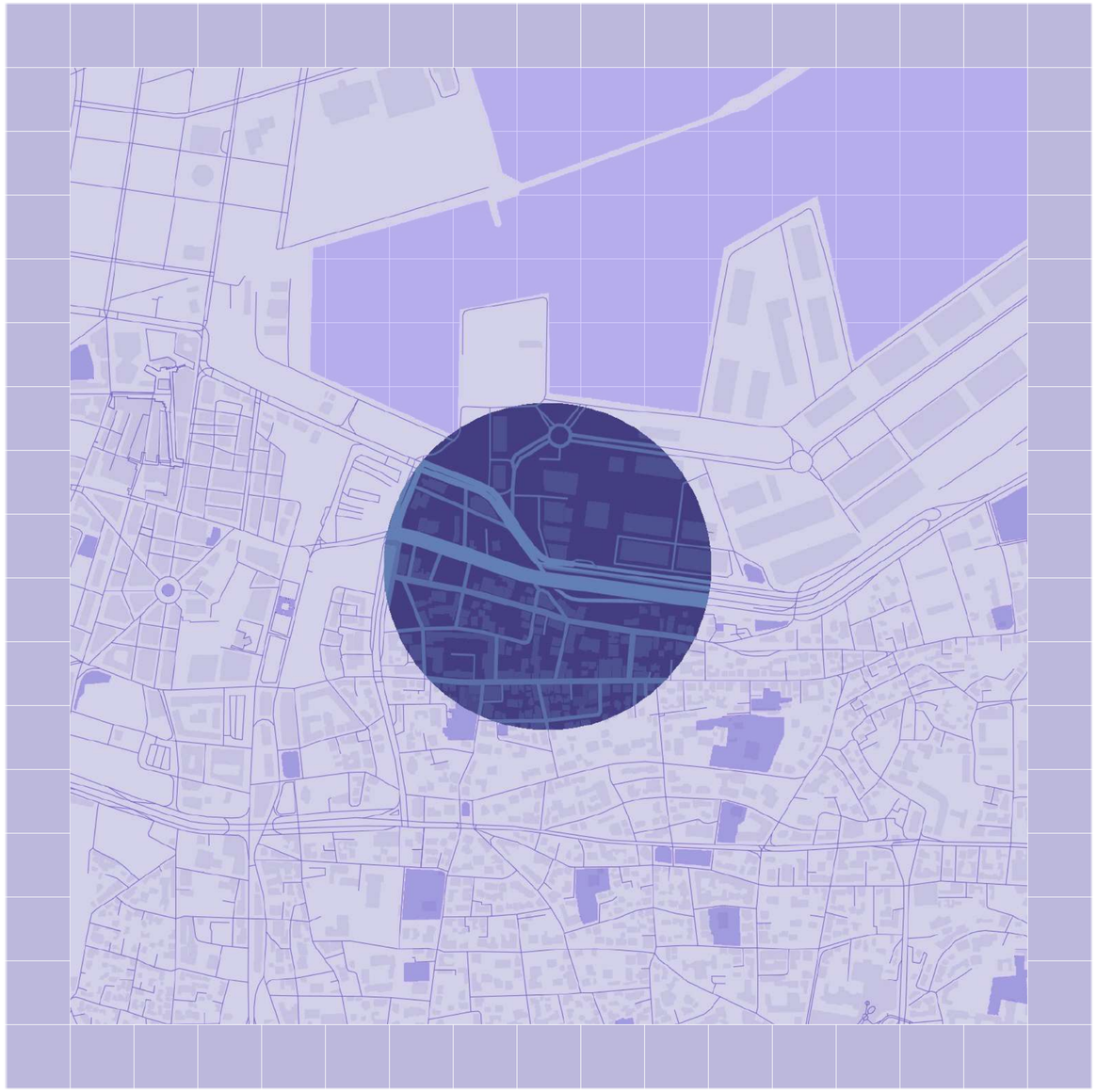
Over the ages the human race has faced illness, pandemics, wars, injuries... and at each period of history there has been a form of healthcare institution to accommodate the people in need. This thesis's main interest is oriented towards hospitals, and what could the future of the hospital be. Looking at the different typologies of "hospitals" throughout history and studying their relation, chronology and differences while studying in parallel the timeline of medical discoveries, a pattern can be discerned: Every time a medical breakthrough happens a change of typology follows.

The main problem of the healthcare typology is that every time a hospital designed for a certain technology is built, it is already outdated due to a new discovery. Therefore, the hospital of the future, or may I say the future of the hospital has to be based on transformability, adaptability, structure and infrastructure in order to be able to adapt and adopt to the emerging discoveries that will once again impose new requirements; a flexible and fast-pace typology that will be able to keep up with the discovery field. In order to have a critical approach to the question the intent is to look at emerging technologies that will drastically affect the medical field, the one which has already started and will have a huge effect on medicine is Artificial Intelligence (AI).

THE ARTERIES OF THE HEAD AND NECK NODE



THE BEIRUT CIRCULATION NODE



THE POSITION AND APPROACH

[HC + AI] Projecting 50 years onwards AI will not only be a crucial component in the way people are diagnosed, treated, intervened on and healed, but also on the architecture typology and the spatial needs of the healthcare institution. Having more than 50% of the world population dying each year due to emergencies (John Hopkins medicine), and a lot more during periods of war, revolution, movements, epidemics, pandemics, fire, mass shootings... emergency medicine is crucial to allow the population to overcome these occurrences. Therefore, the challenge will be creating the typology of an emergency hospital. Following up the patient "post-emergency" is as important, if not more, as the actual intervention, since approximately 10% of patient dispatched will be back in the emergency department within three days.

[HC + DE] Consequently, a wellness and holistic recovery component will be added in order complete the full cycle of the patient's health, the Emergency Hospital must not only be able to intervene on patient's treatment time in the fastest way possible but also to make sure they are staying healthy and following their needs and prescriptions after that. The future of the hospital will then be the combination of an AI (artificial intelligence) activated emergency intervention module and a wellness and recovery module, therefore breaking away from the strict hospital typology and reimagining it in order to be more efficient and more humane. The mix of these two antipodes will also be a catalyzer in changing the aspect and the feeling generated by going to the Emergencies by creating a peaceful Eden which is only fueled by the will to heal.

TOP-
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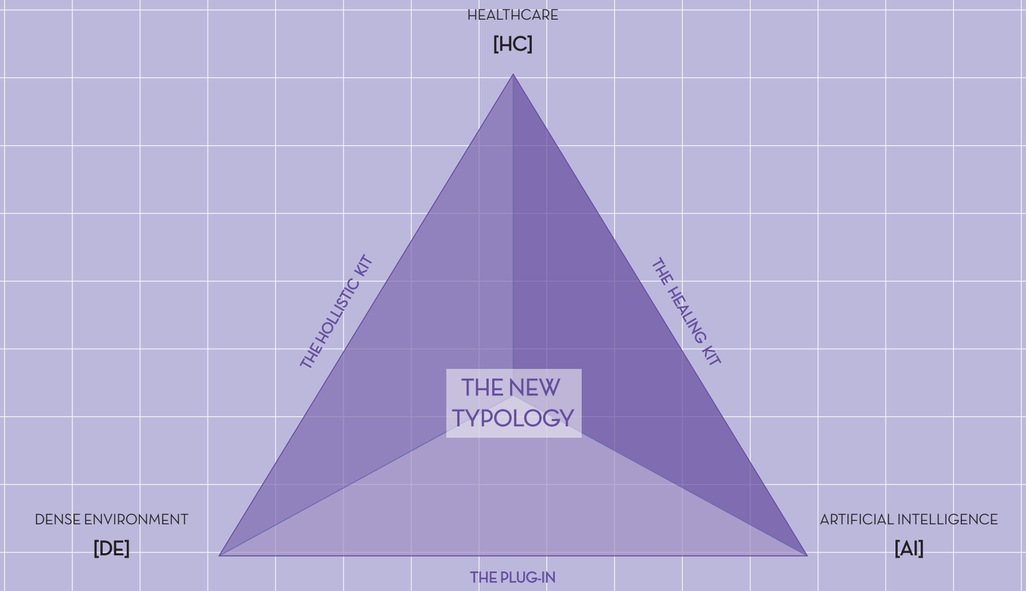
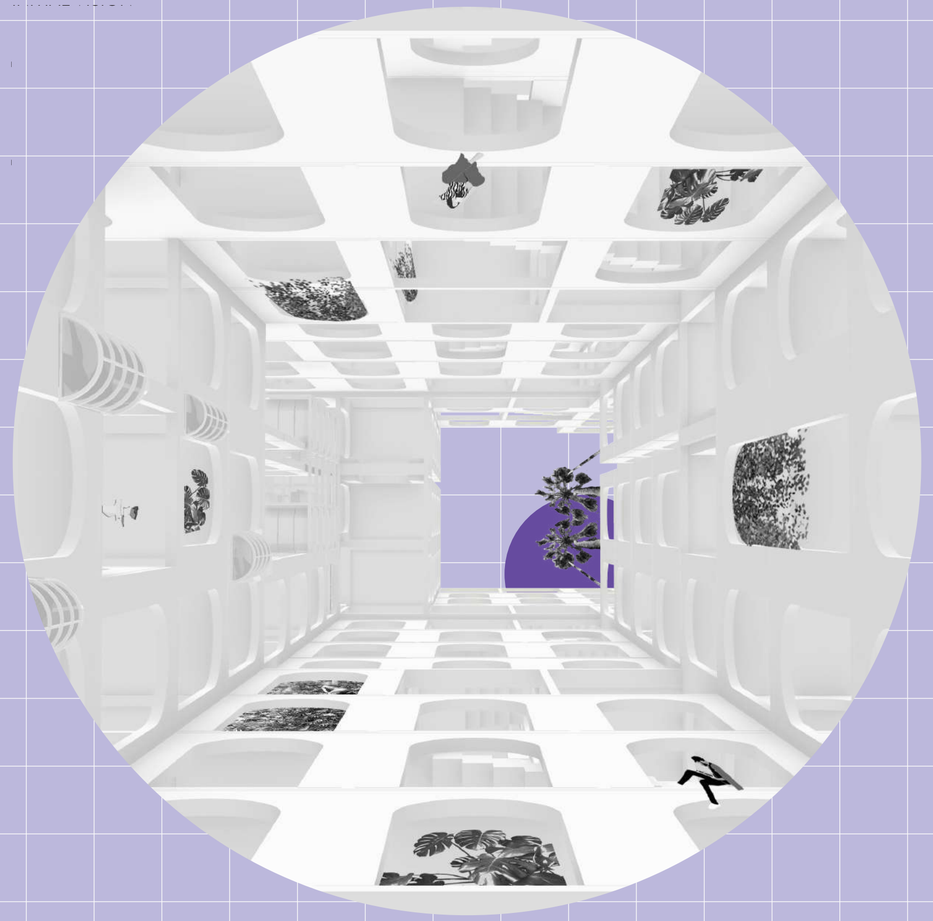
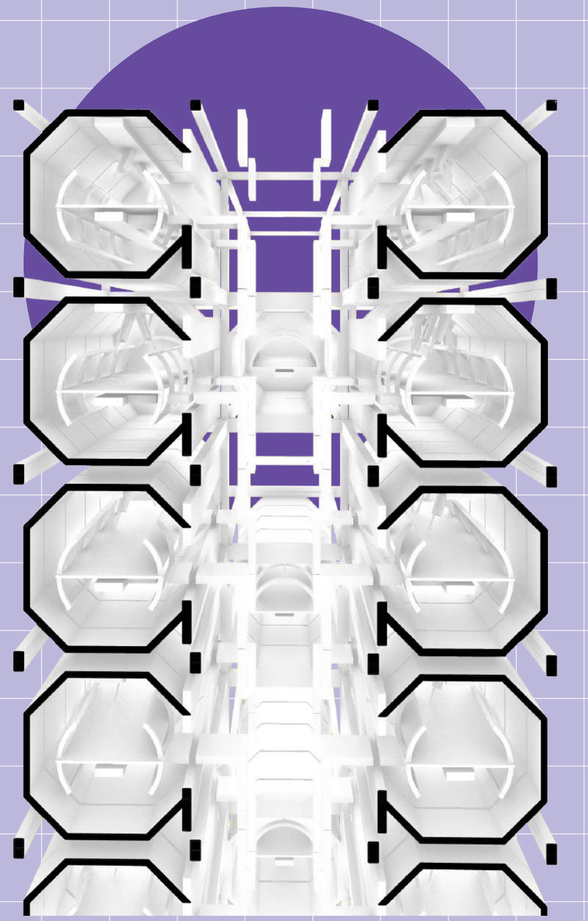


[AI + HC]

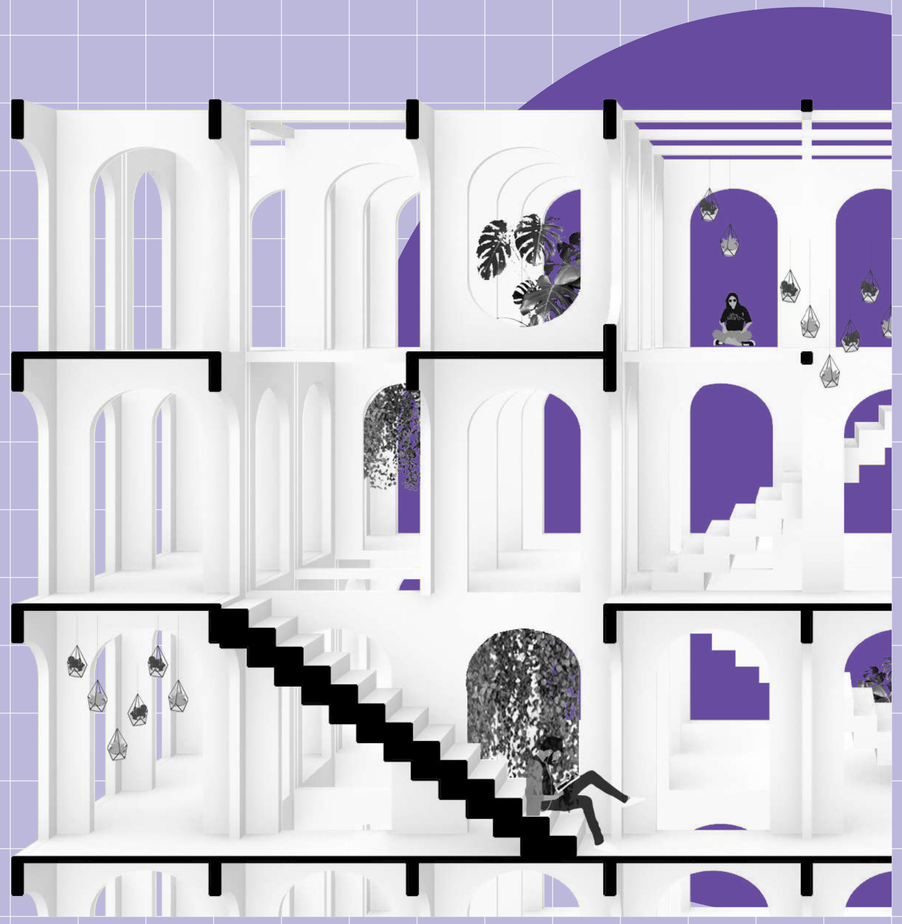




EMERGENCY DEPARTMENTS SITES & COVERAGE

[HC + DE]

EMERGENCY HOSPITAL POTENTIAL SITES



WHAT IS THE IMPACT OF ADVANCES IN HEALTHCARE TECHNOLOGY ON HOSPITAL TYPOLOGIES WITH REFERENCE TO AN URBAN DENSE ENVIRONMENT?

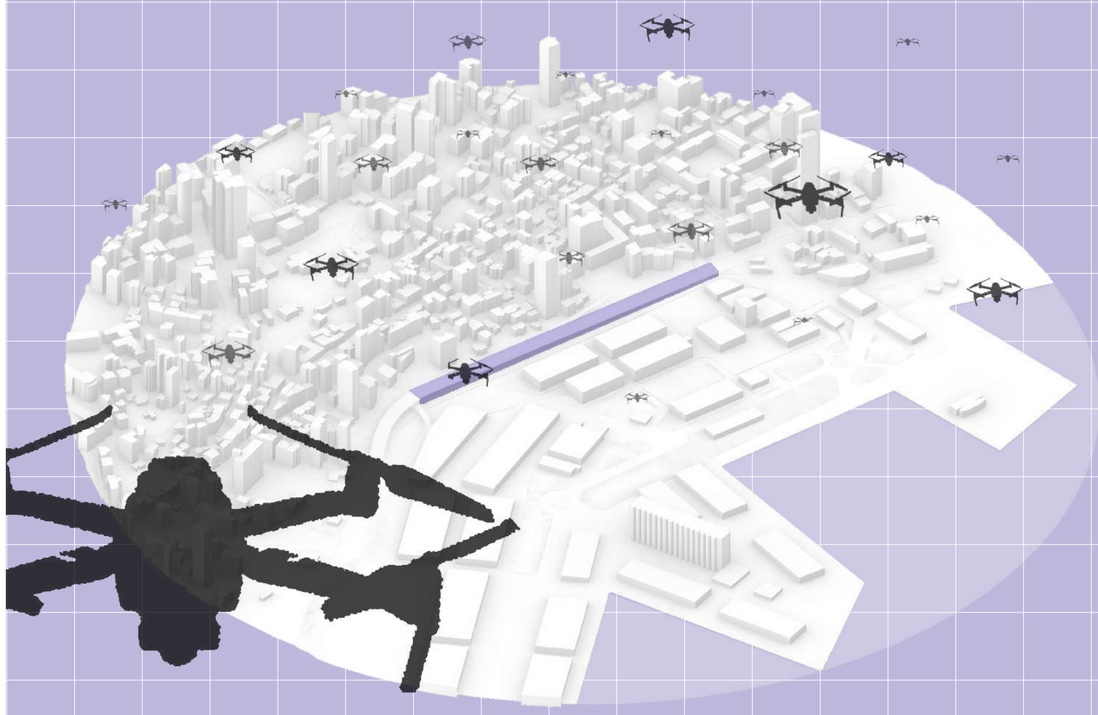
THE DESIGN STRATEGIES

[AI + DE] A critical design exploration and speculation to the question would be that of tackling contemporary problems with near-future technologies towards emergencies in a crowded city. Our generation is facing today the first of many forthcoming pandemics, which is the Corona virus outbreak, with until today nearly five million infected and 312,000 deaths. Therefore, it is not only critical but also imperative to start incorporating, on a very elaborate scale, designs based on individualism. This, consequently, ensures the necessity of the no-human contact AI pods; medical kits that cater for pandemic crises. Plugging in the healthcare infrastructure to the existing transport infrastructure and re-imagining and reconstructing it in networks that will focus on the complementarity and the duality of the two systems coming together: Healthcare and Transportation; thus the project: **The Healing Garage**. To start designing this Healing Garage it is important to rely on speculative design ideologies and modes, and architecture schools of thinking such as Achigram and the Metabolist architecture, which when coupled up will form the Mechanistic part of the intervention. The problematic also comprises the systematic approach, which deals with the fields of systems, high-technology resources and biology.

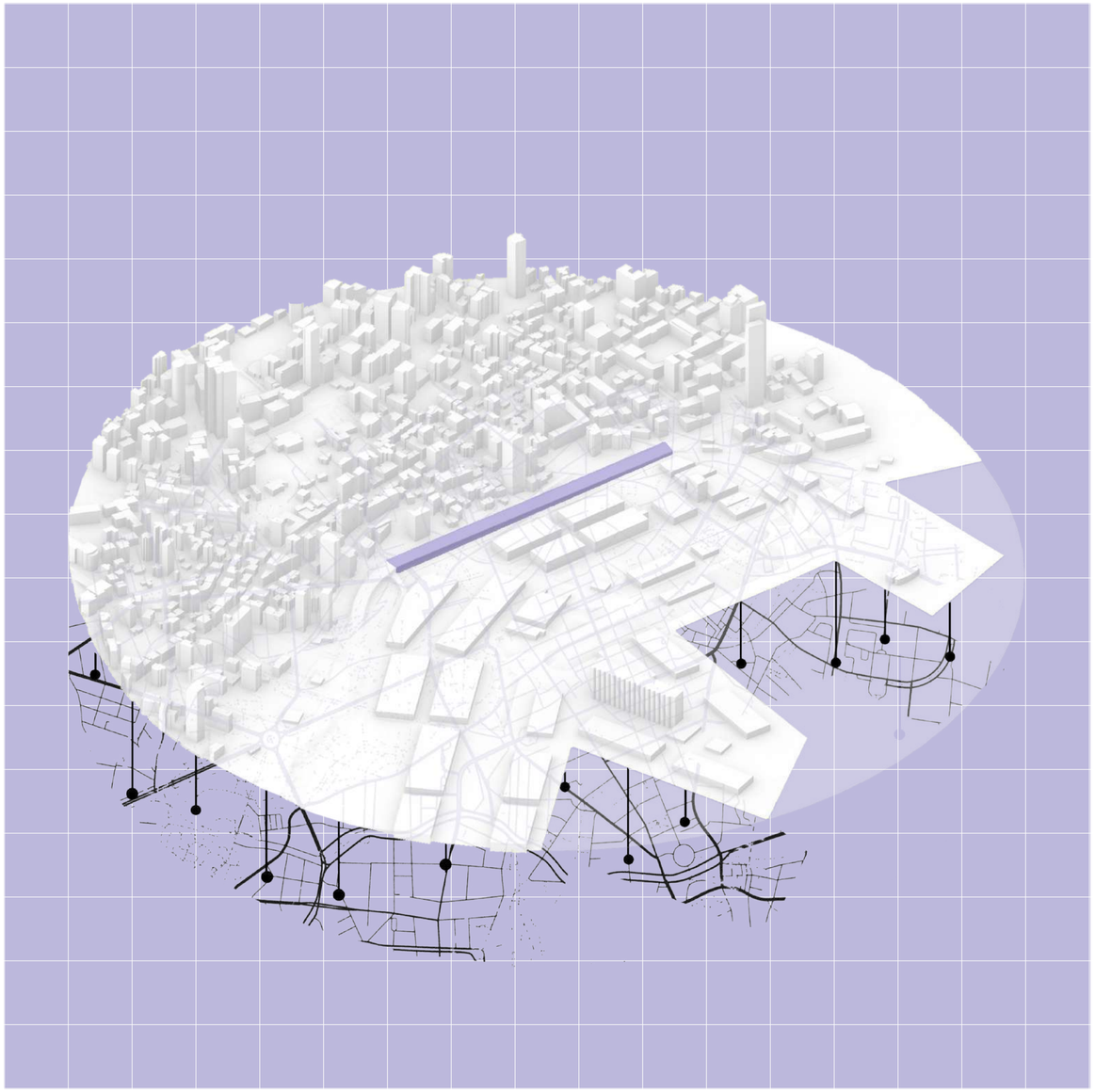
[HC + AI + DE] Conceiving the building in the bases of infrastructure, high-tech movement and modules (Metabolist) introduces the concept of rationalizing the design vision; while the mechanistic approach helps find design solutions to the project, which when combined will define the strategy. These strategies are applied into a specific location – The Charles Helou Bus Station- while being concurrently revised, readjusted, and readapted to a new era; 2070. Therefore, the formulated design approach needed to conceive the healing garage consists of plugging in the city infrastructure within the composed building and Plug in (Archigram) a modular infrastructure (Metabolist) based on a systematic approach (Beaubourg), while simultaneously superimposing it on a transportation node which gives way to deconstructing and reconstructing the problematic intersection.

THE HEAL-ING GA-RAGE NET-WORK

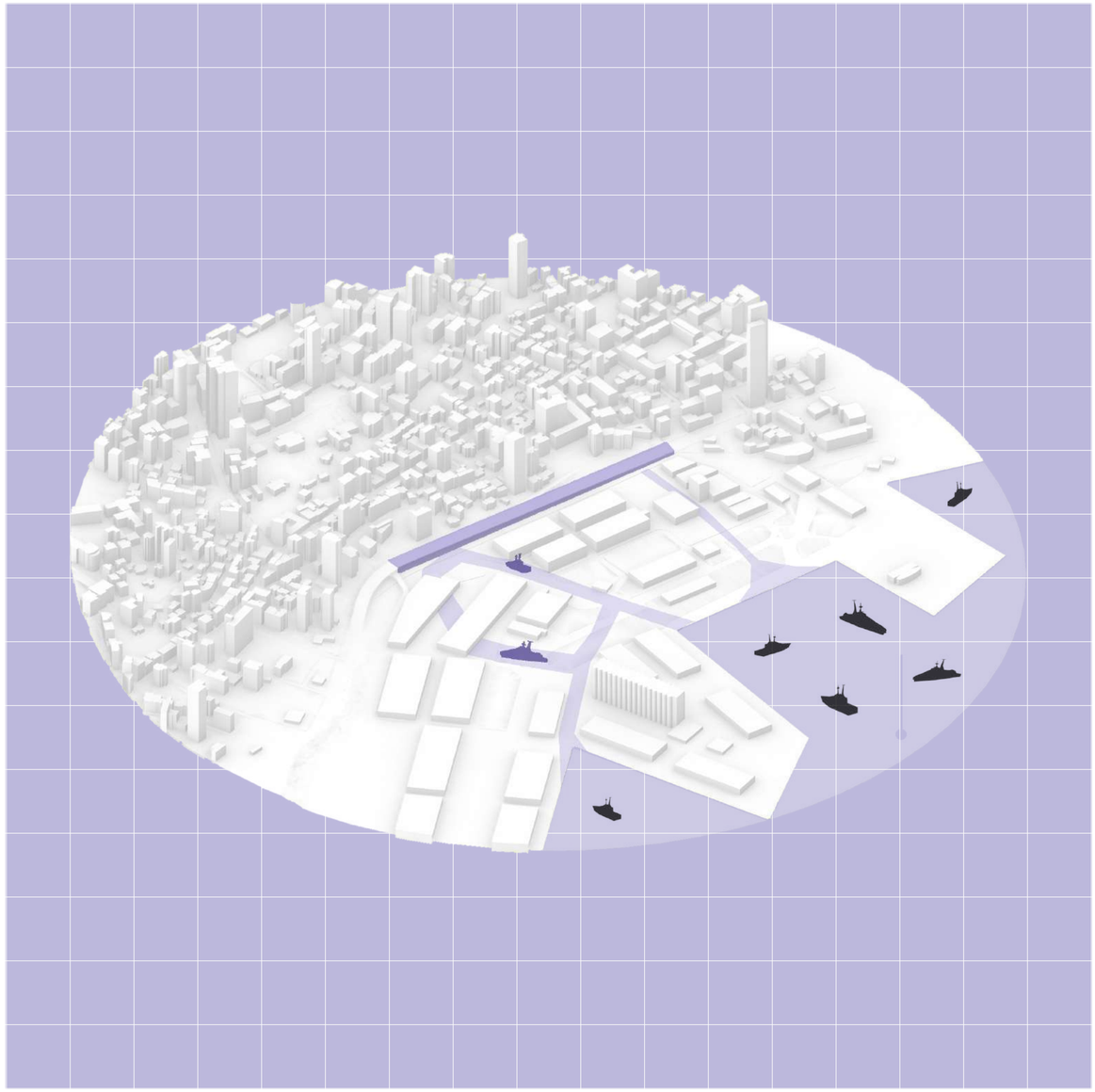
[AI + DE]



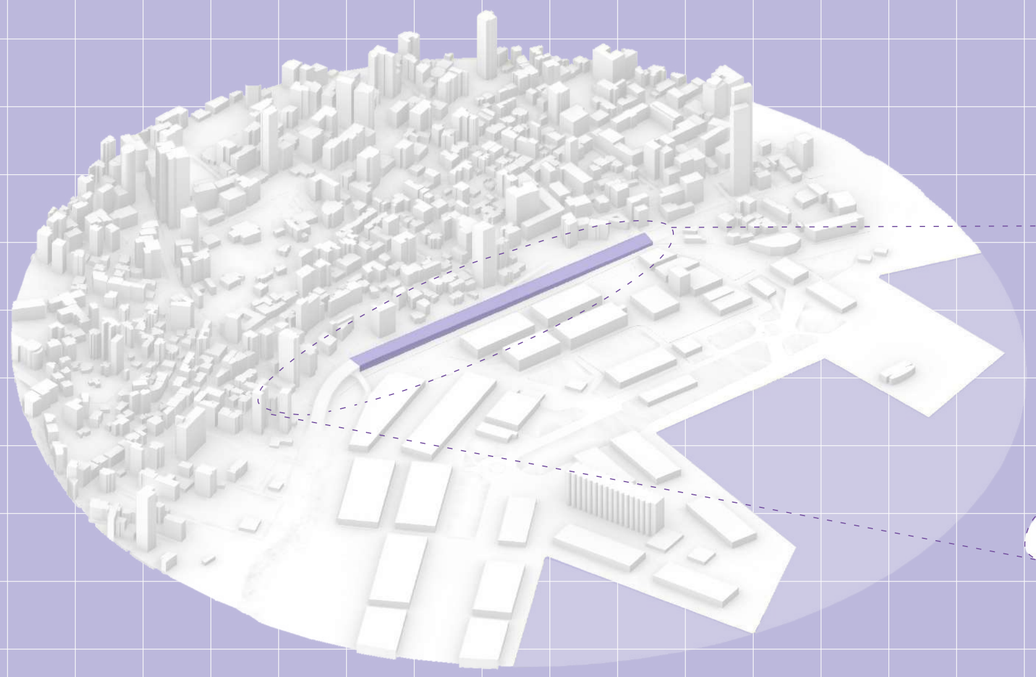
SITE ACCESS **UNDERGROUND / NETWORK**



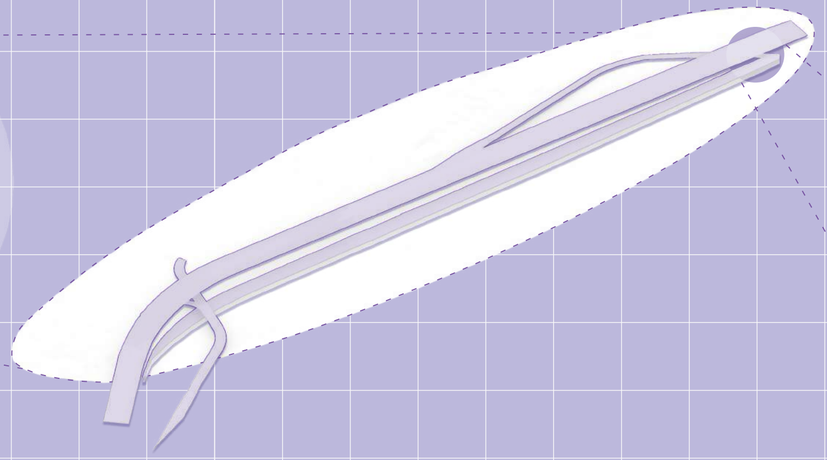
SITE ACCESS **NAUTICAL / SEA**



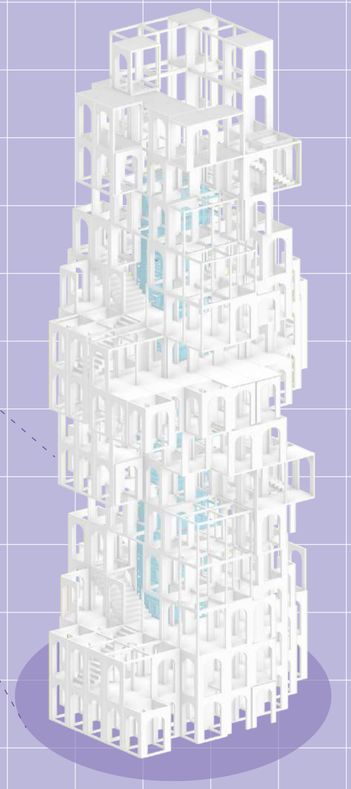
TRANSPORTATION INFRASTRUCTURE VS HEALTHCARE INFRASTRUCTURE



BEIRUT PORT AREA
THE PROJECT SITE LOCATION



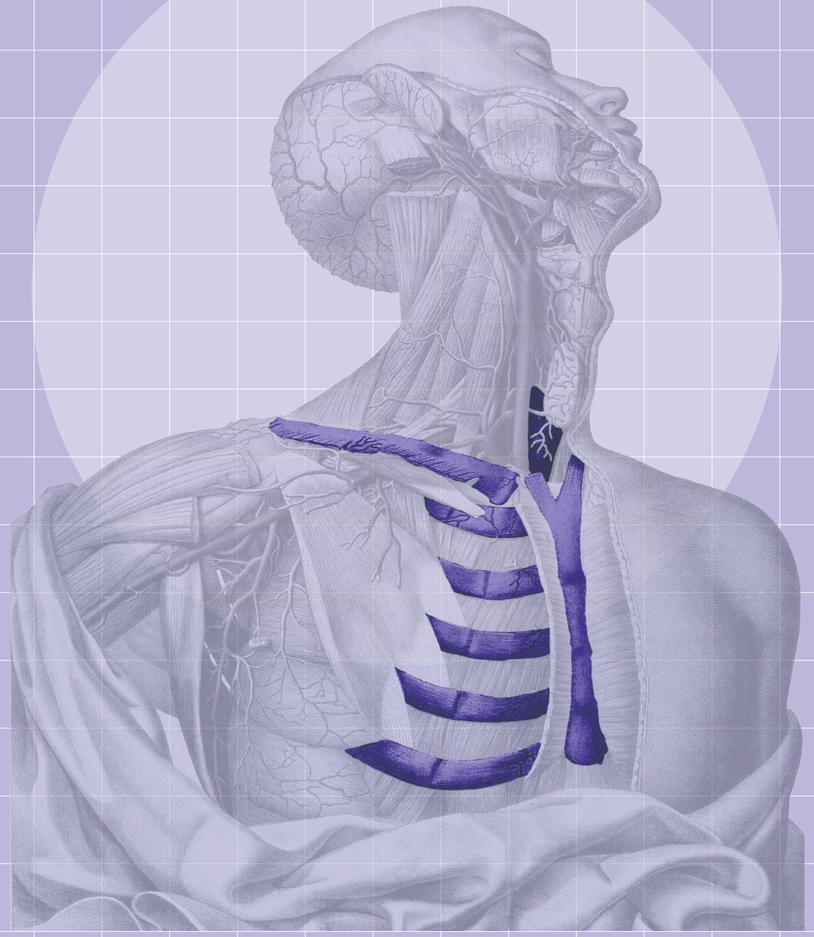
CHARLES HELOU BUS STATION
TRANSPORTATION INFRASTRUCTURE

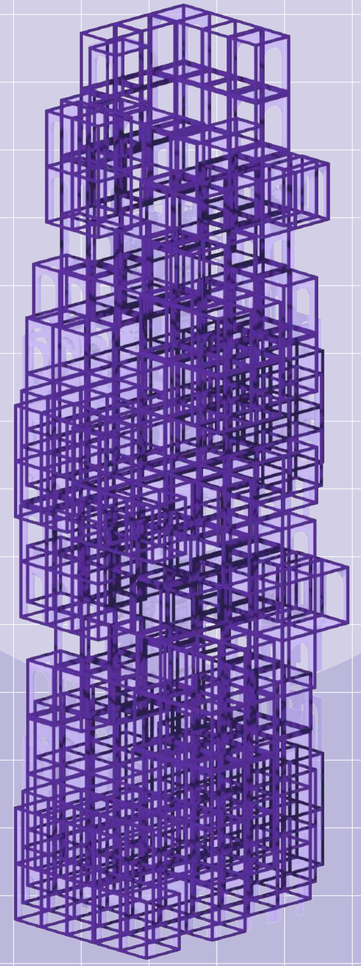


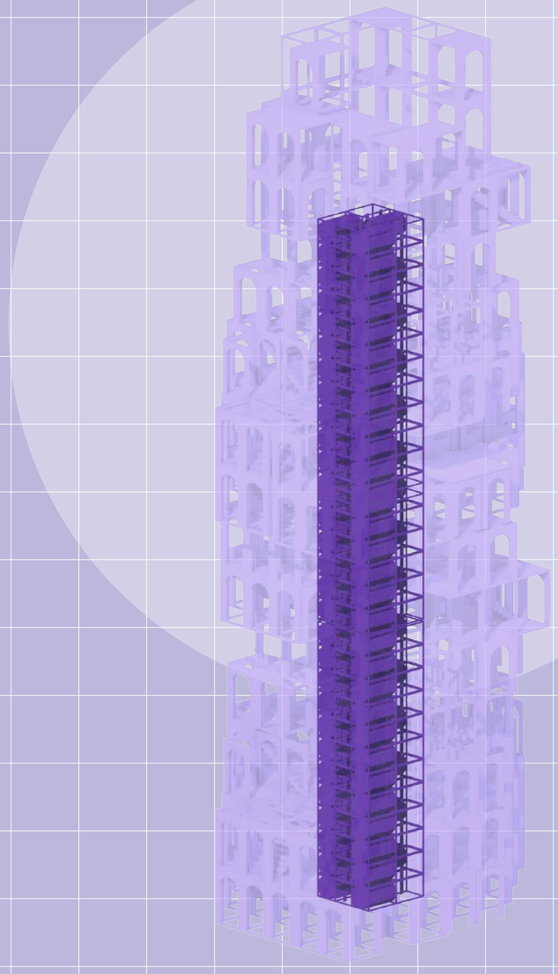
THE HEALING GARAGE
HEALTHCARE INFRASTRUCTURE

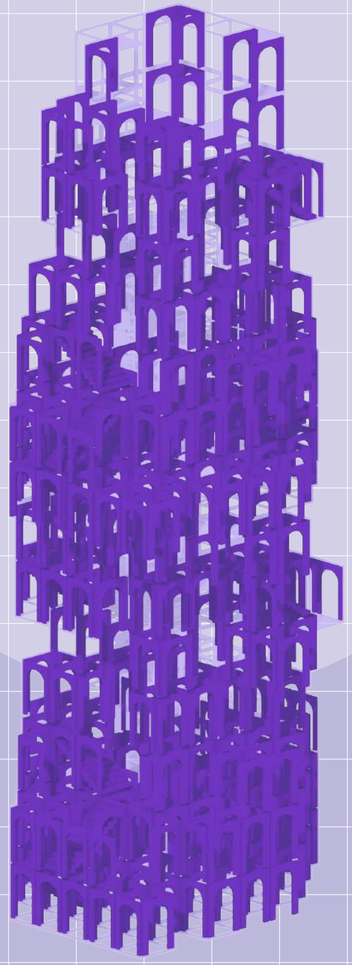
TRANSPORTATION INFRASTRUCTURE VS HEALTHCARE INFRASTRUCTURE

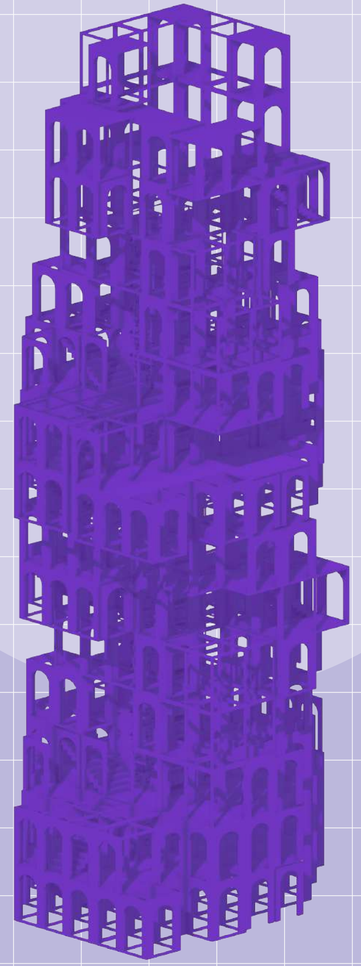
[AI + HC + DE]











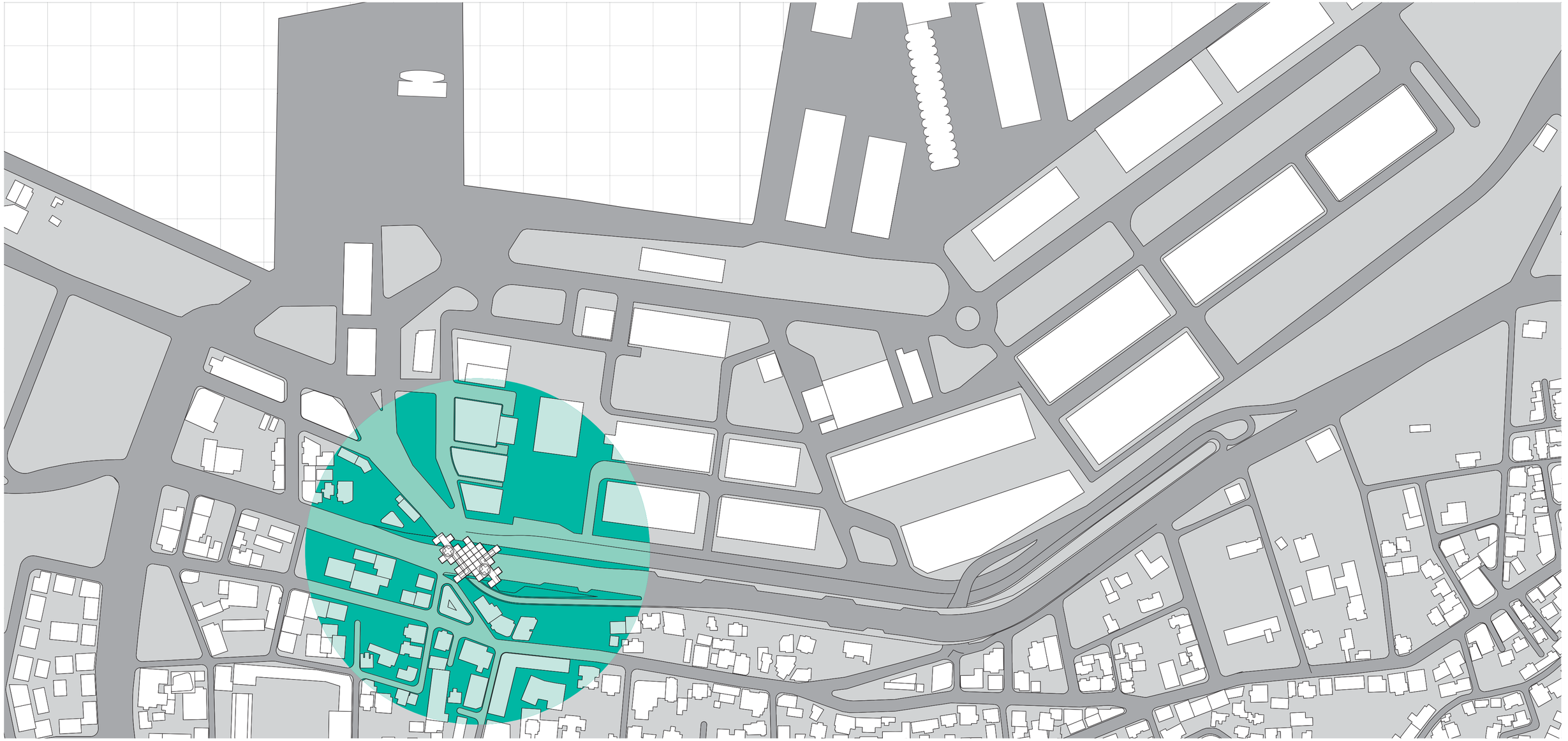
THE DE-SIGN EX-PLORA-TIONS

THE DESIGN EXPLORATIONS

The Healing Garage is presented as a kit; an instrument which consists of the union between an artificial intelligence (AI) module and a Recovery module both plugged into a framed structure. By 2070 approximately 70% of the world's population will be living in cities (UN DESA), therefore, the has design is transformable, as it can be assembled in different ways in order to accommodate to different potential sites. The site best equipped to host such an emergency hospital depends on the crucial aspects of accessibility, fluidity and location. Thus, the potential sites had narrowed down to The Charles Helou Train Station. This site, which acts as both an infrastructure and a parking, is in fact located on the main artery that allows for the circulation towards and from the capital city of Beirut to occur. The kit is specifically placed on the node of the Charles Helou Bridge, which is the element within the artery that permits the access towards the city. The assembling of the kit in this location followed a specific biological methodology towards architecture. In fact, the building anatomy has the same essence as that of the human anatomy. Similar to how the human physiognomy is formed by the union of its infrastructure: bones, its system: nerves, and its structure: muscles, so does the building physiognomy, through the amalgamation of its infrastructure: the grid, its system: AI pods, and its structure: recovery modules. Thus, there exists a particular relationship between the human body and the Healing Garage.

The challenge, however, is to discover a method that allows two independent infrastructures to exist within the same baseline; the health and transportation infrastructure. The two latter subjects, which typically do not intersect, are challenged in this project in order not only to coincide but to feed upon each other as well. The clashing between the two infrastructures generates a Surrealist mega-structure that plugs into the city at a very critical intersection point. The city's high density, along with the overcrowded highway, gives way to the creation of the Urban Jungle typology, which does not rebel against the zone's existing conditions, but rather finds ways to not only coexist with the latter but to more importantly interact with them. The infrastructure then merges into the underlying existing parking and ramp, reorienting and recreating the circulation at that intersection; thus creating a buffer zone. The healing garage creates yet another connection to the city through the networks created to repatriate and dispatch EMSVs , which operate within underground pipes, through drones and through the sea. In this sense the building relates and adapts to the city, without losing its essence and complexity. In fact, at the critical moments of intersection between the building and the city, the Healing Garage portrays the epitome moments of horizontal and vertical absurdities.

SITE PLAN SCALE 1/2000



SITE PLAN SCALE 1/1000

THE USER MANUAL

THE USER MANUAL
THE USER MANUAL
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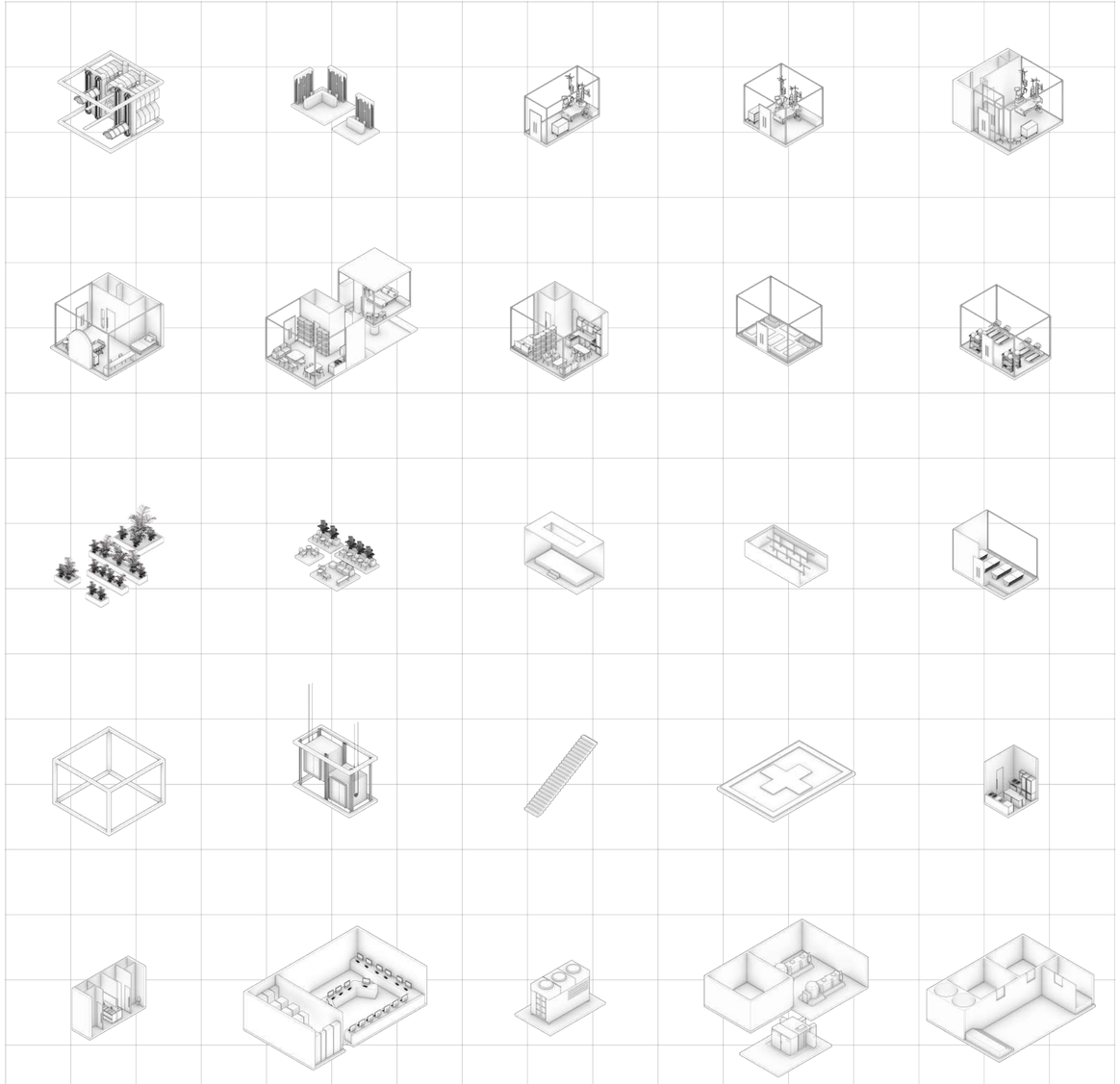
1 - THE KIT

2 - THE CITY

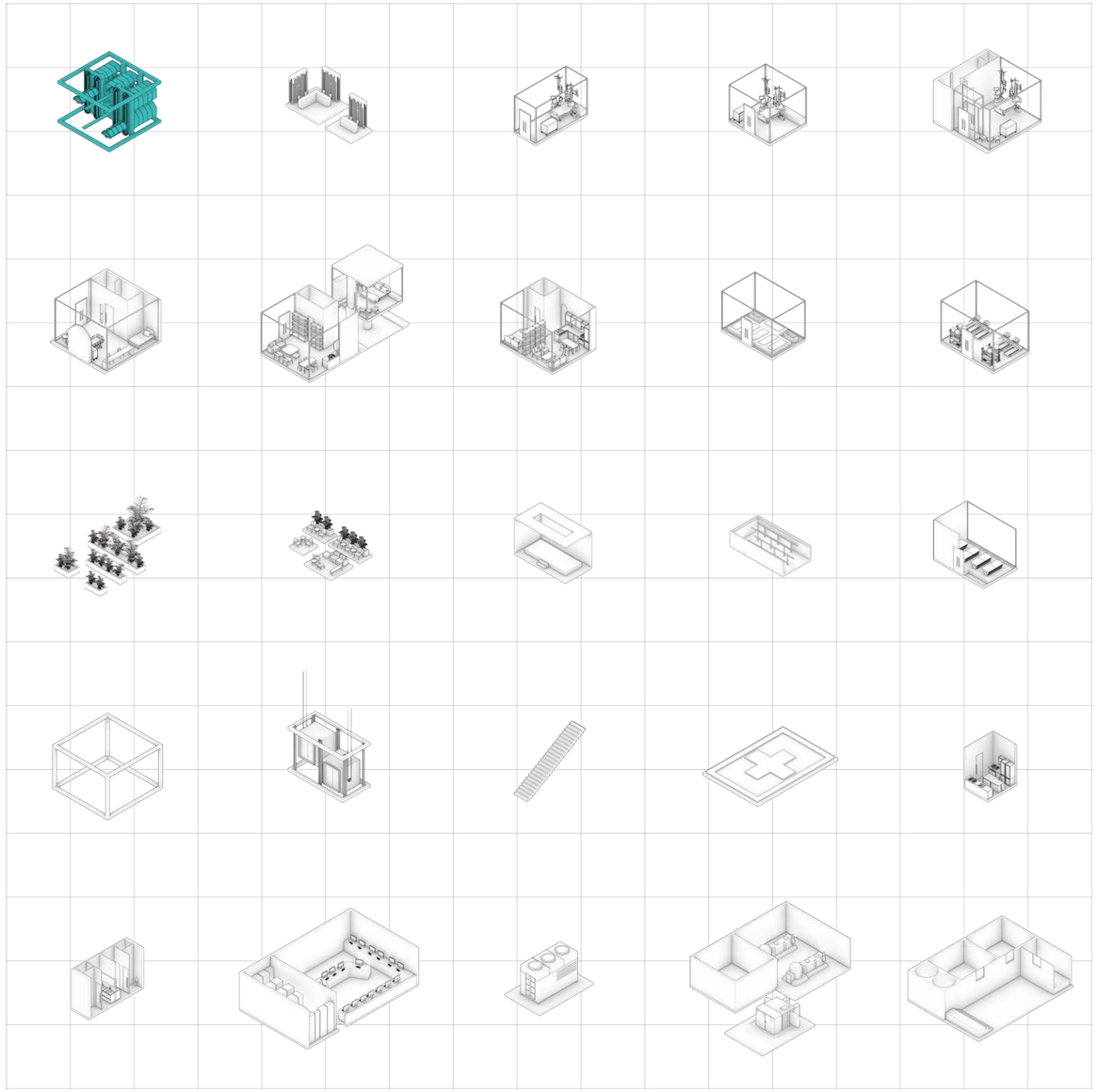
3 - THE SITE

4 - THE PILOT PROJECT

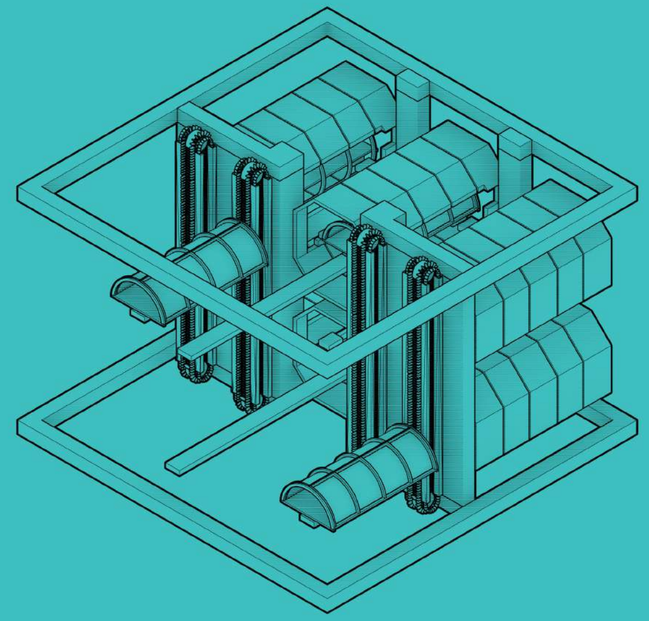
5 - YOUR PROJECT



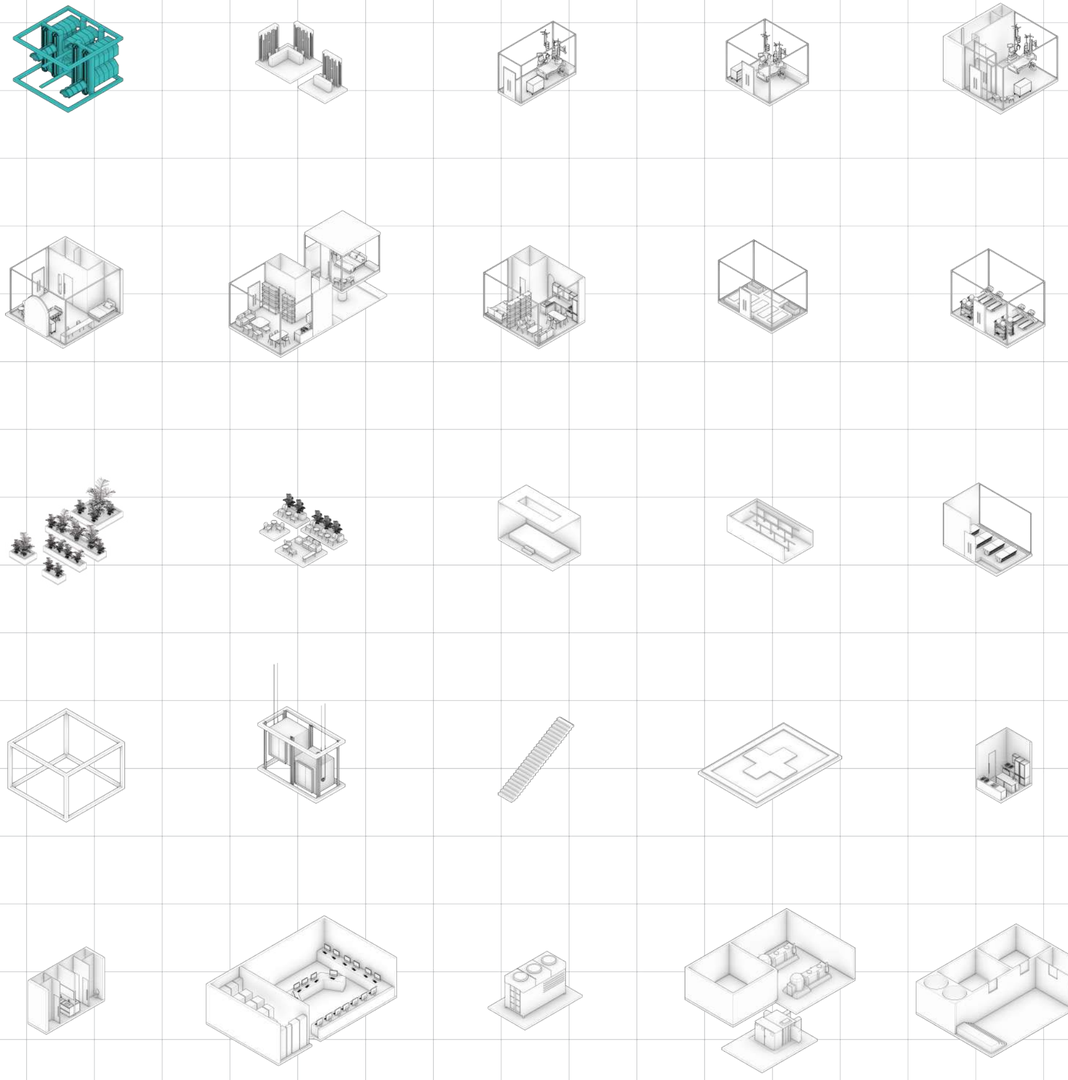
THE KIT

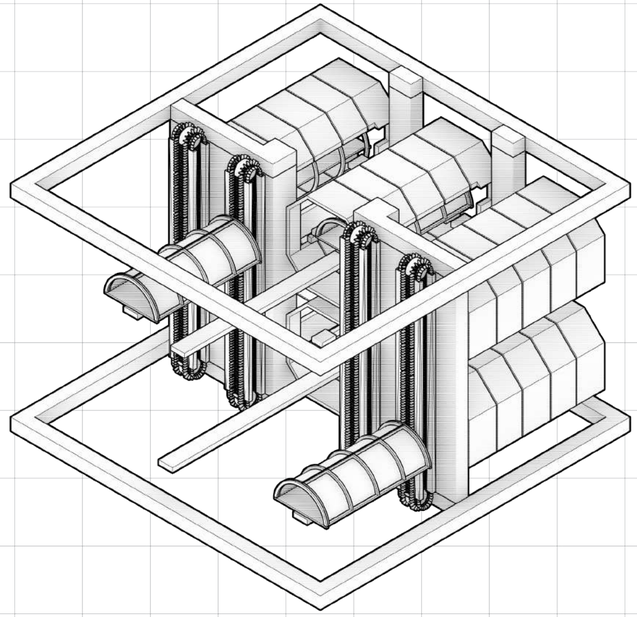


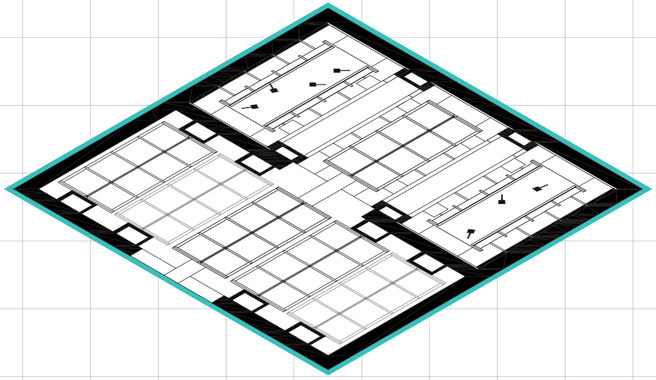
THE MEDICAL PACK

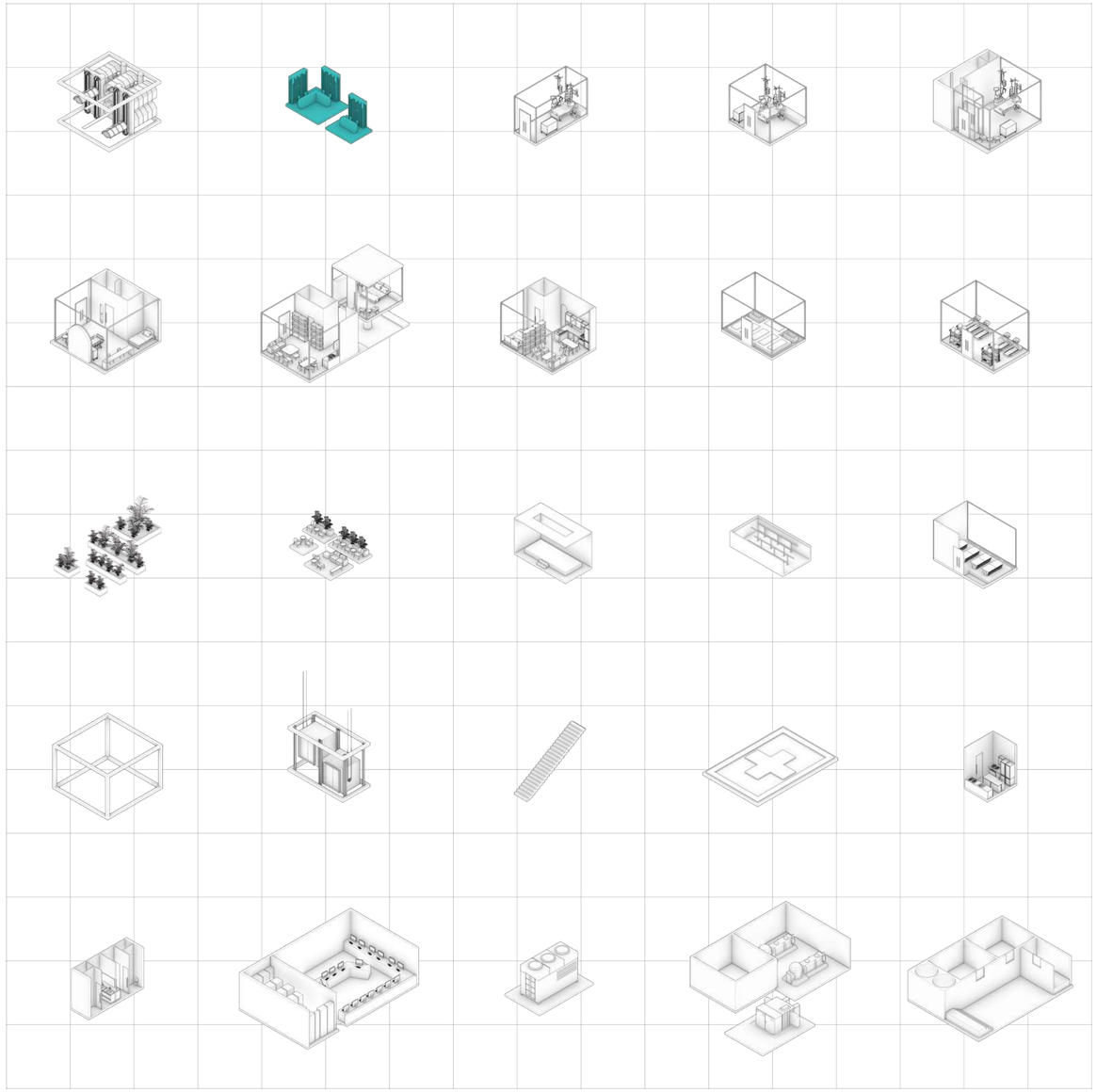


THE ARTIFICIAL INTELLIGENCE EMERGENCY MODULE









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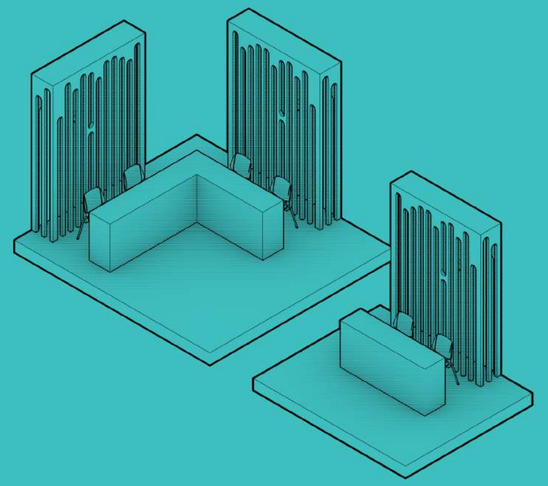
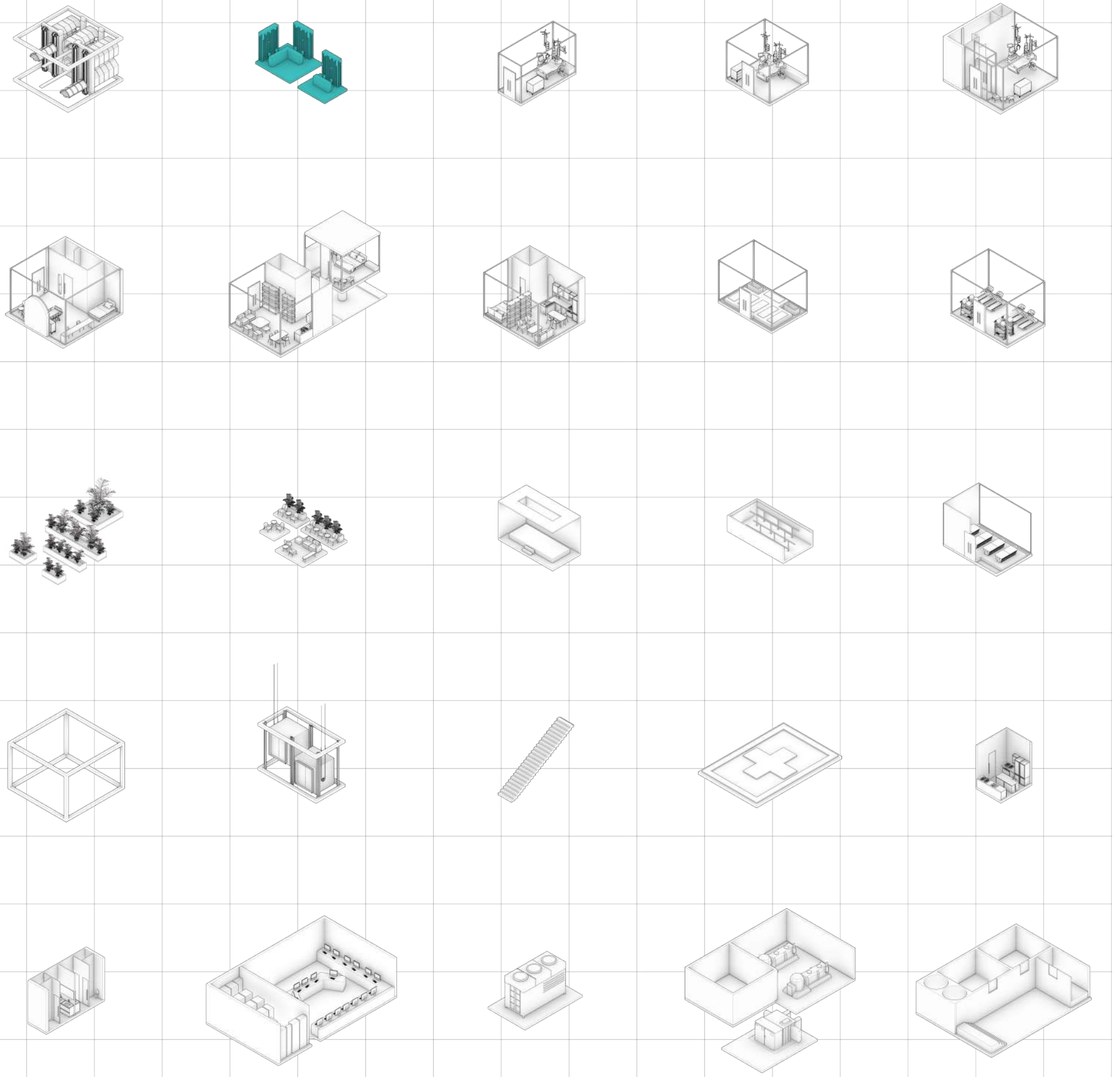
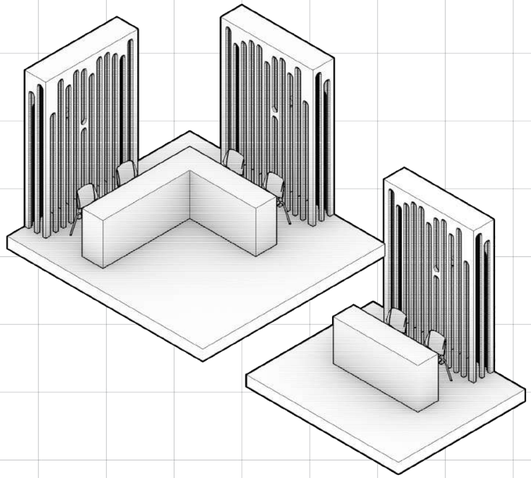
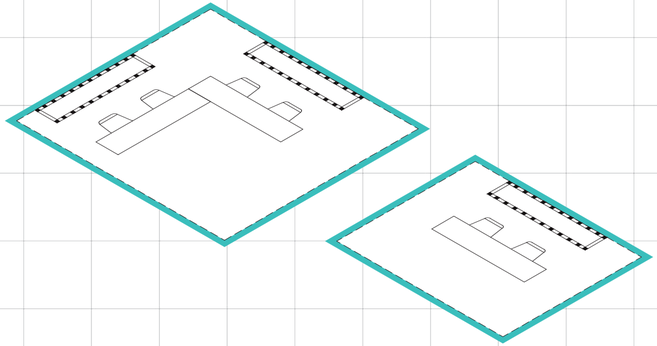
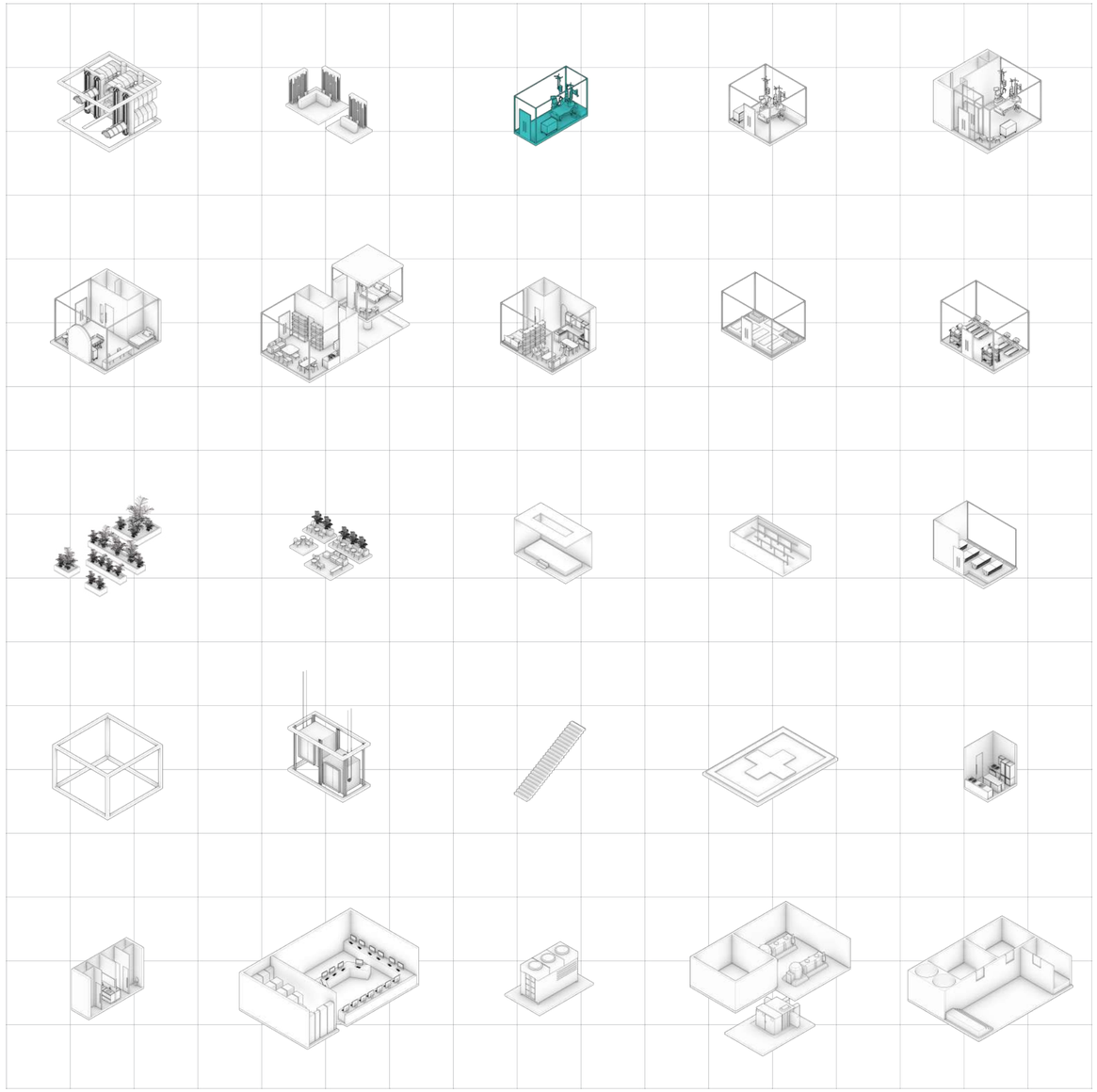


THE NURSE STATION MODULE

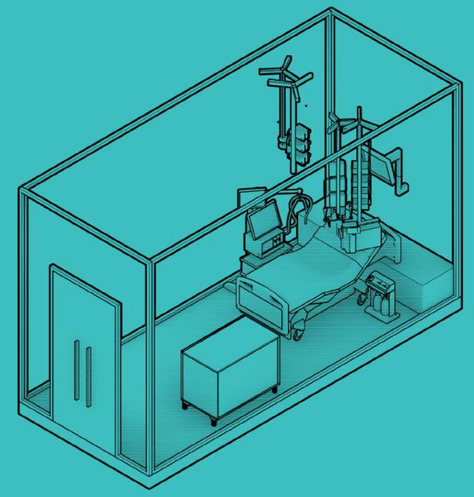




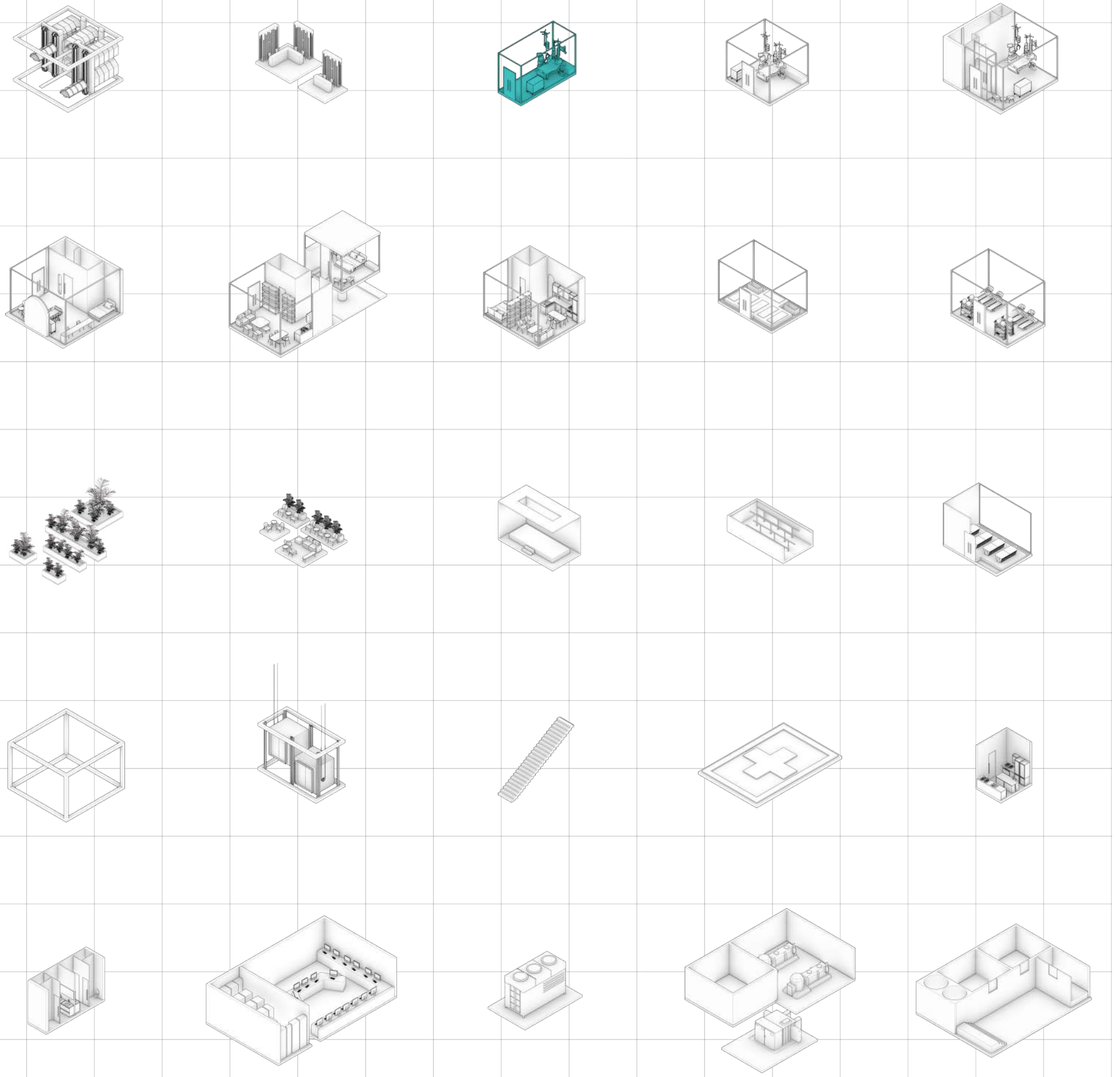


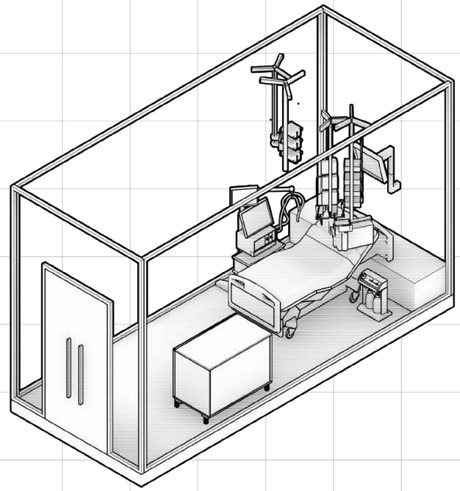


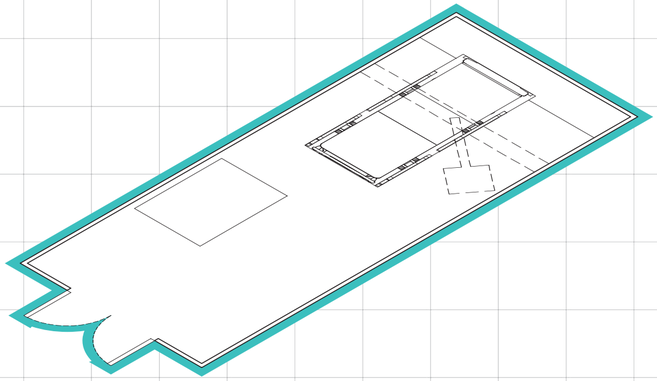
THE MEDICAL PACK

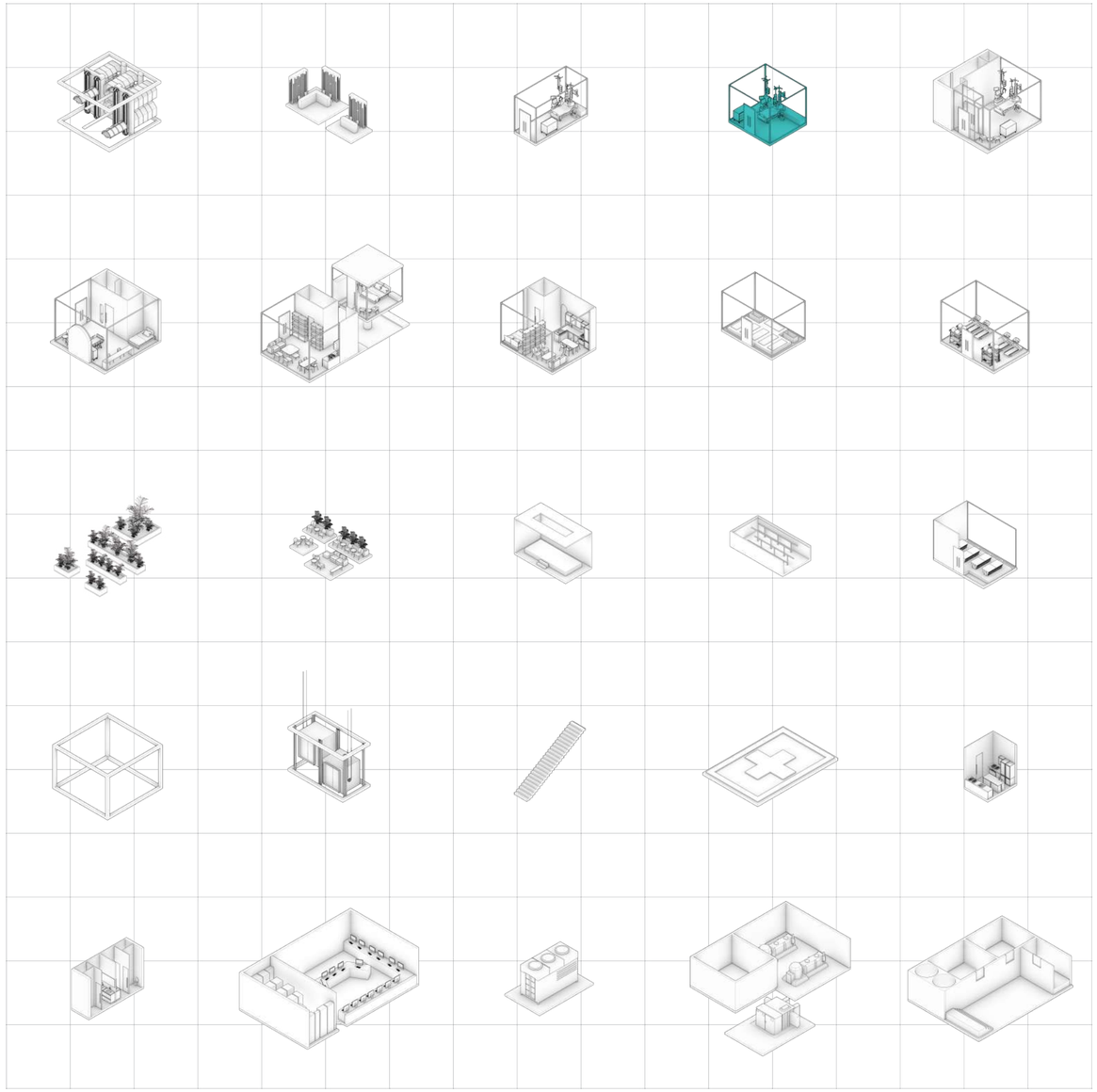


THE EXPRESS INTENSIVE CARE UNIT
LEVEL 3 MODULE









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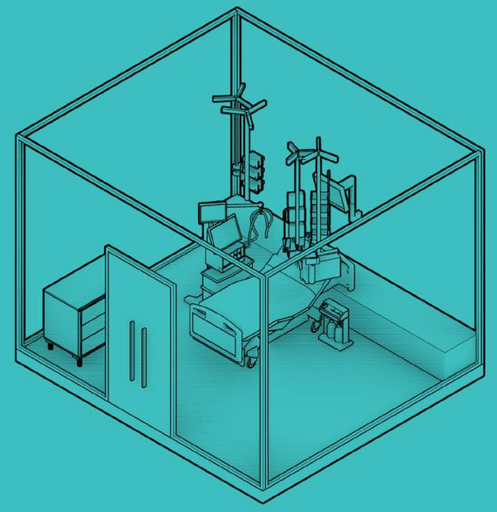
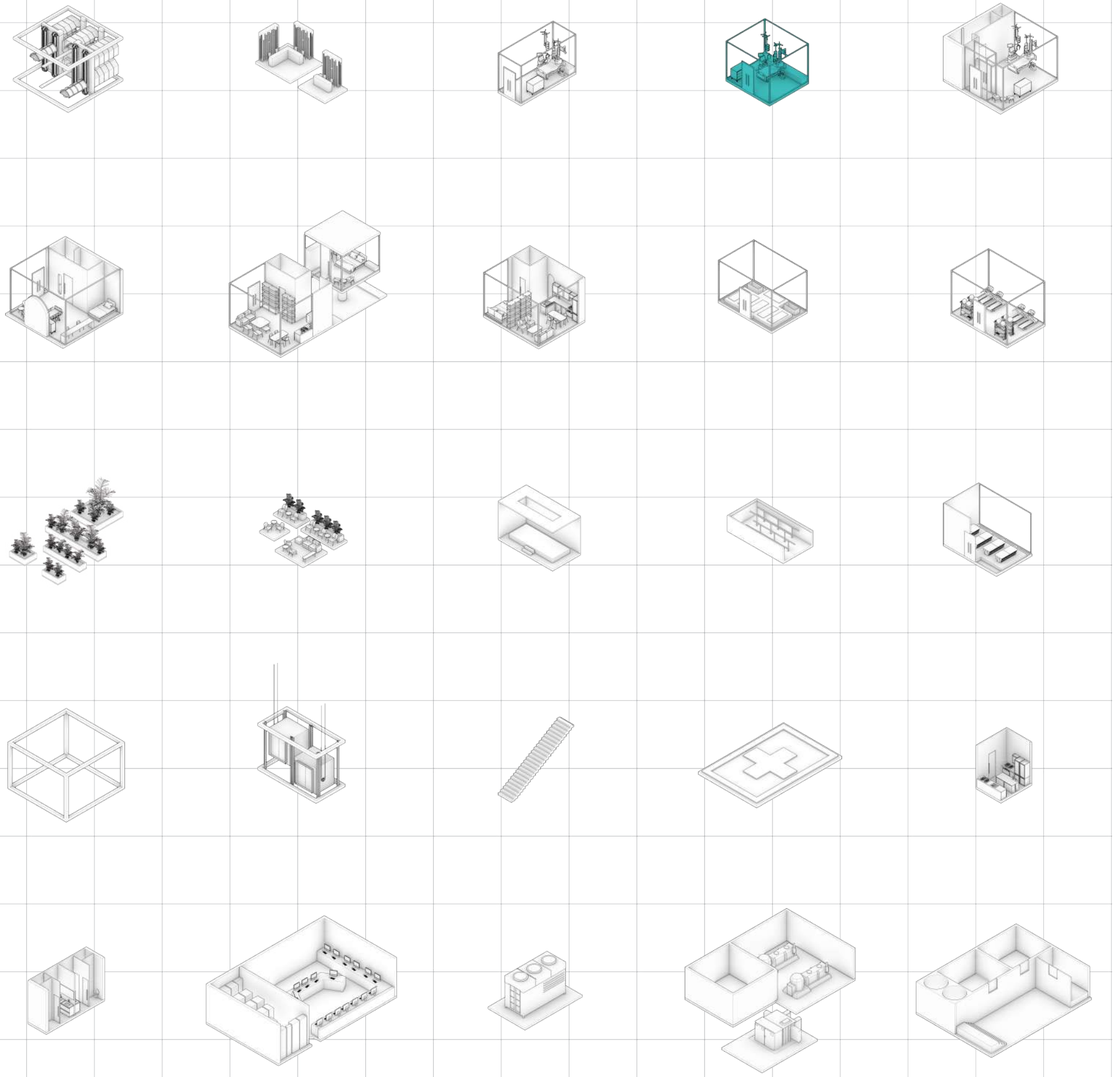
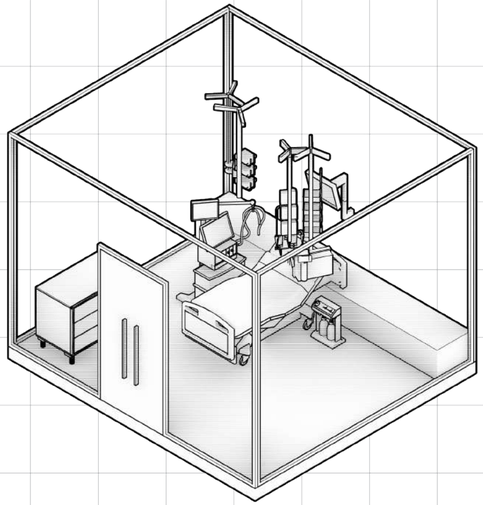
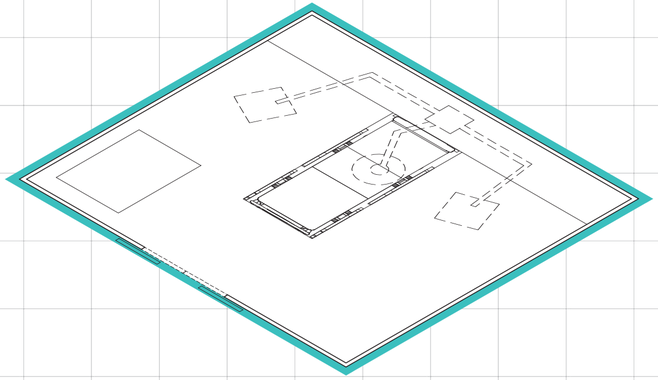
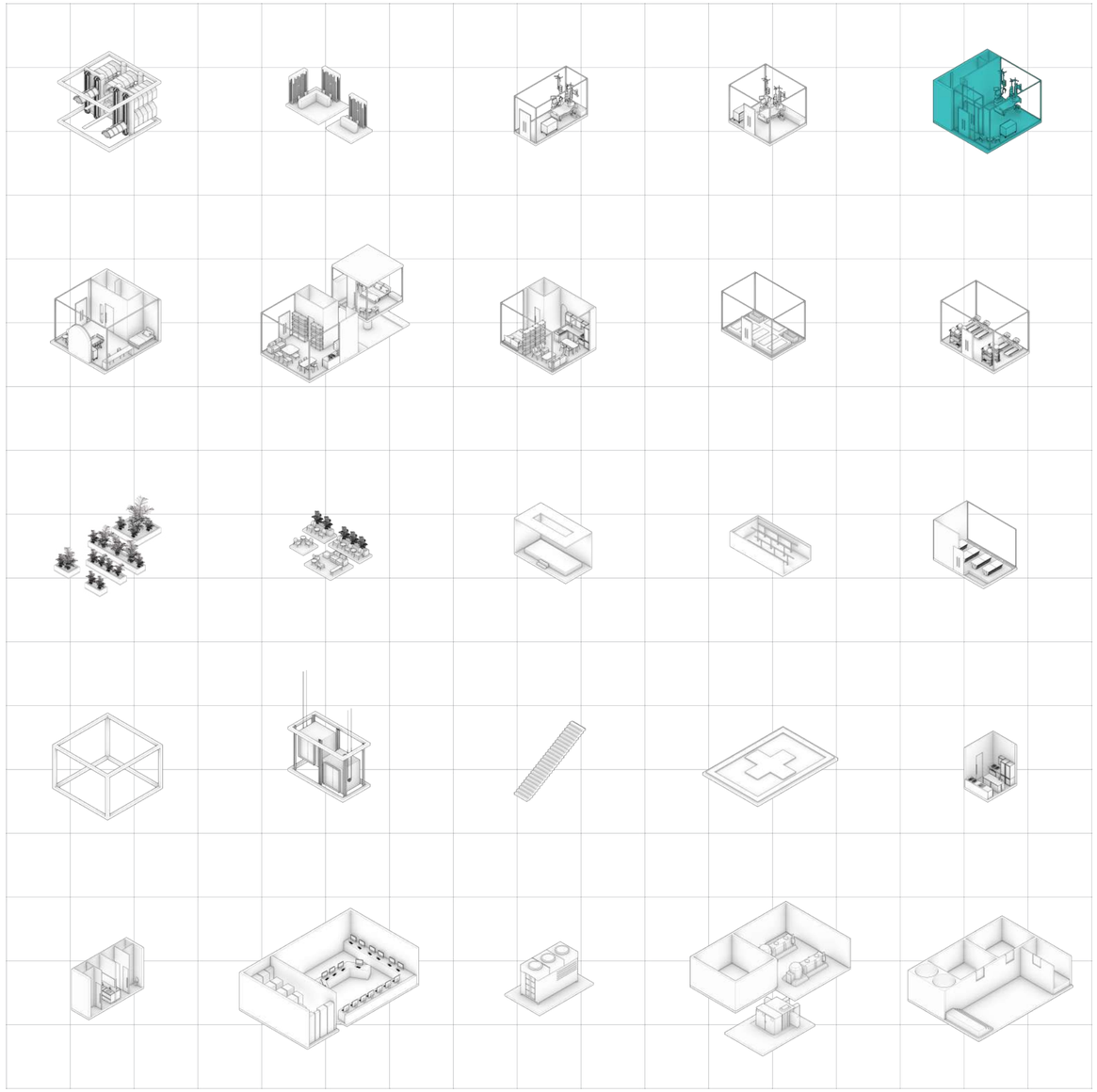


THE INTENSIVE CARE UNIT
LEVEL 3 MODULE









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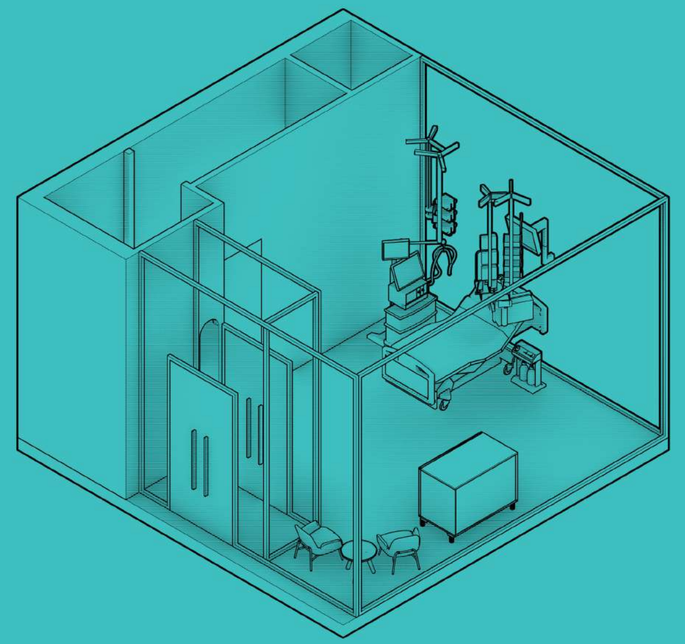

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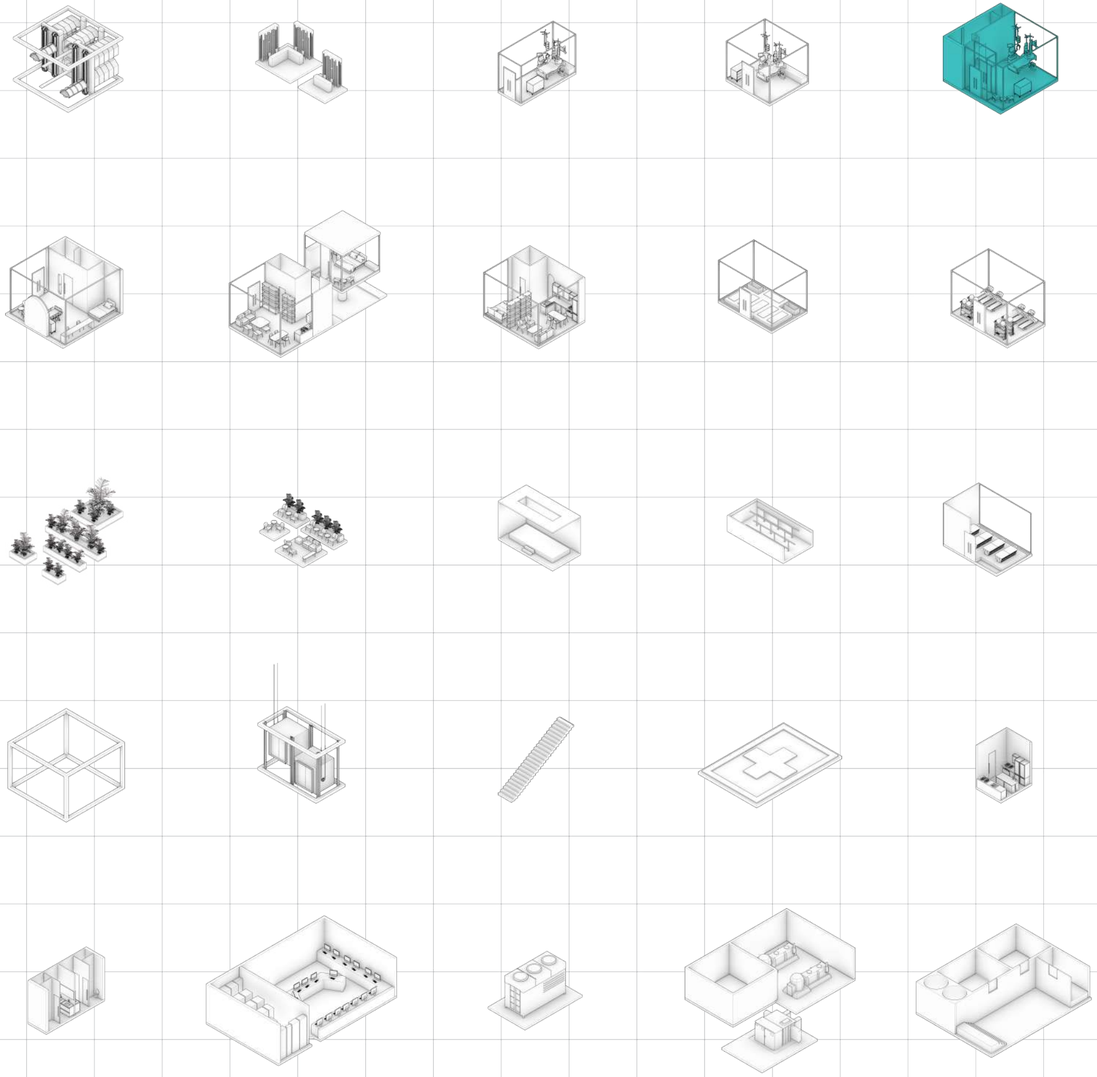
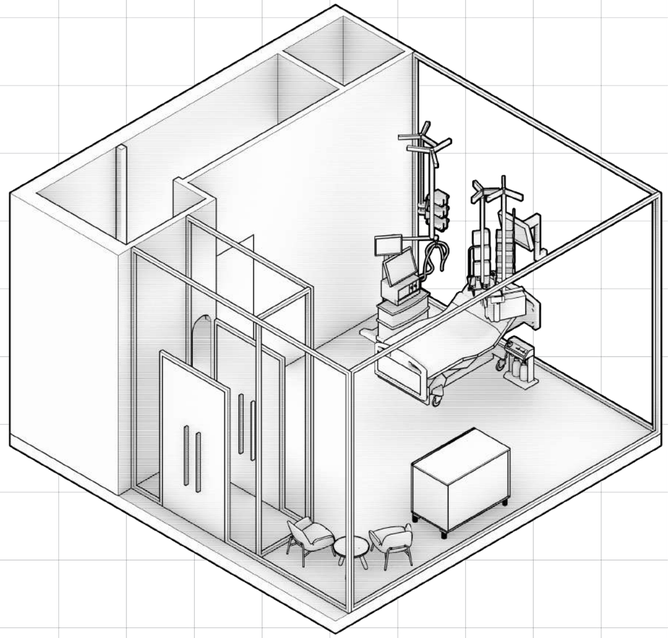
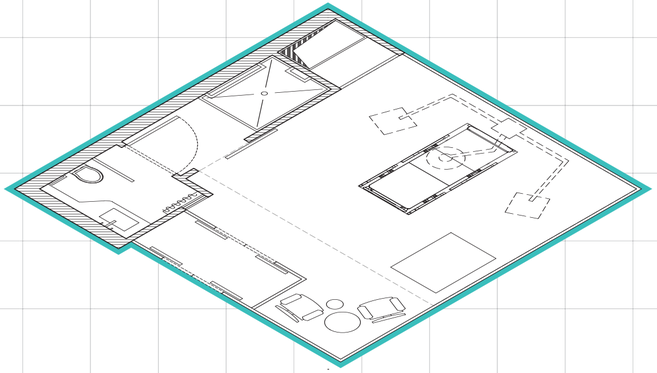
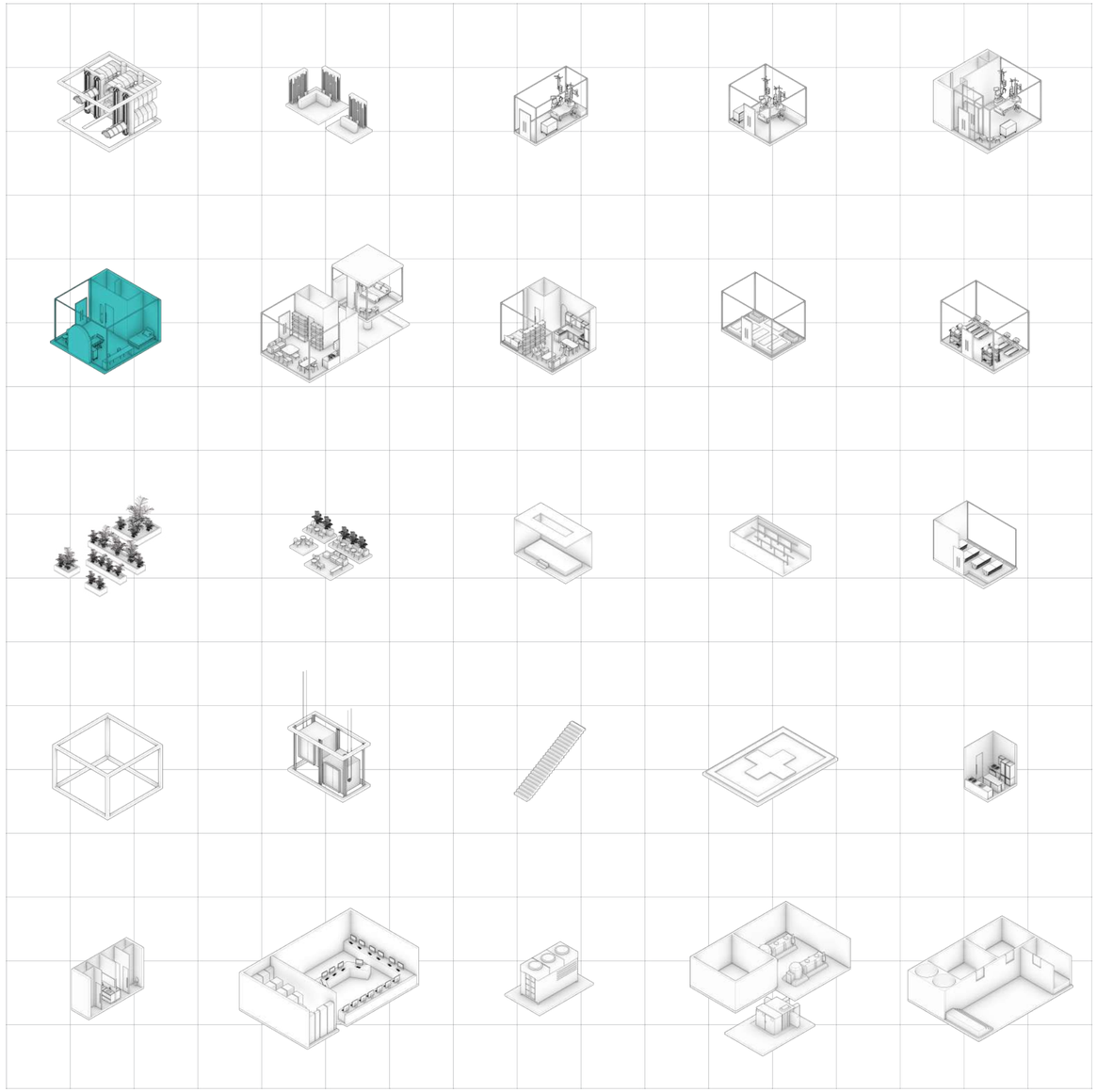
LEVEL 1-2 MODULE









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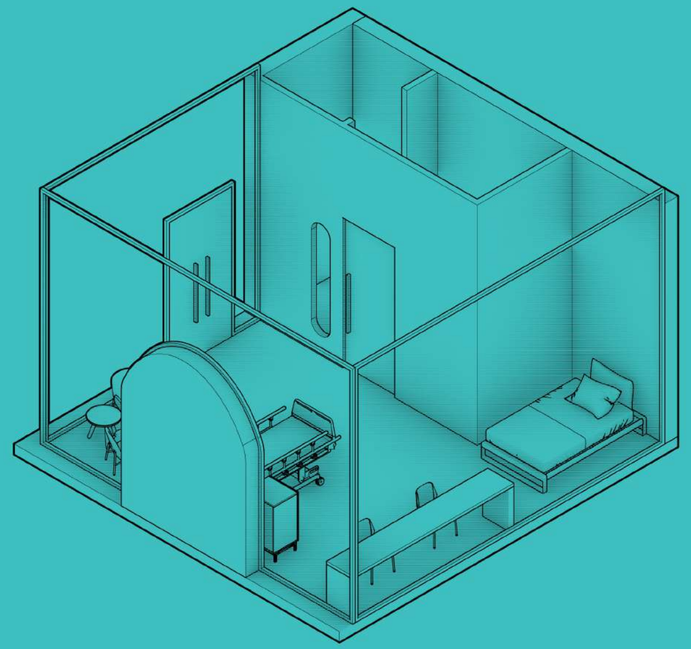
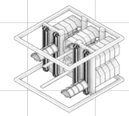
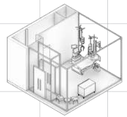
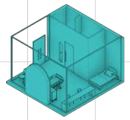
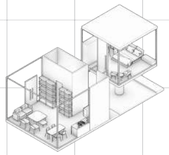
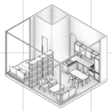
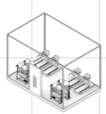
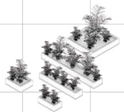
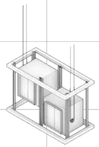


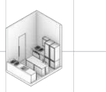
THE SHORT STAY UNIT MODULE

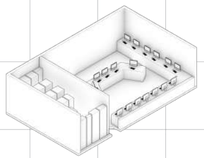
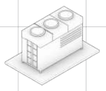
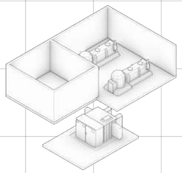
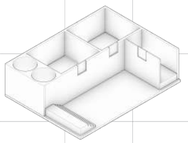


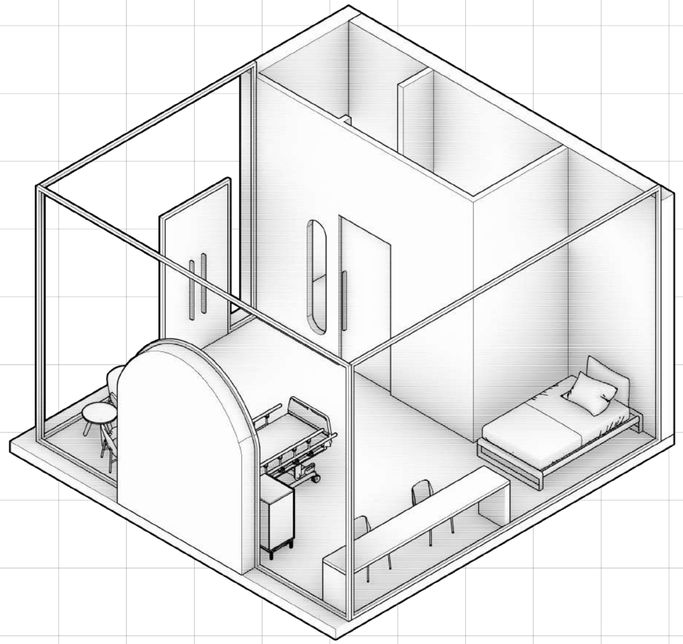
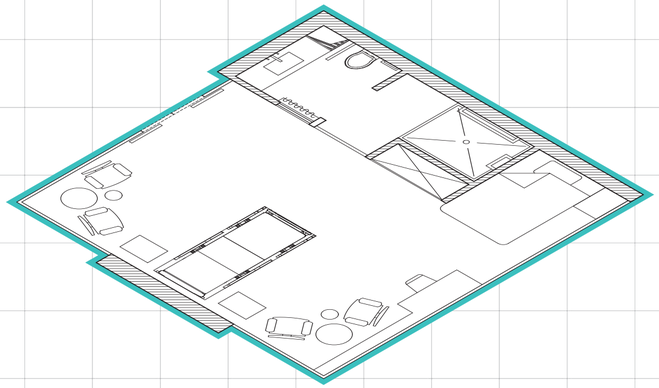





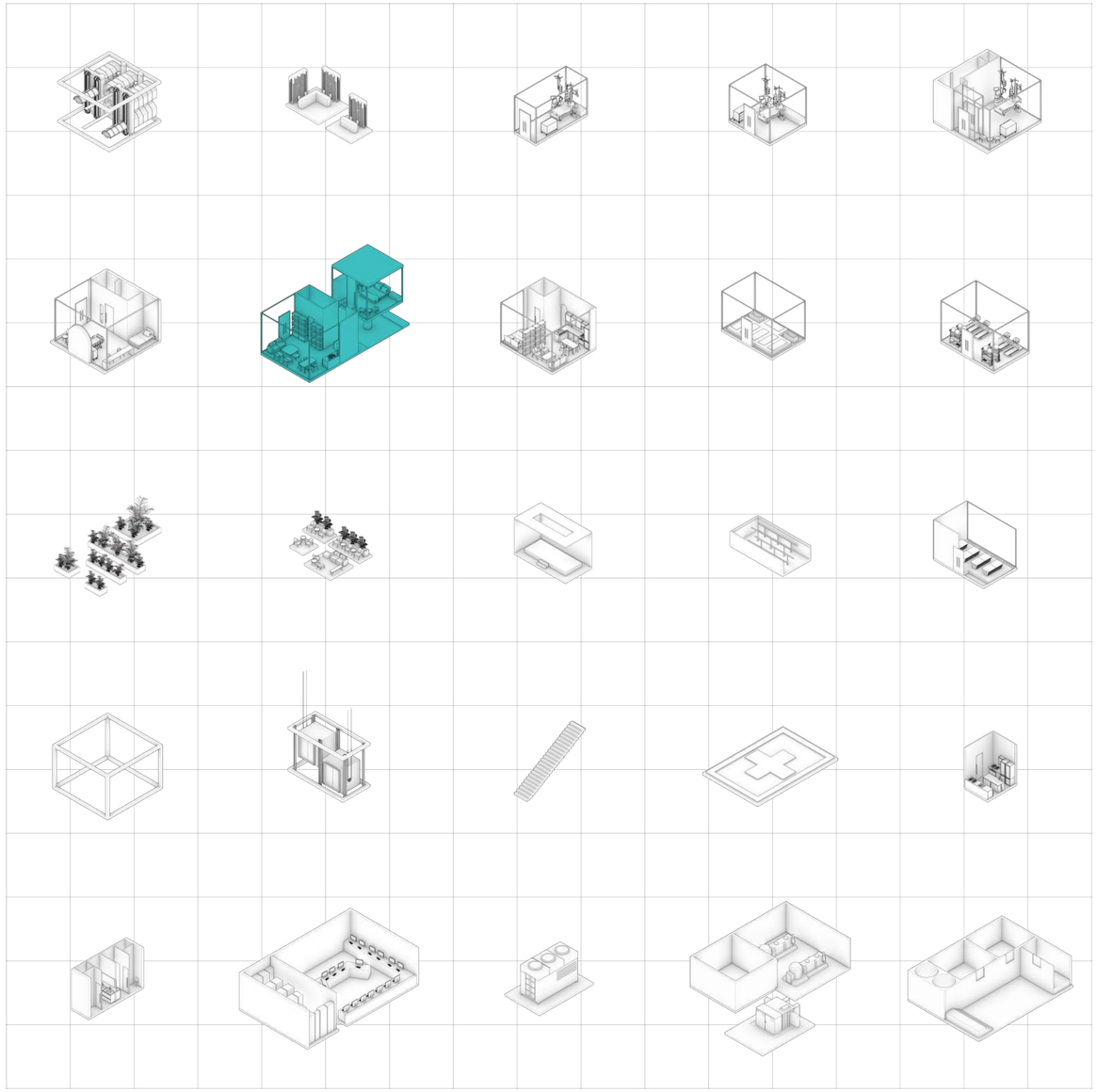









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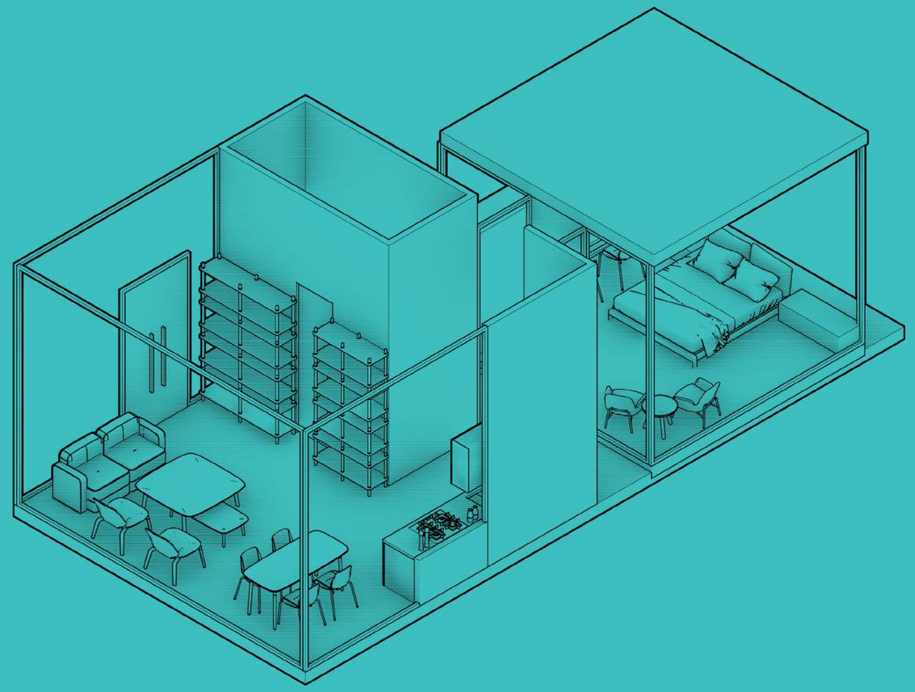

THE QUARANTINE MODULE
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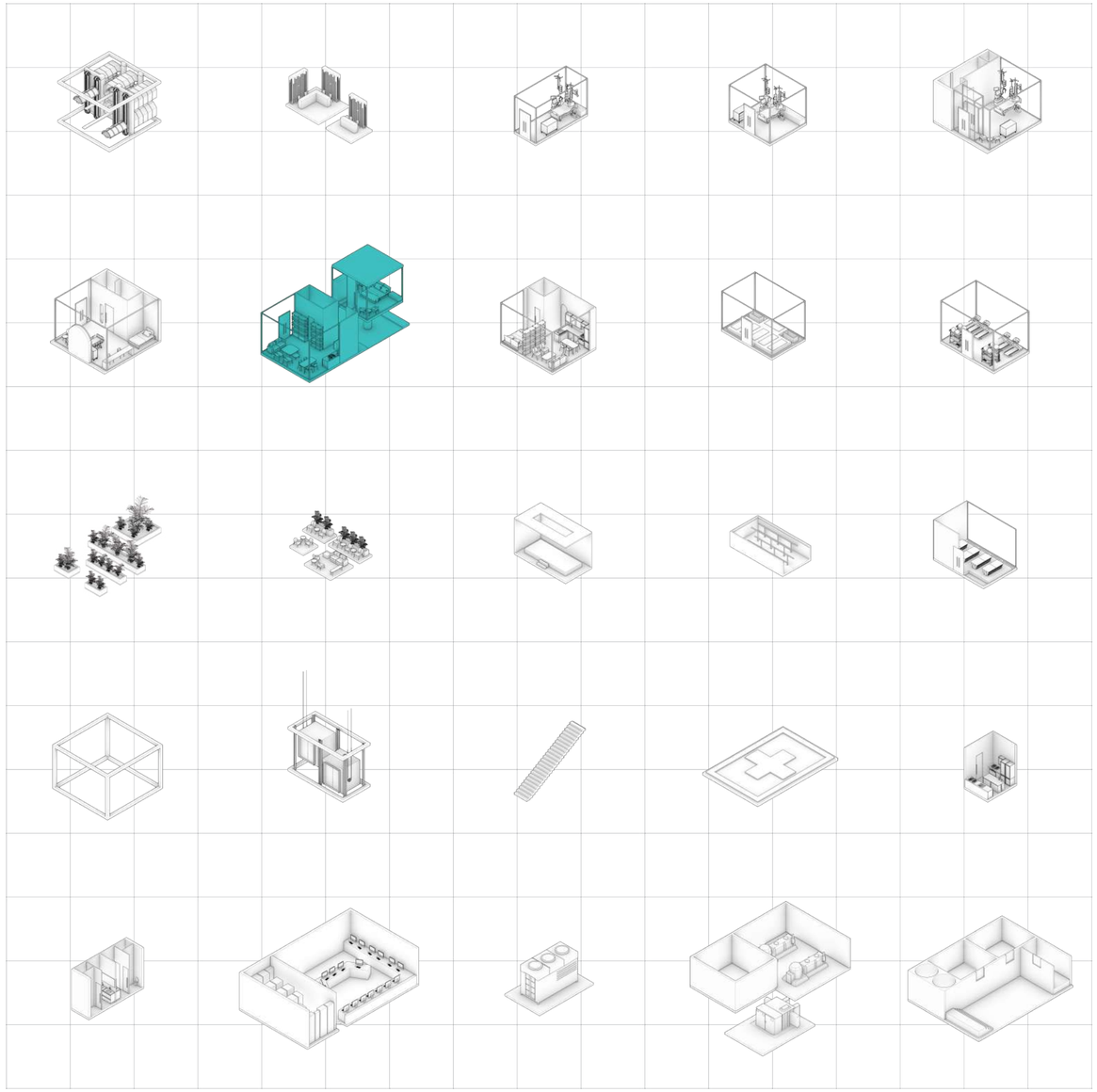

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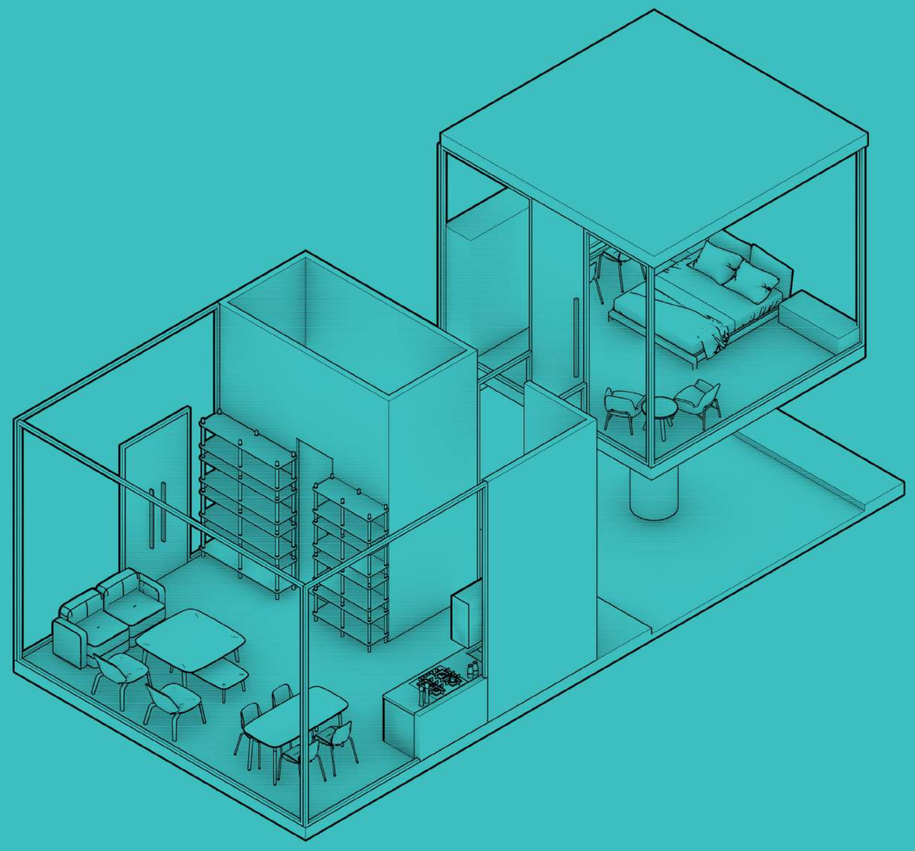

THE QUARANTINE MODULE
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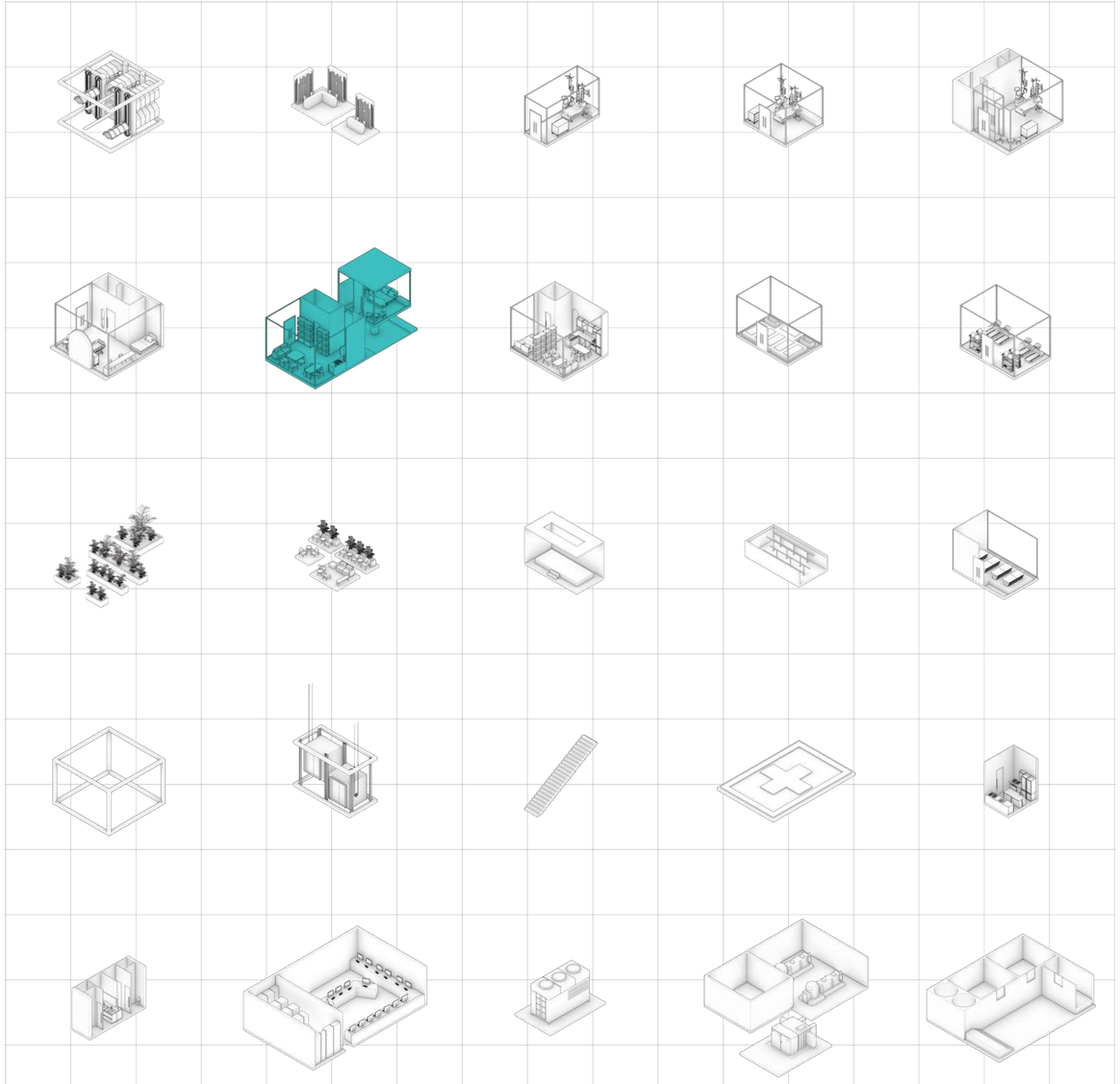

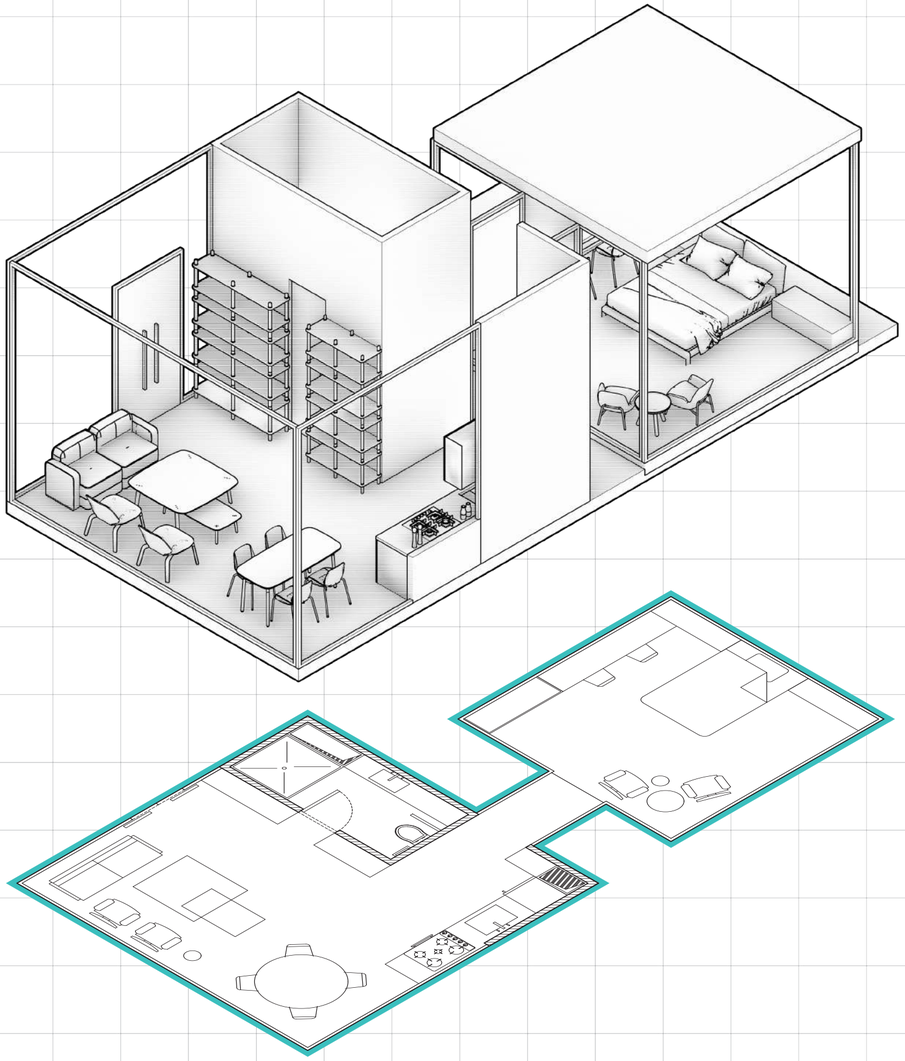

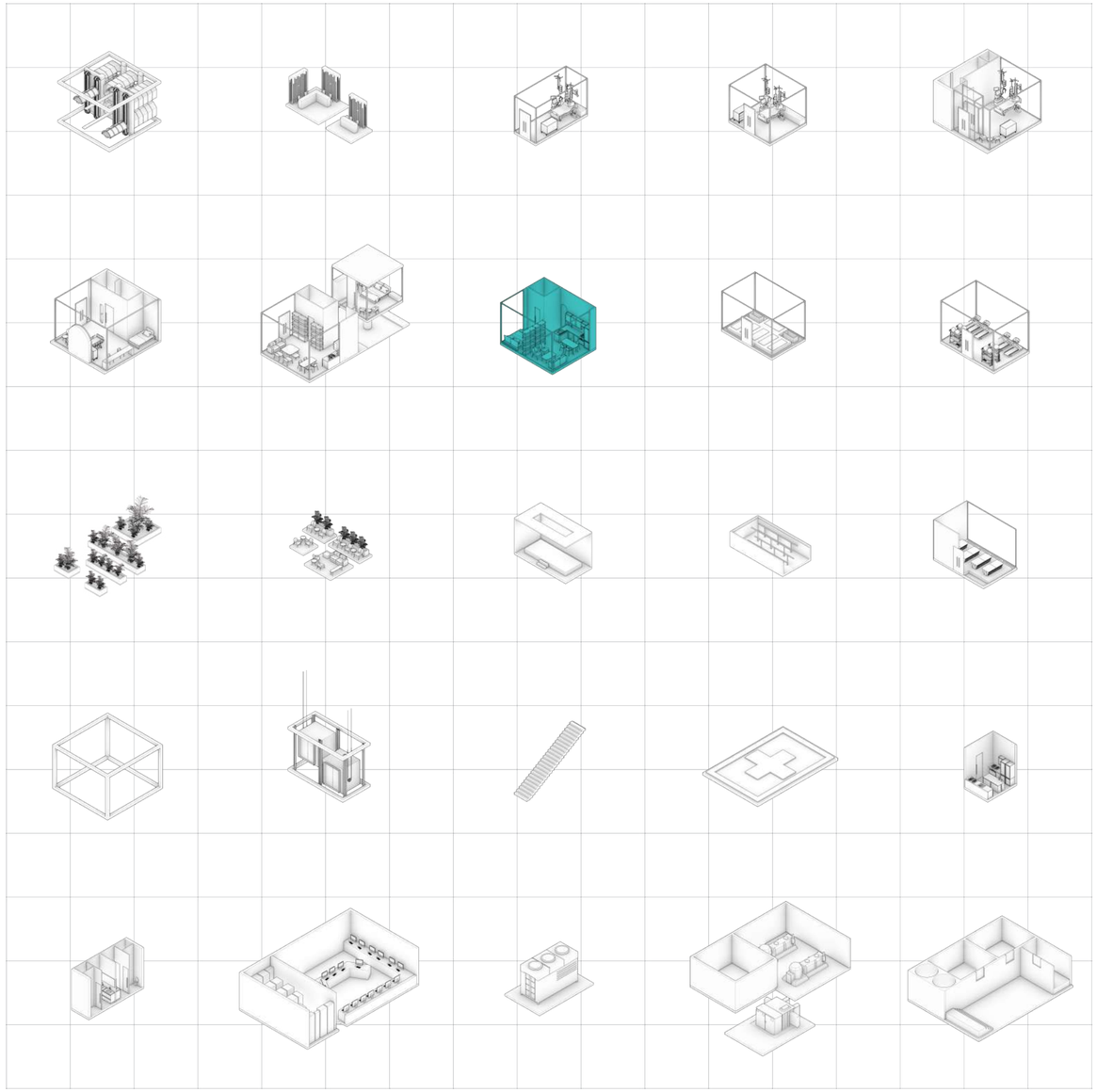

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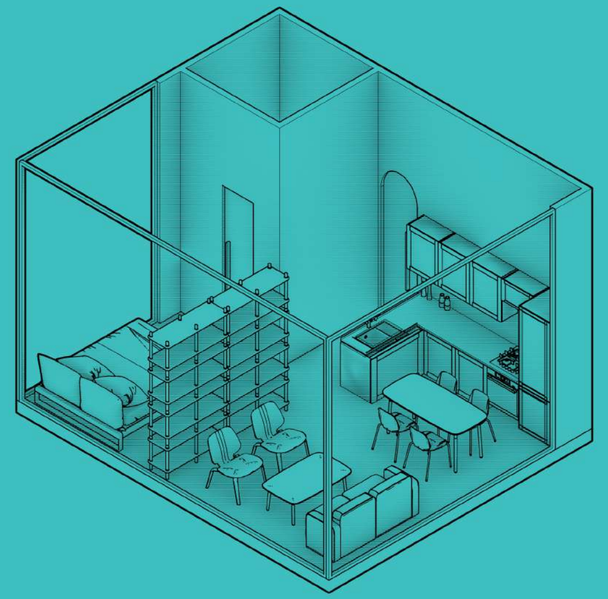

THE QUARANTINE MODULE
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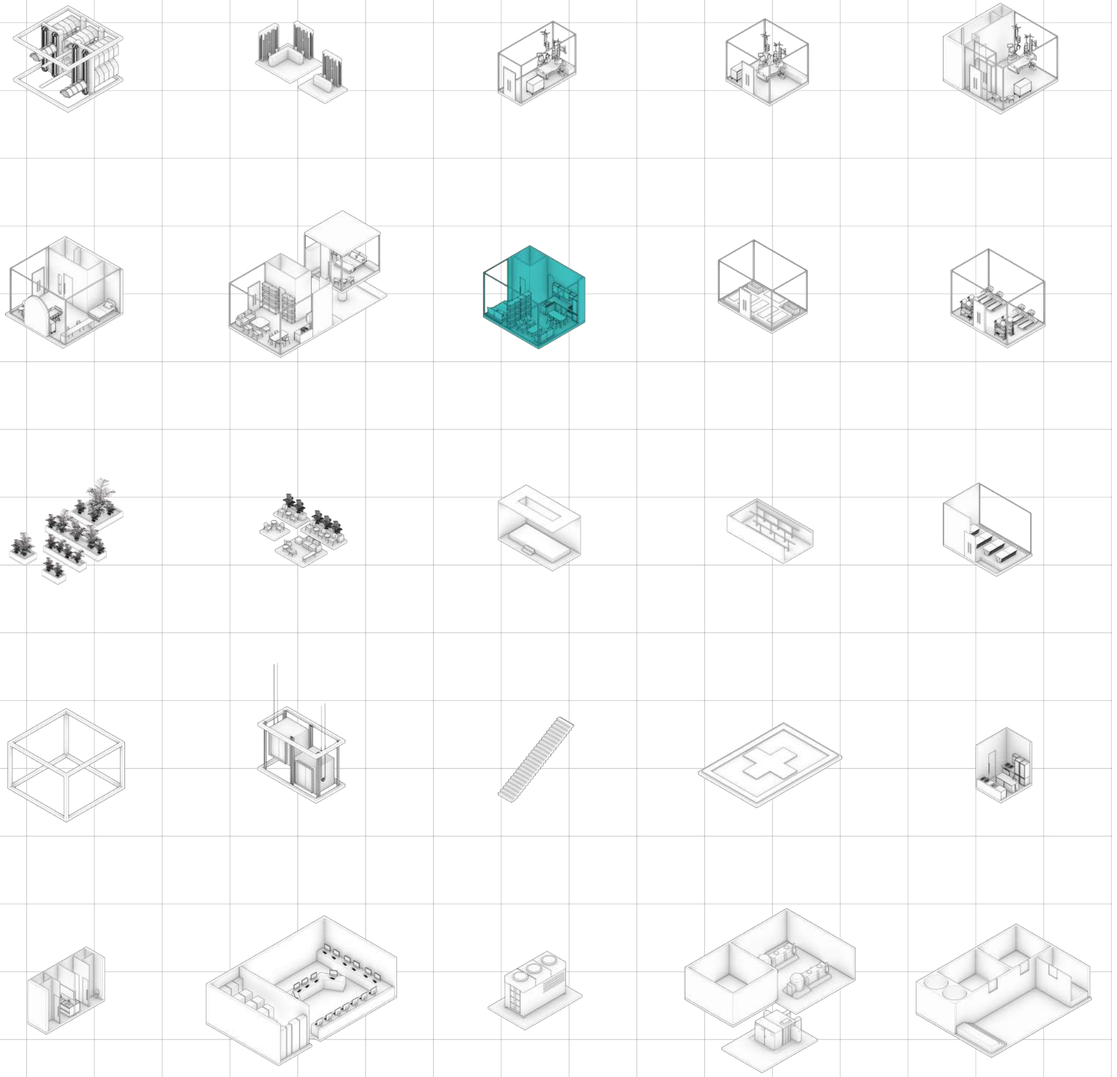

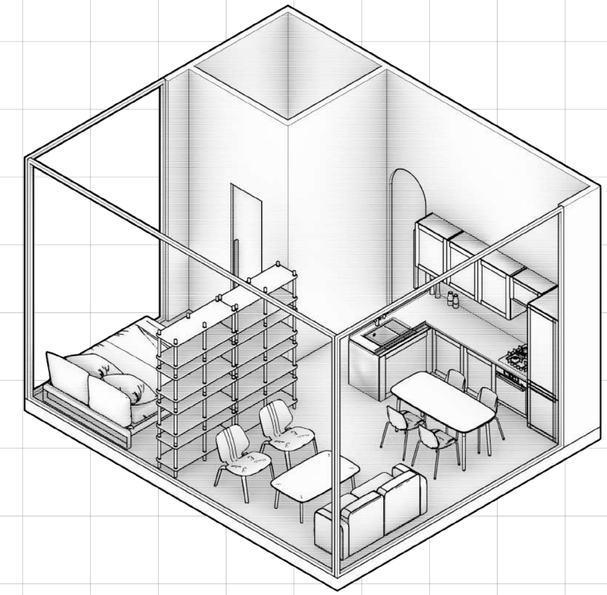

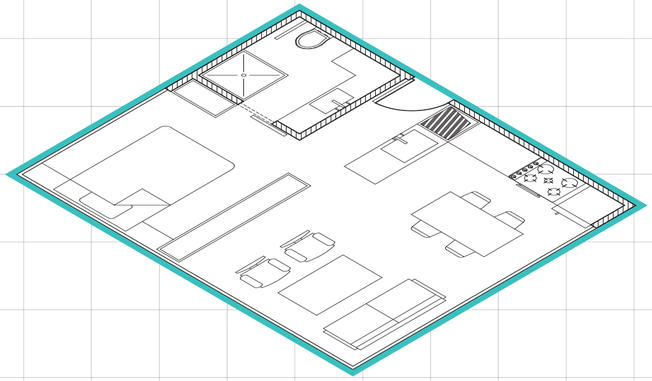

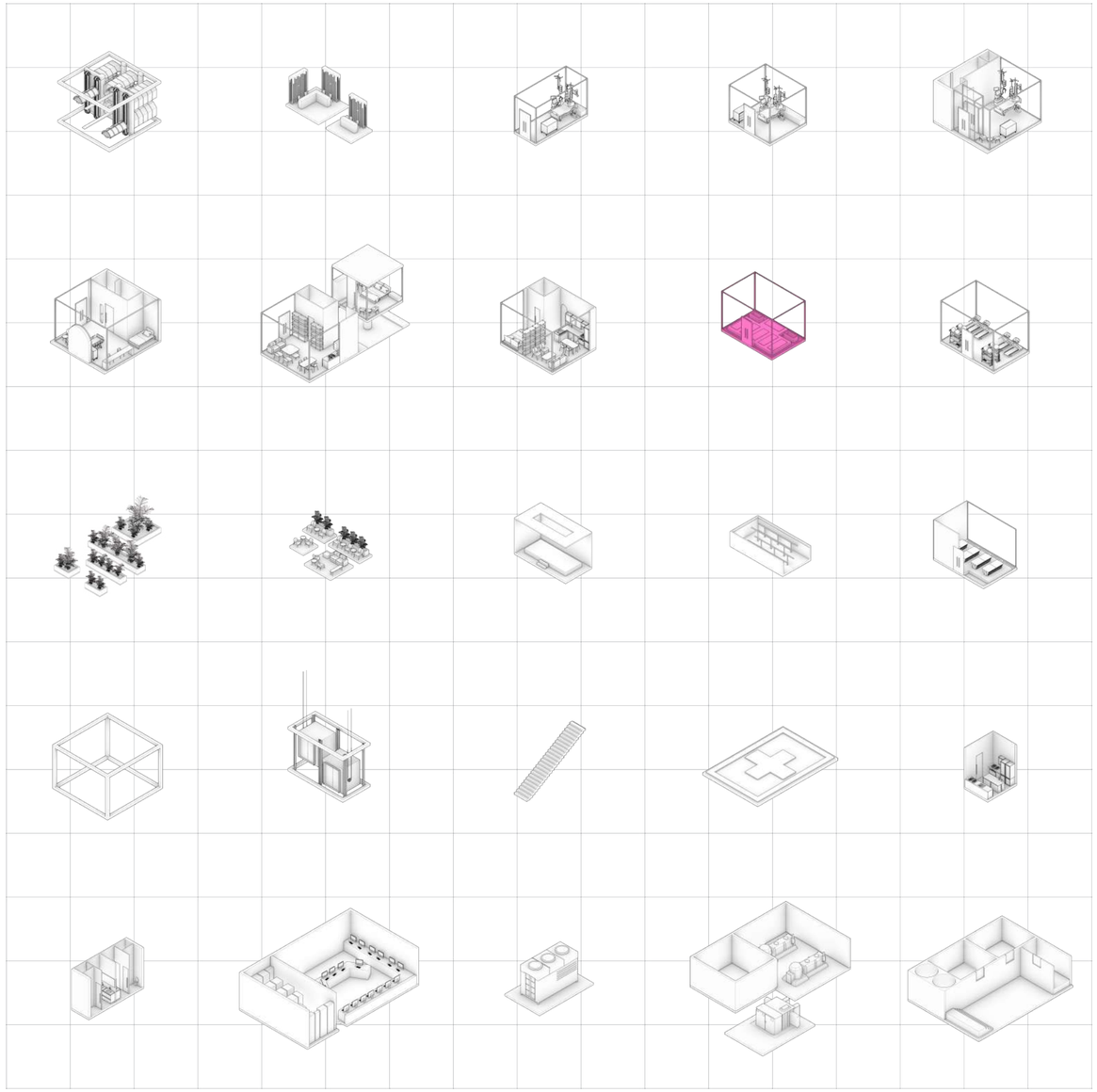

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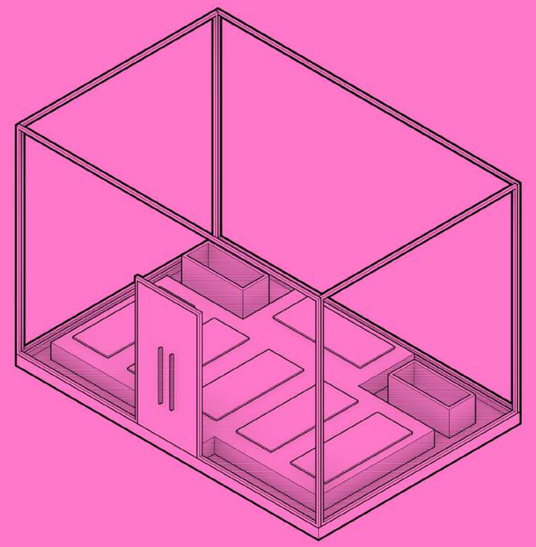
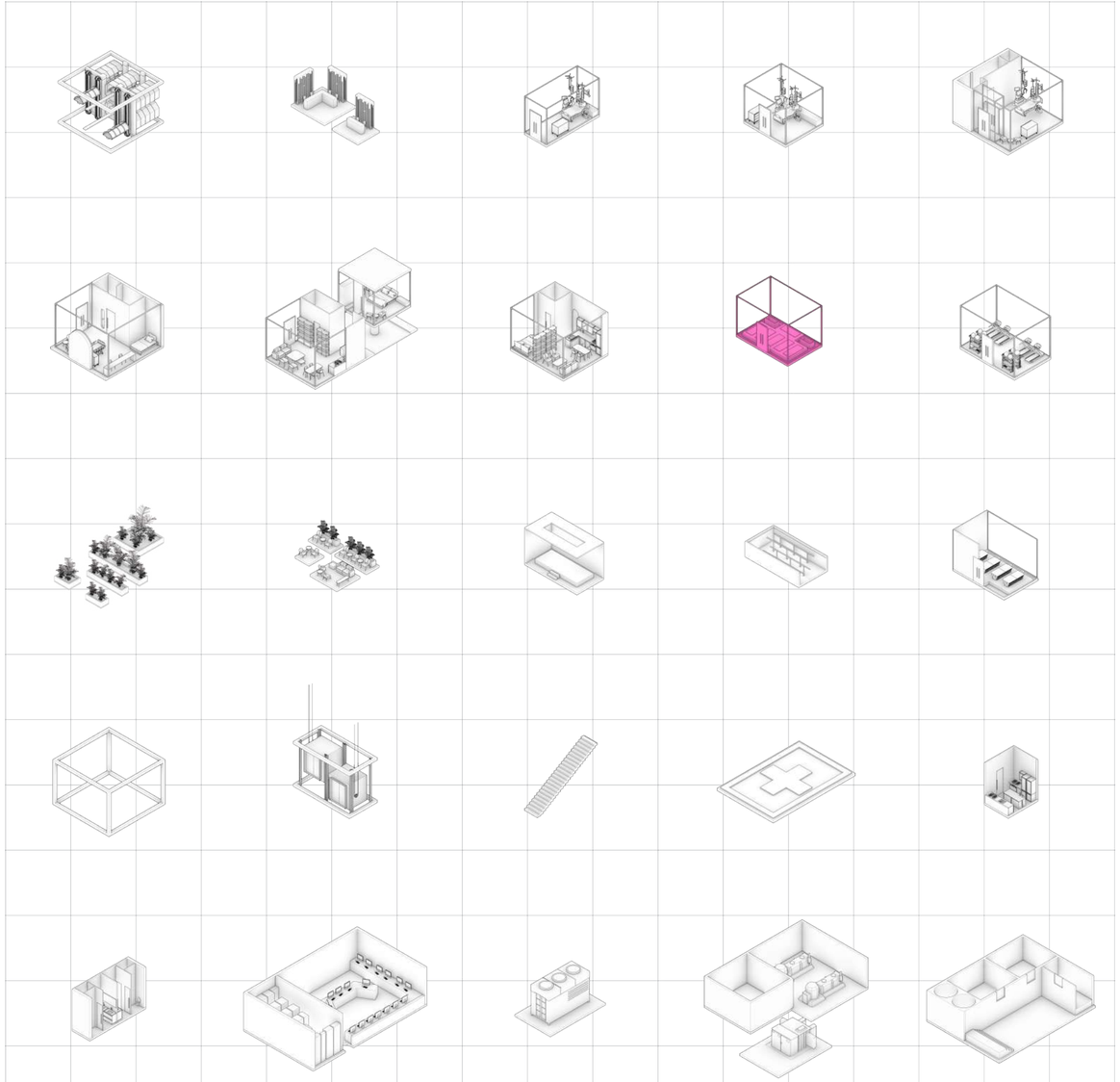
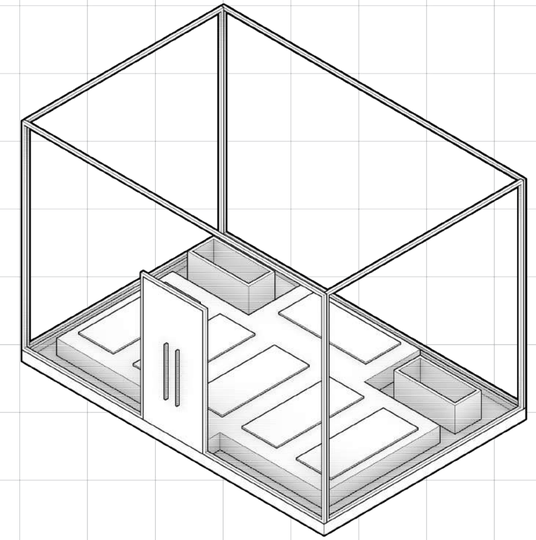
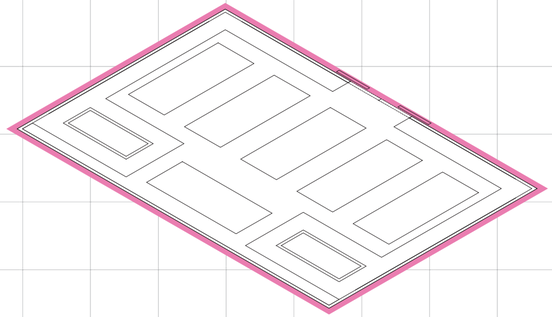
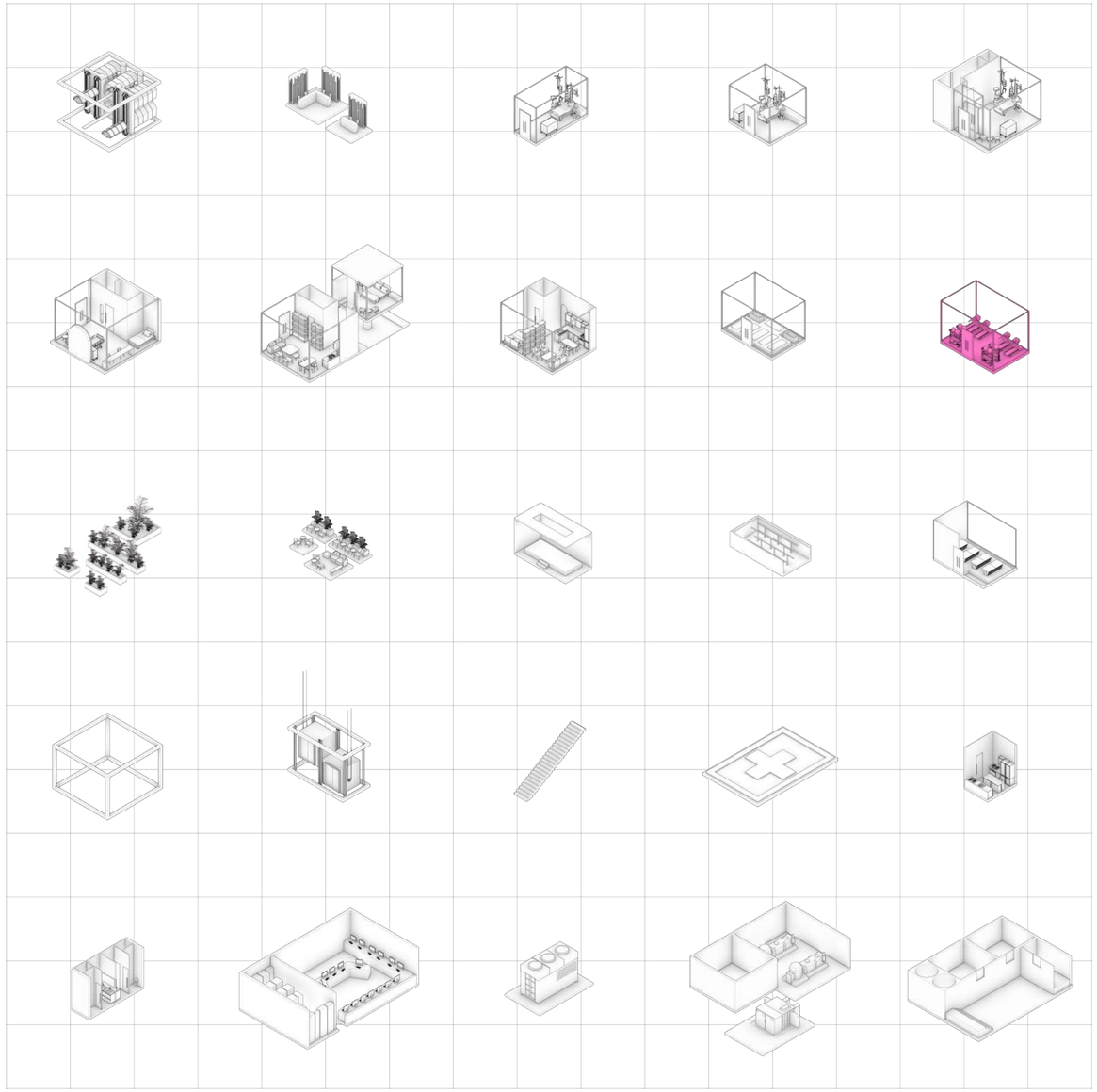


THE YOGA MODULE









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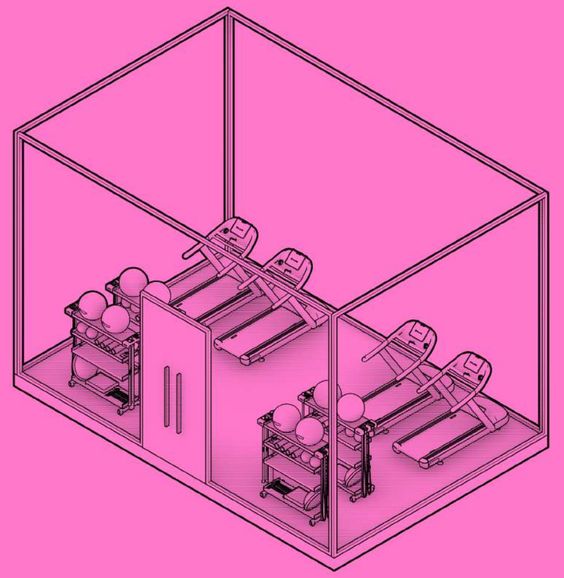
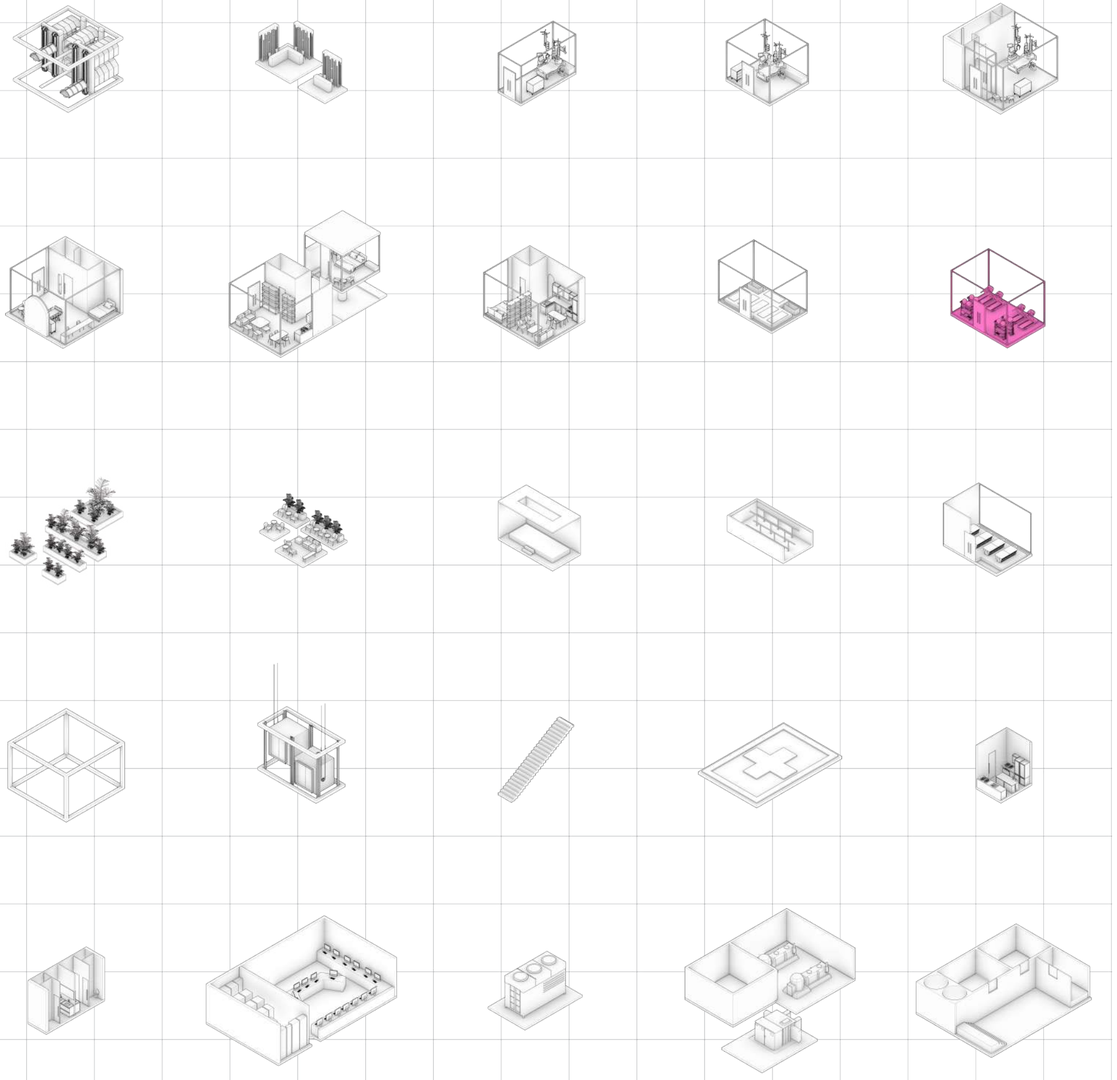
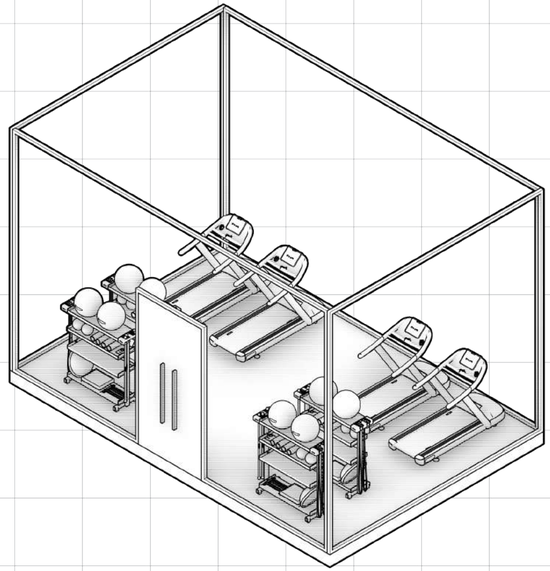
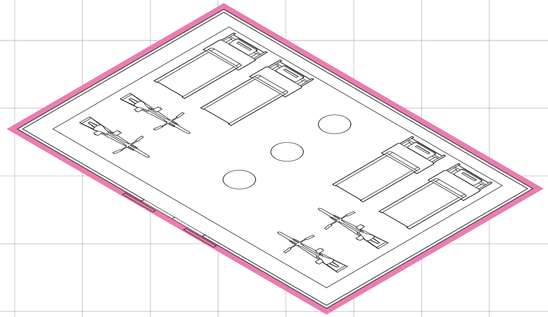
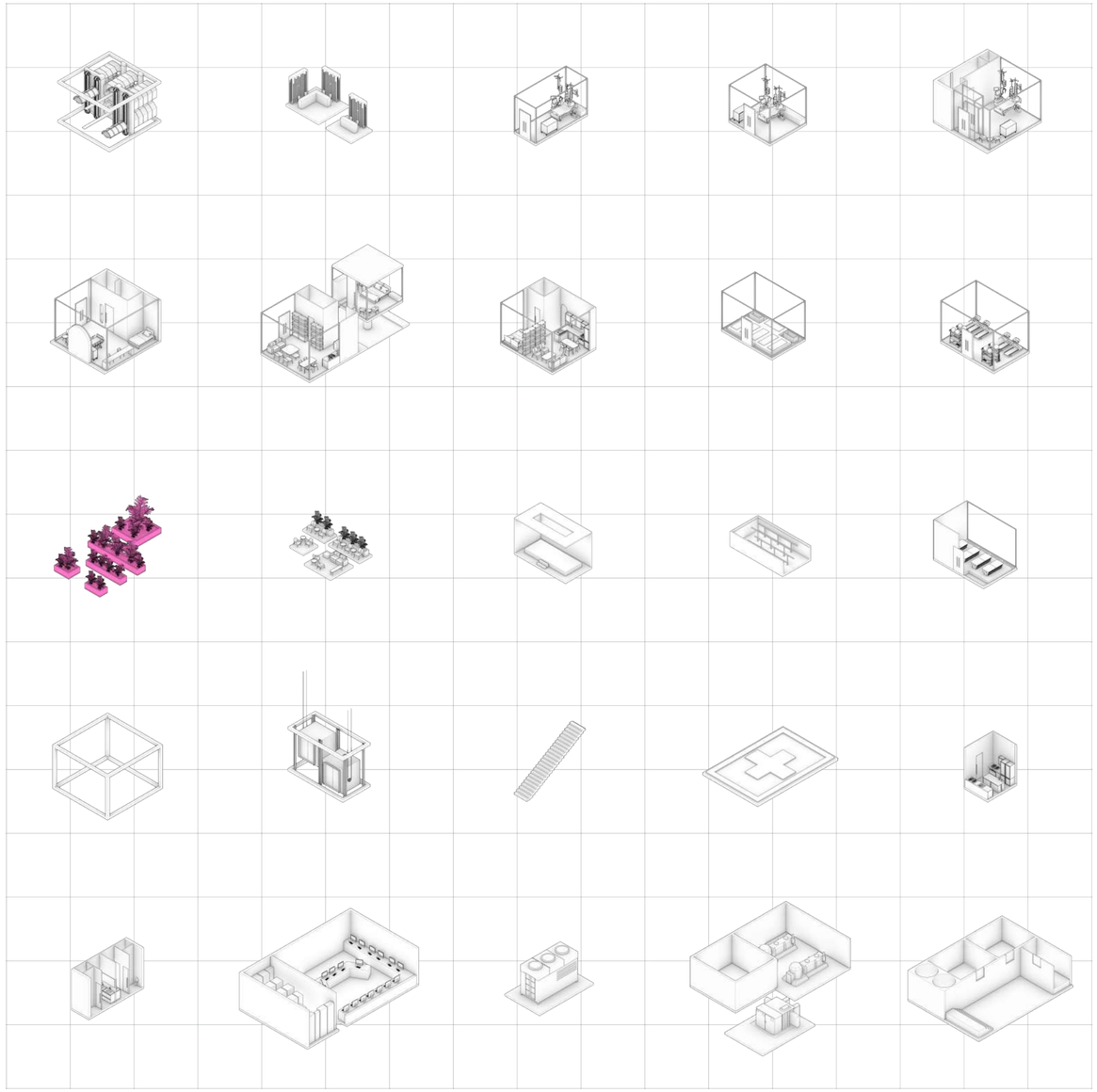


THE PHYSIOTHERAPY MODULE









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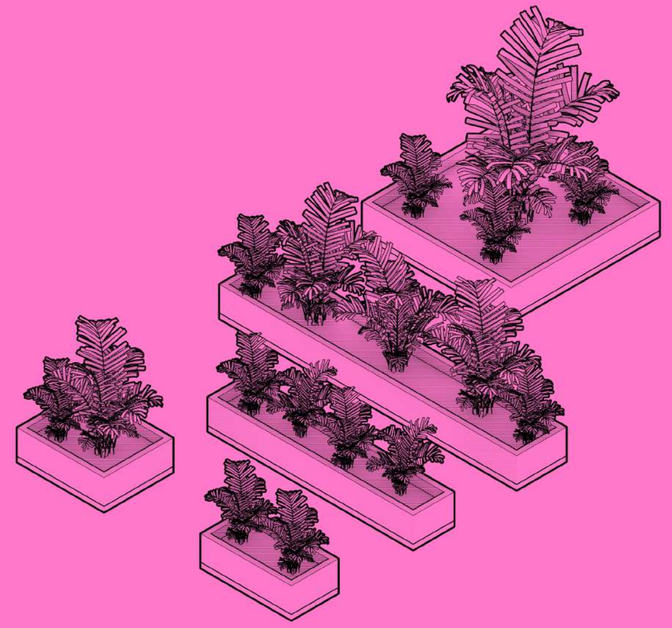

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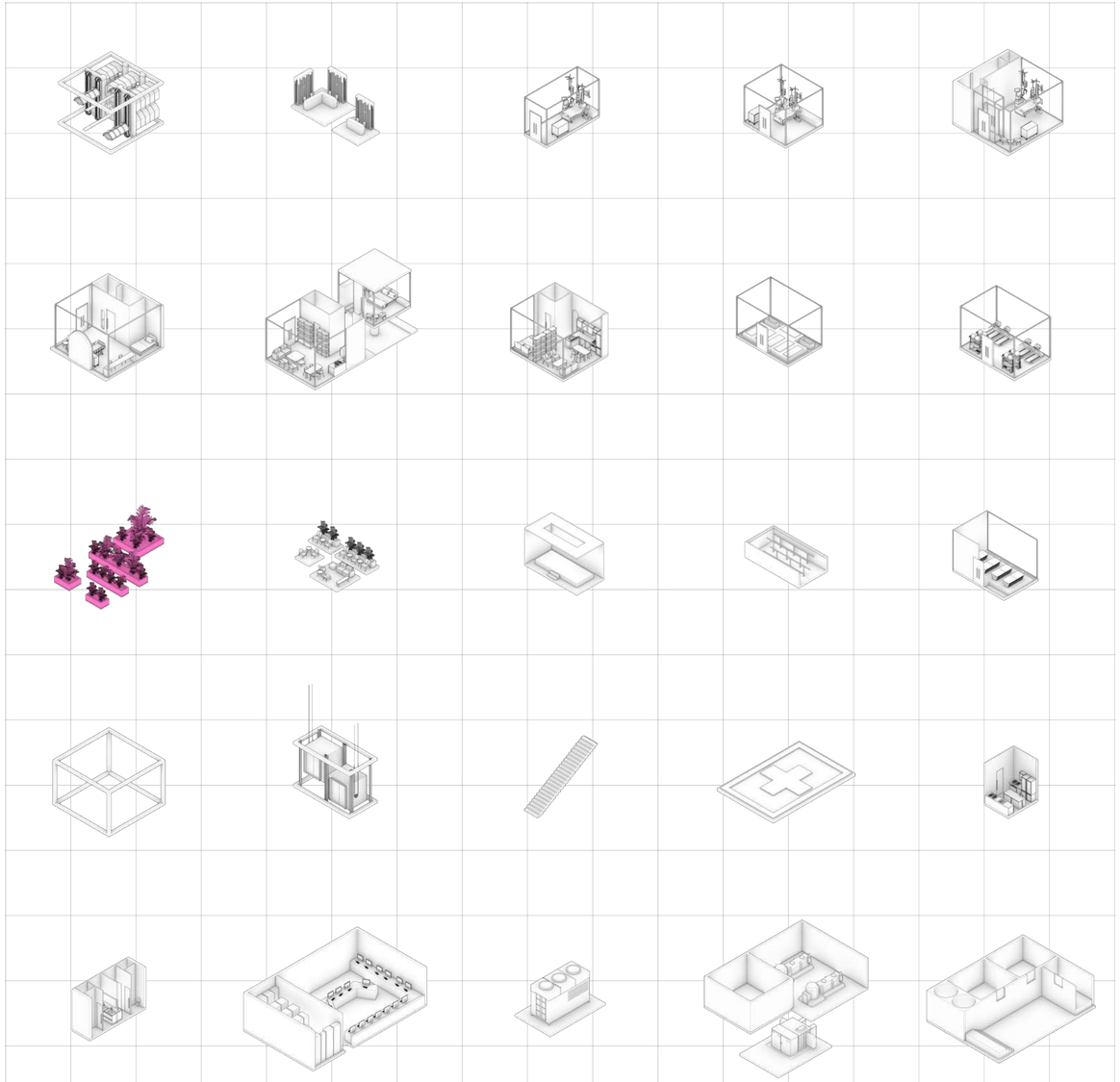

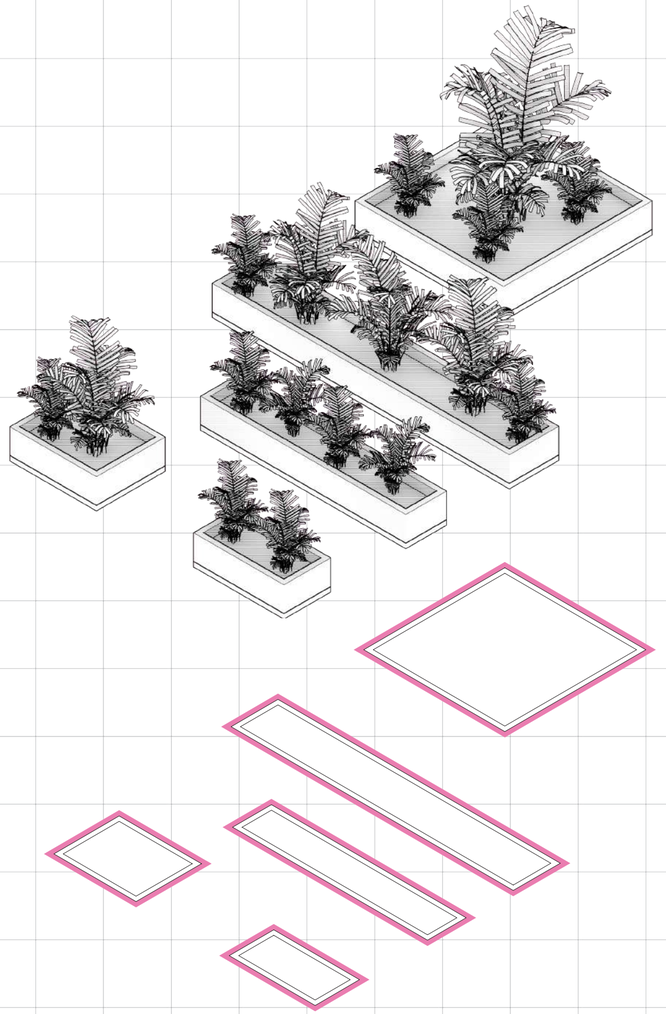

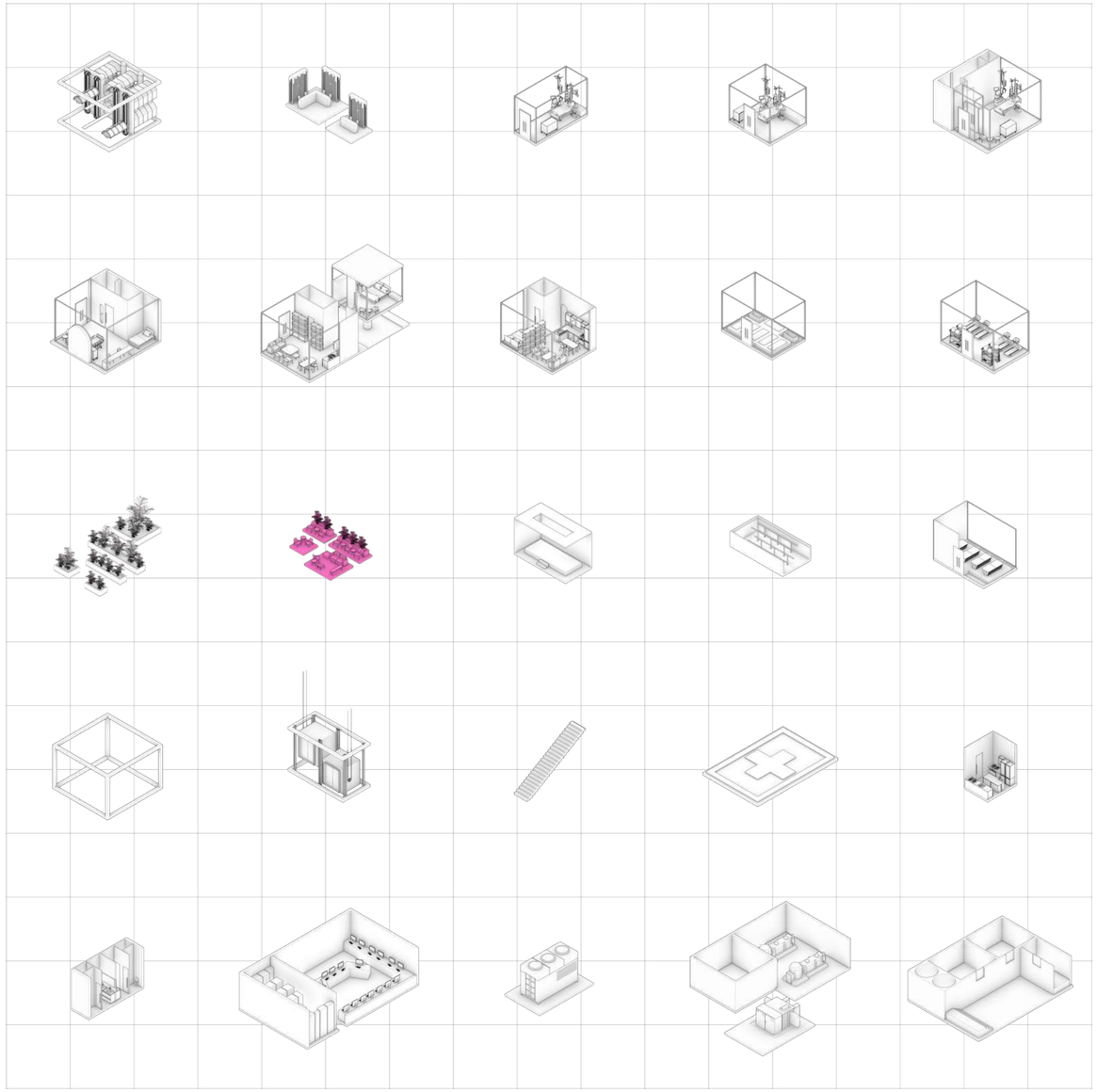

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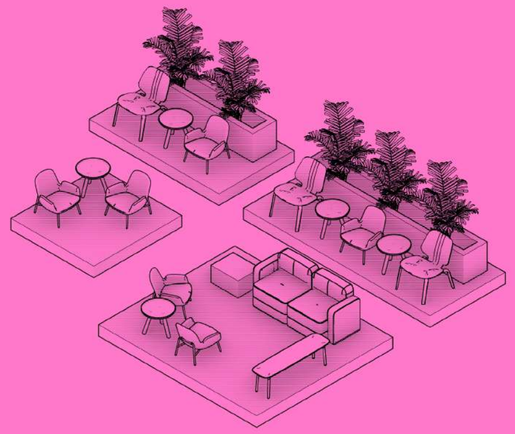

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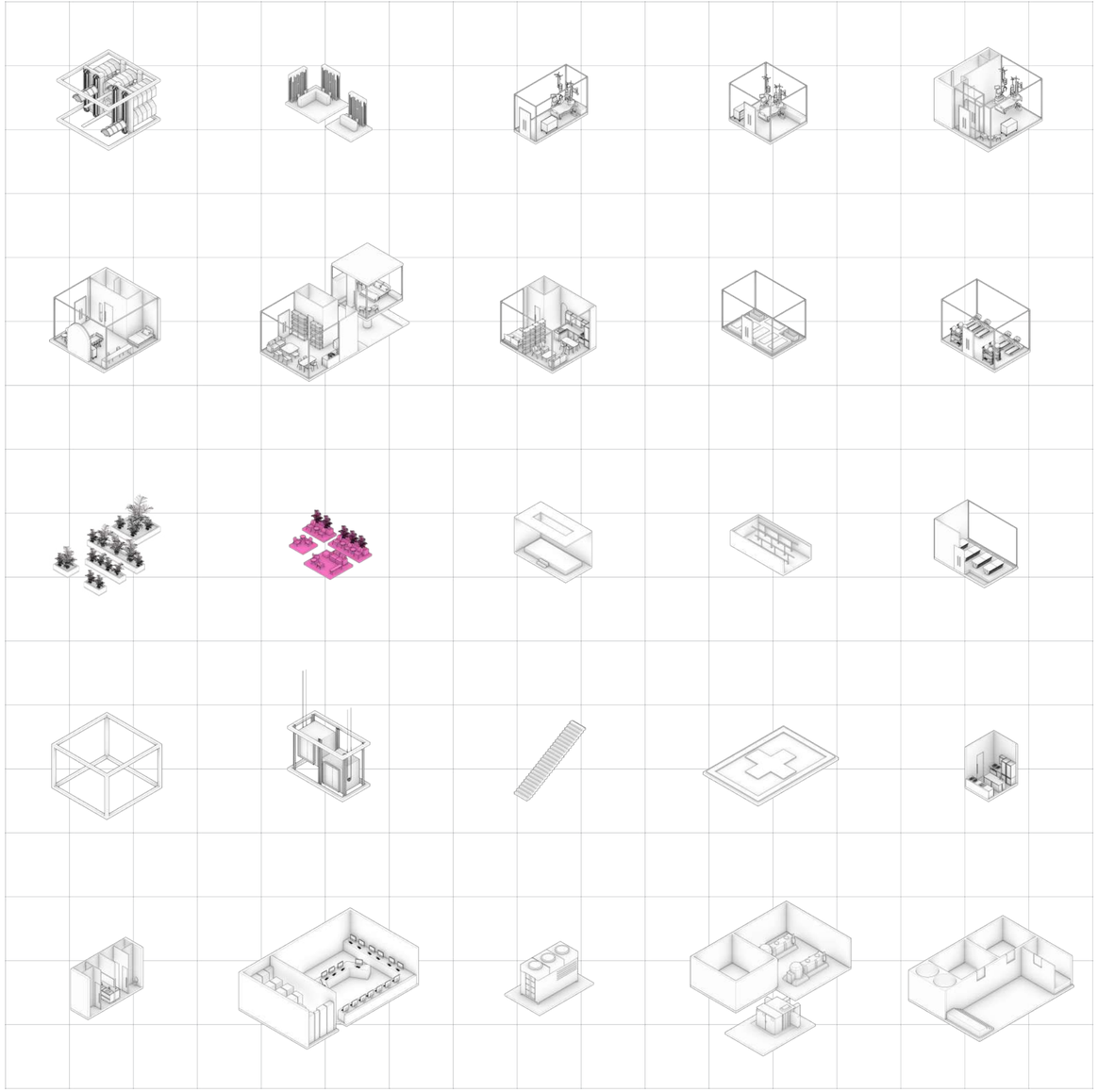

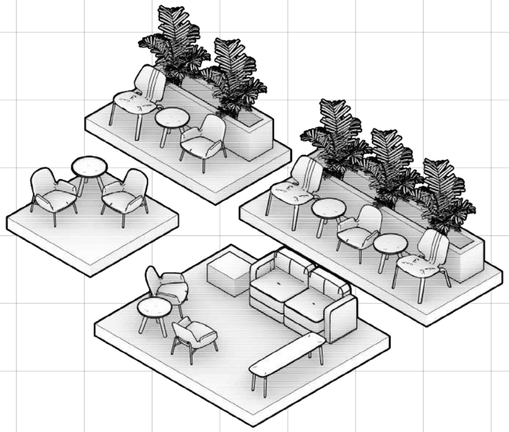

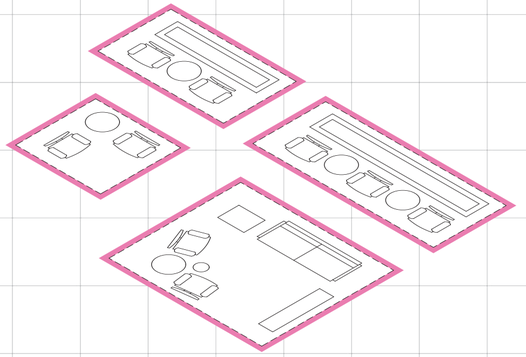

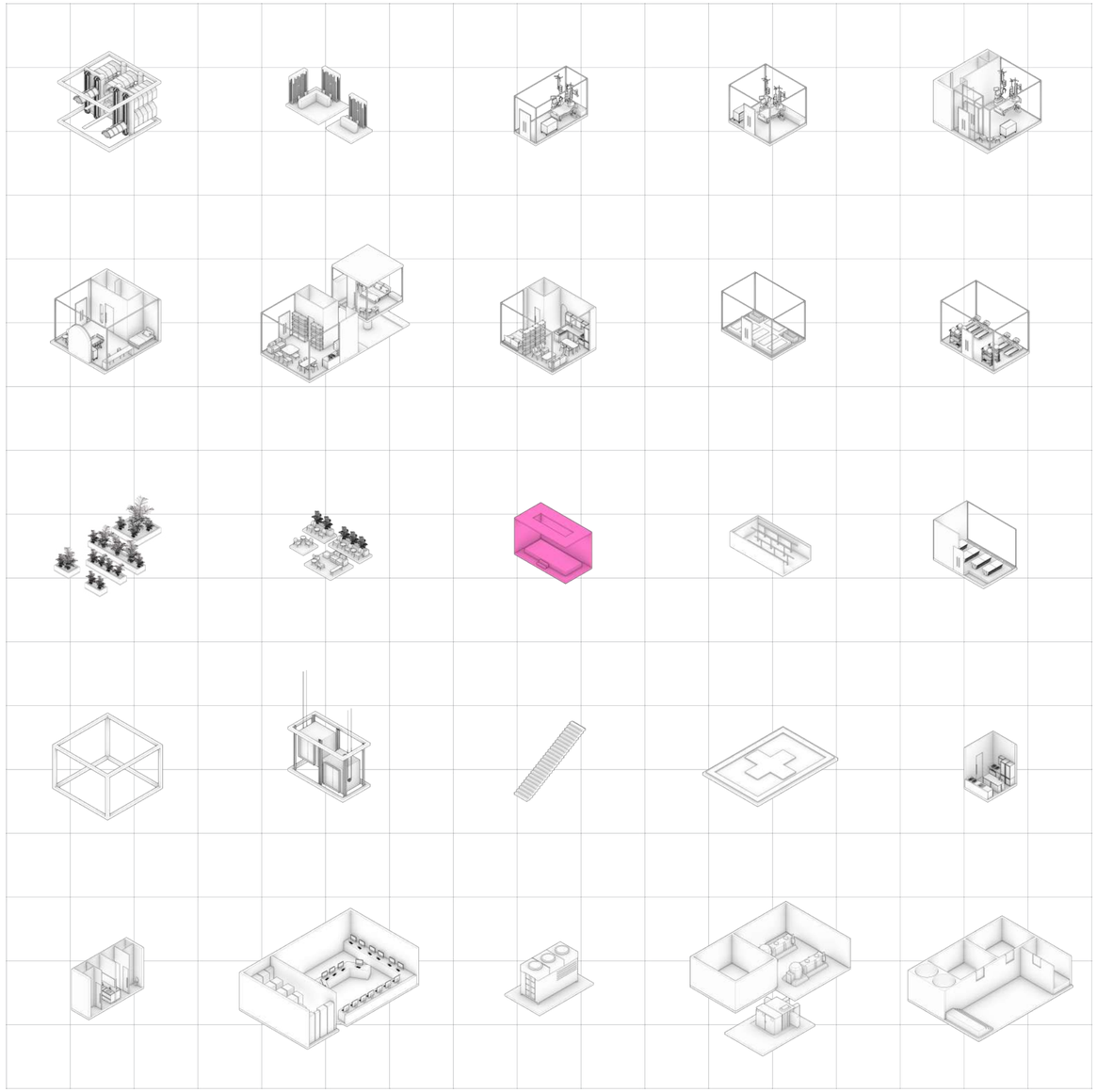

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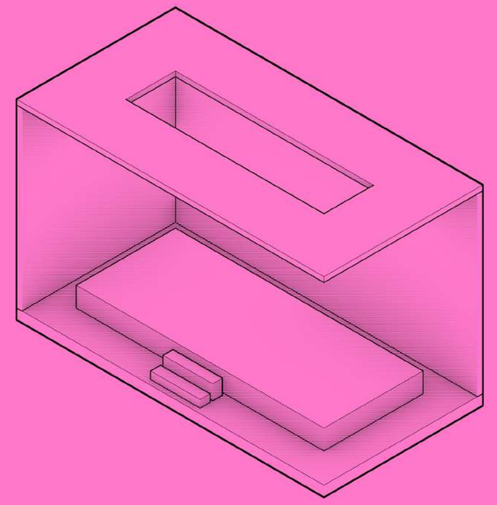

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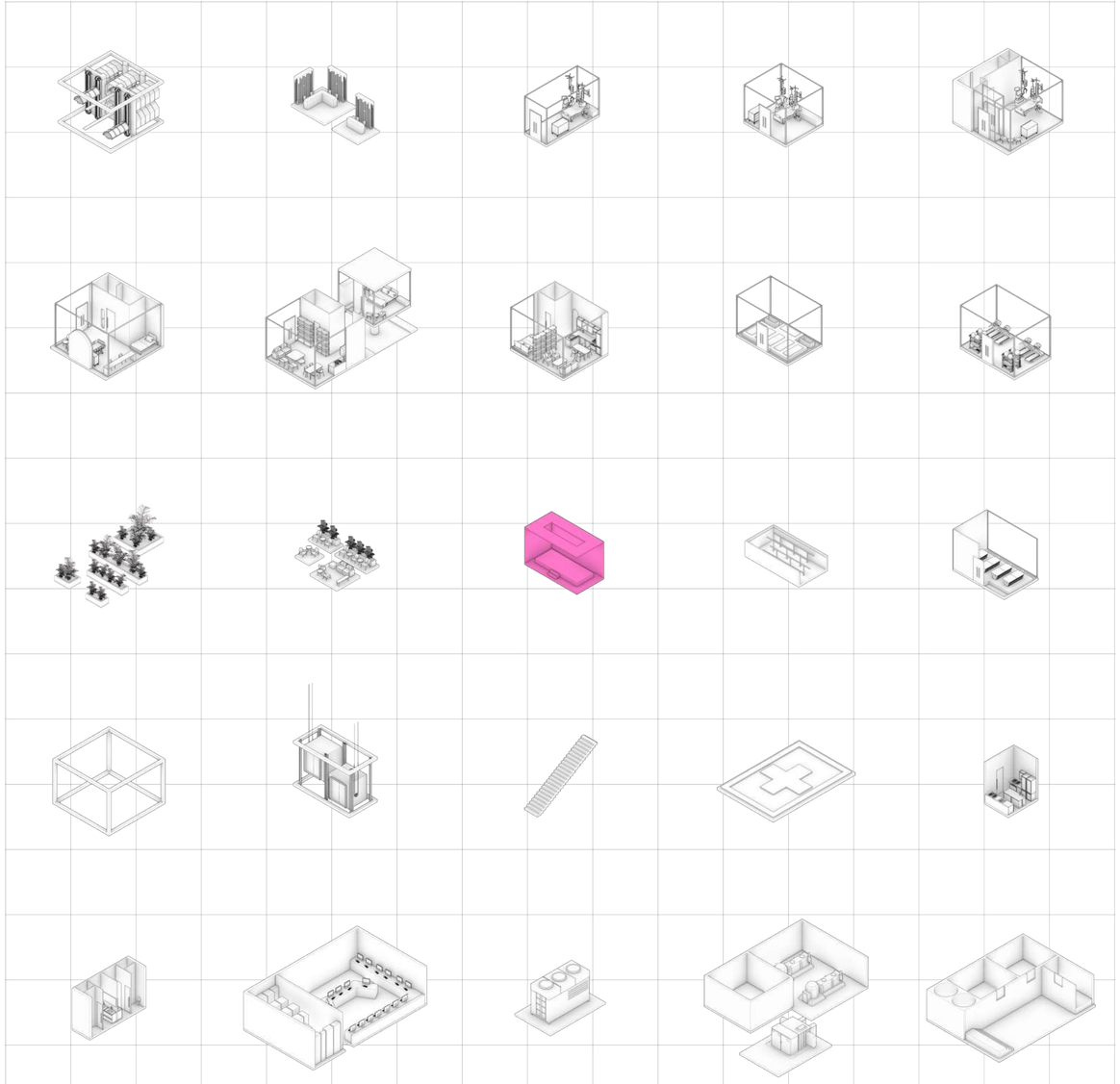

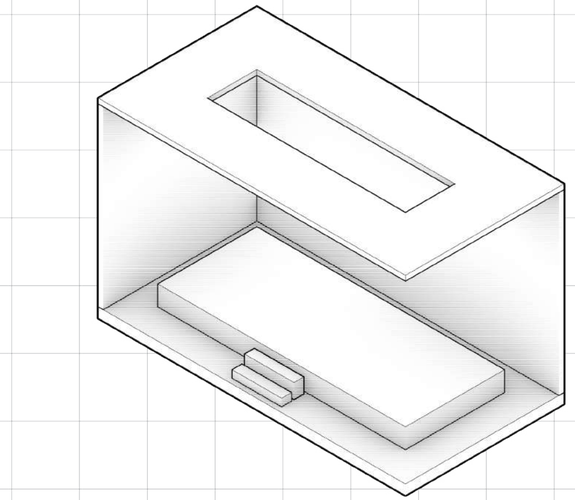

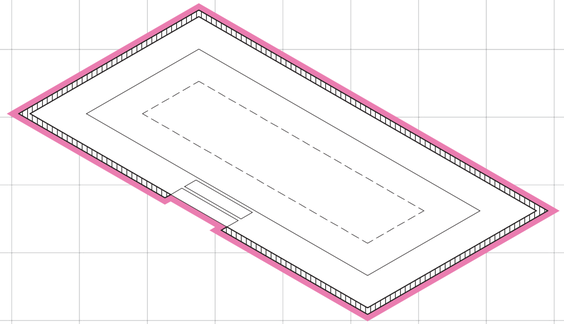

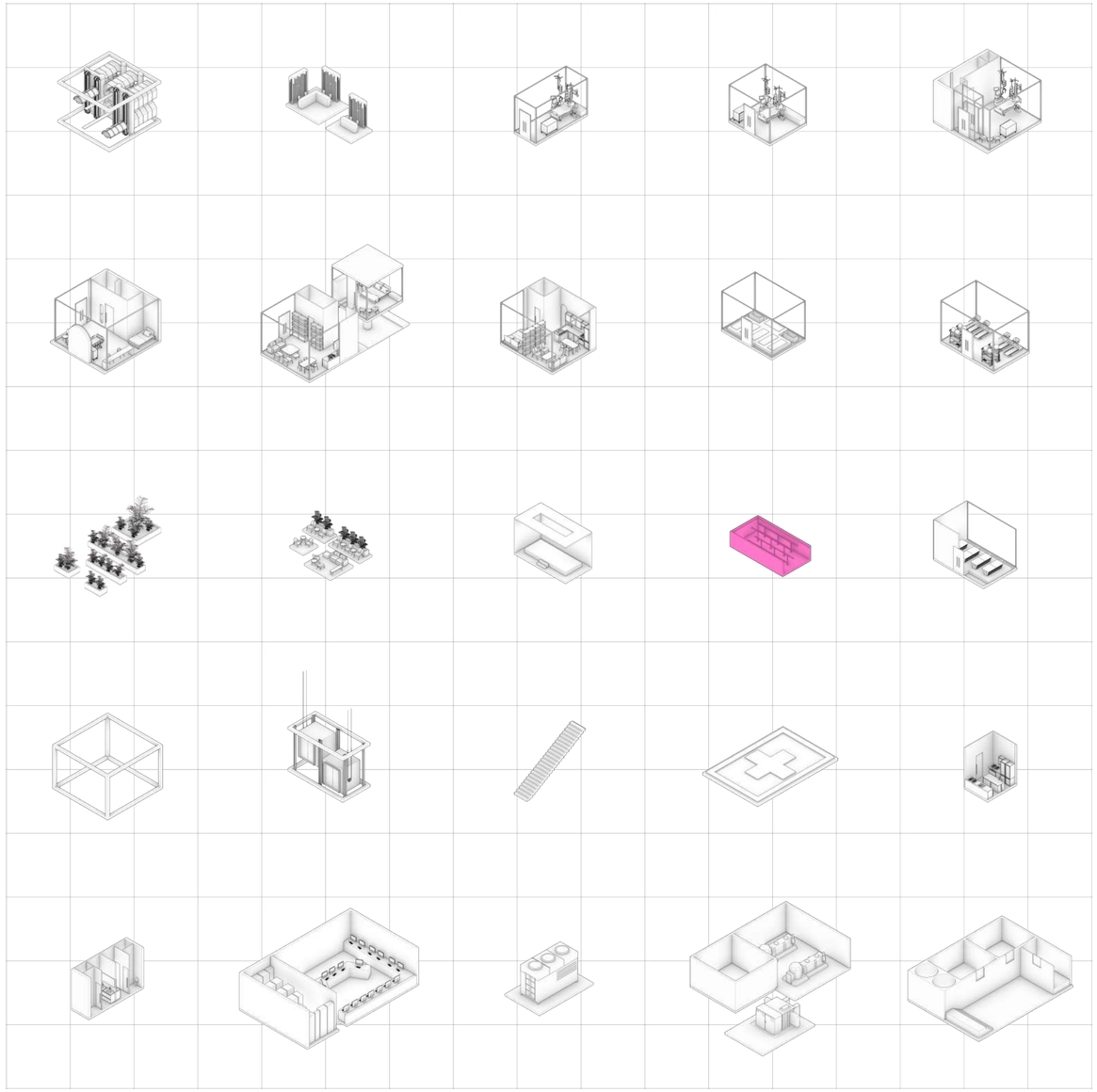

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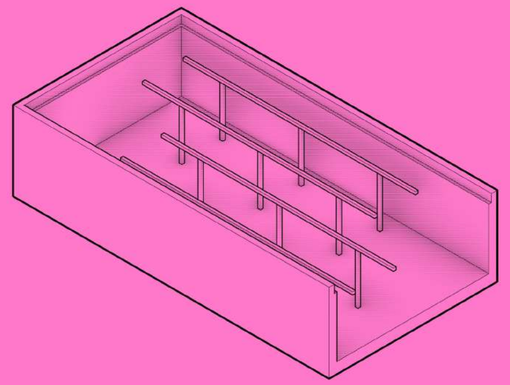

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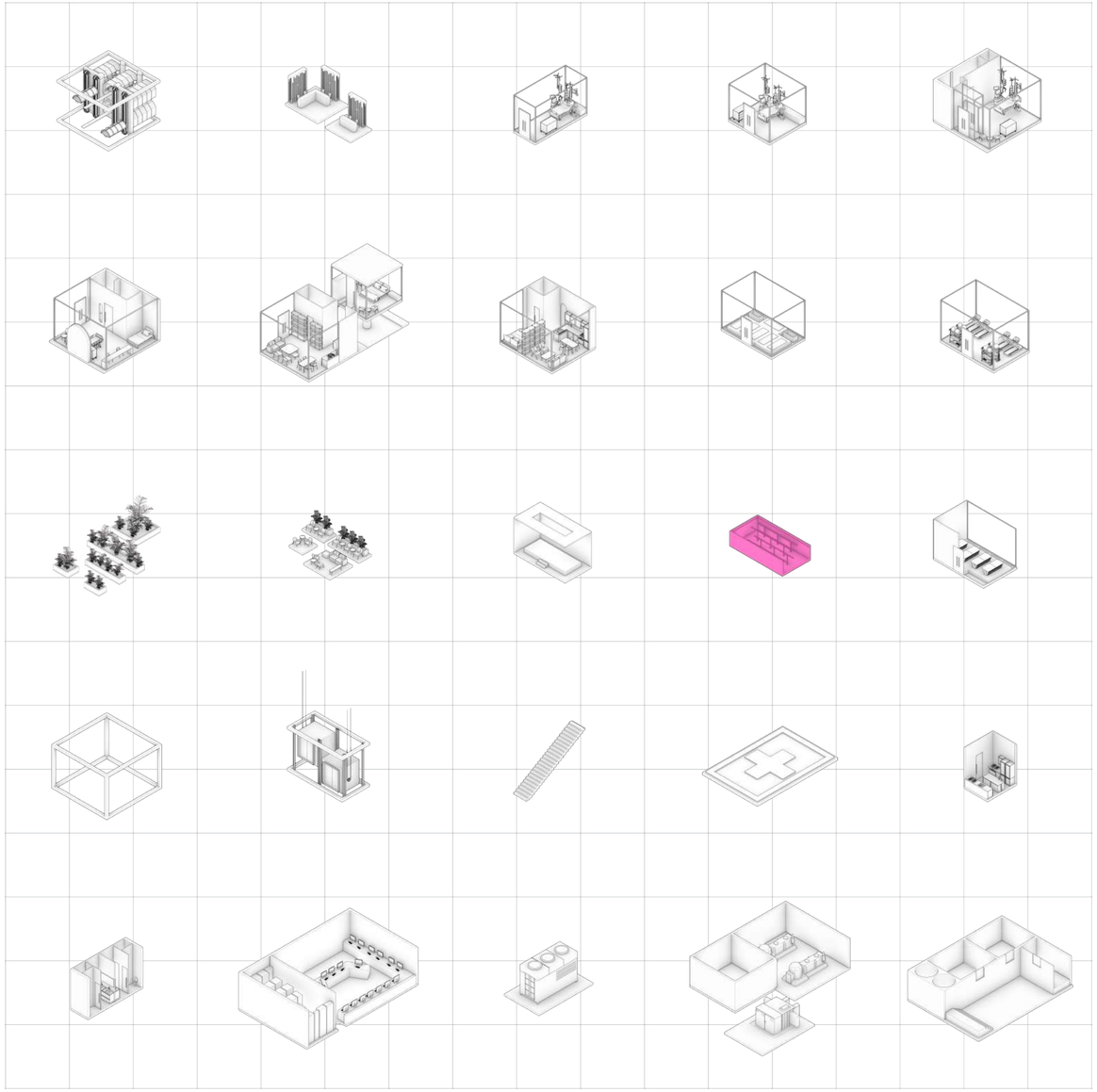

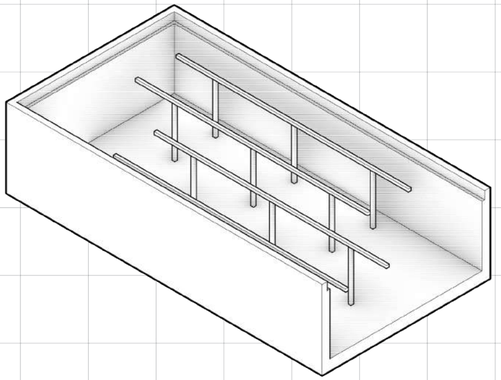

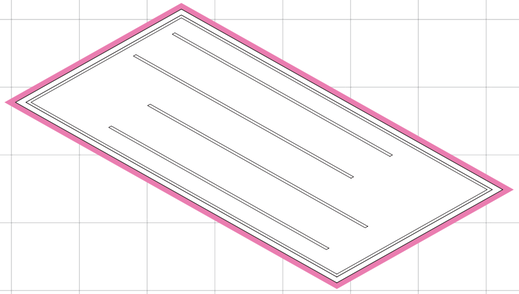

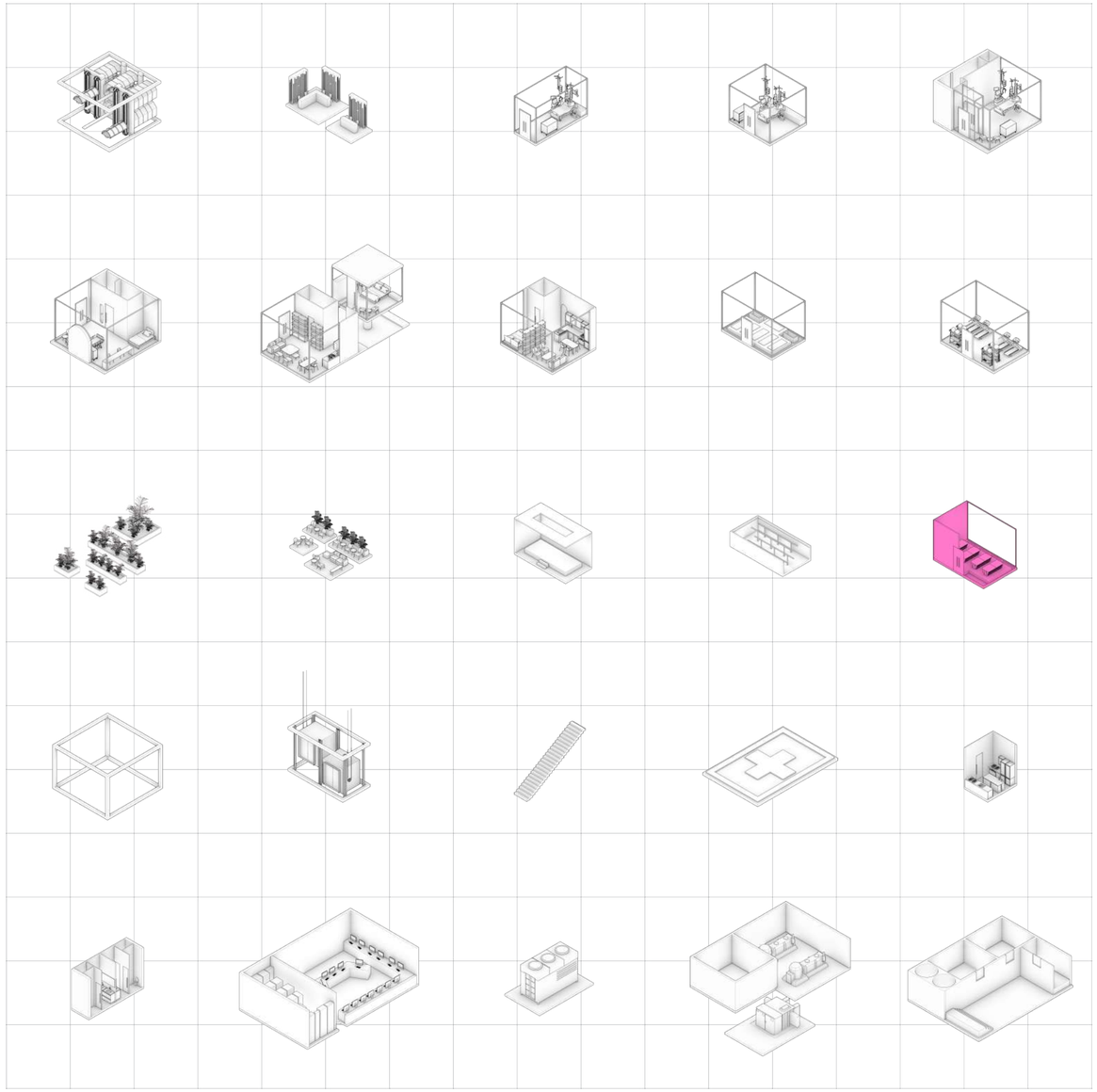

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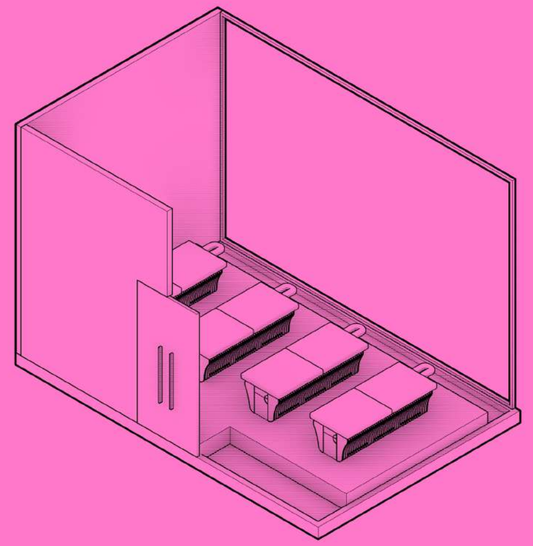

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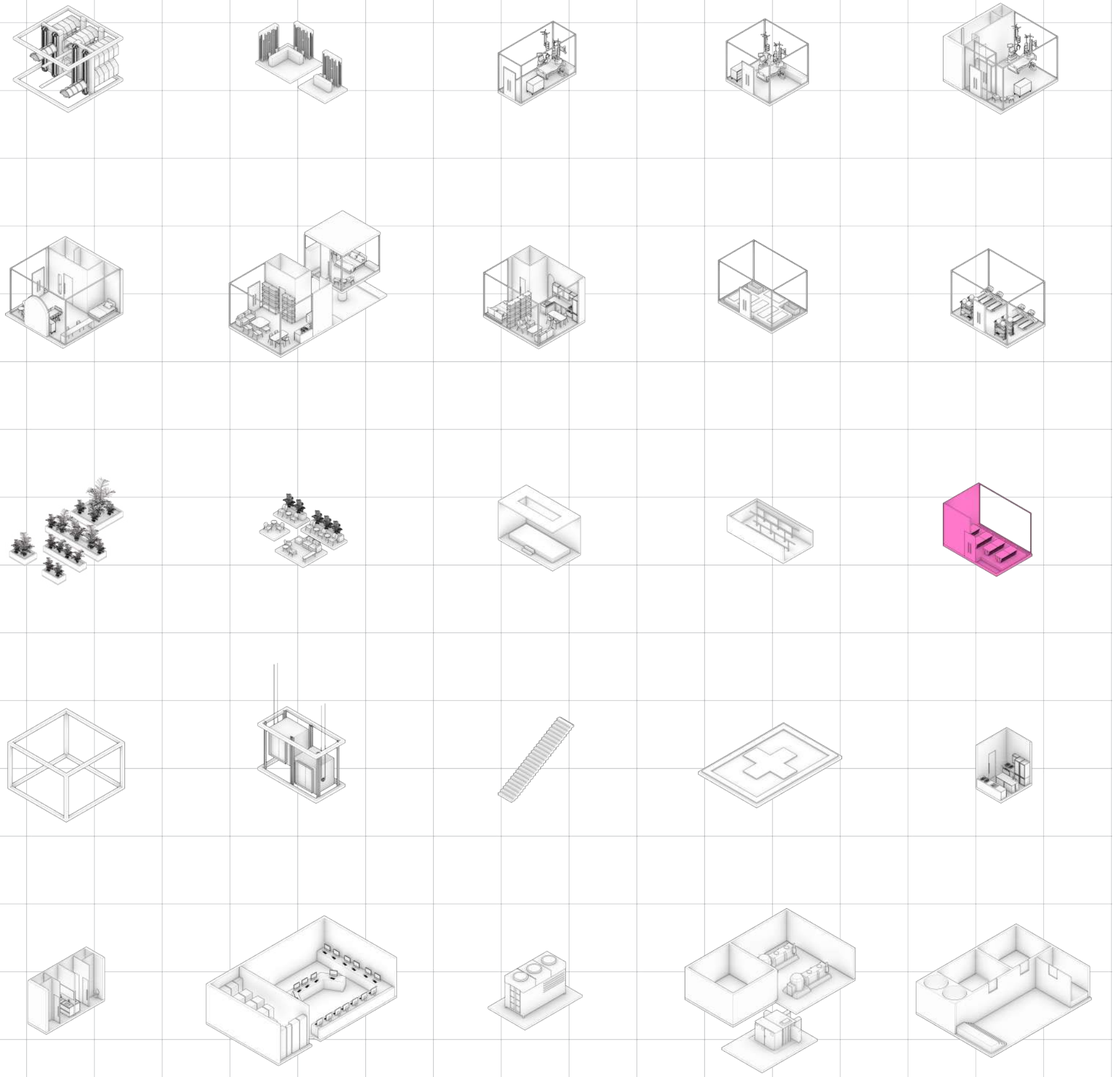

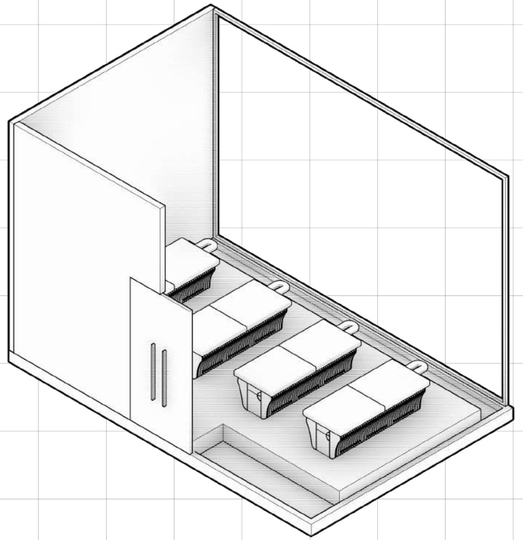

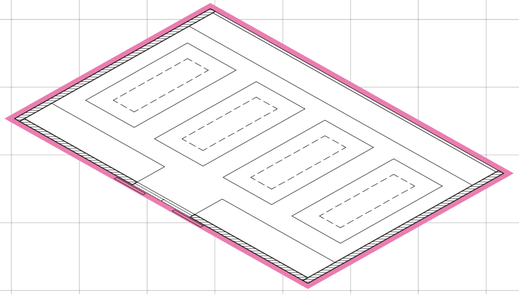

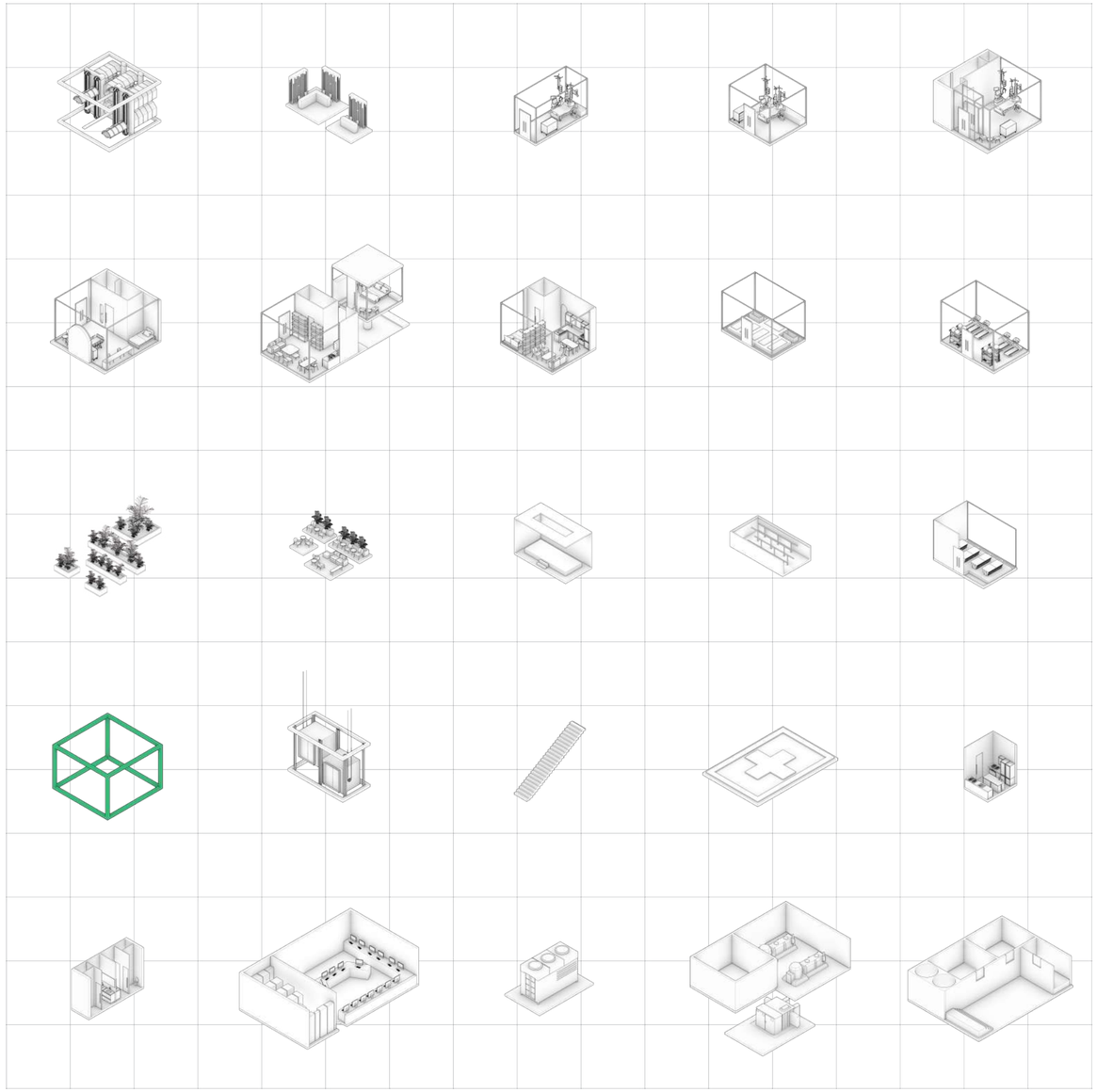

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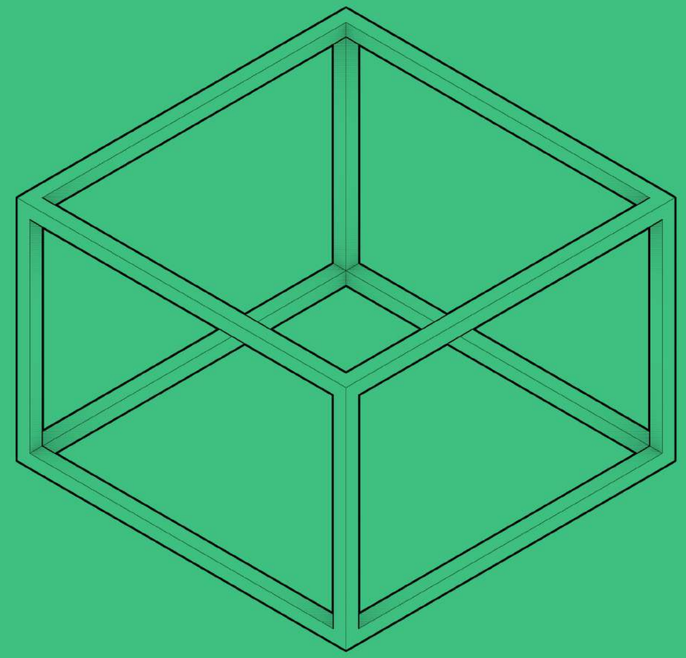

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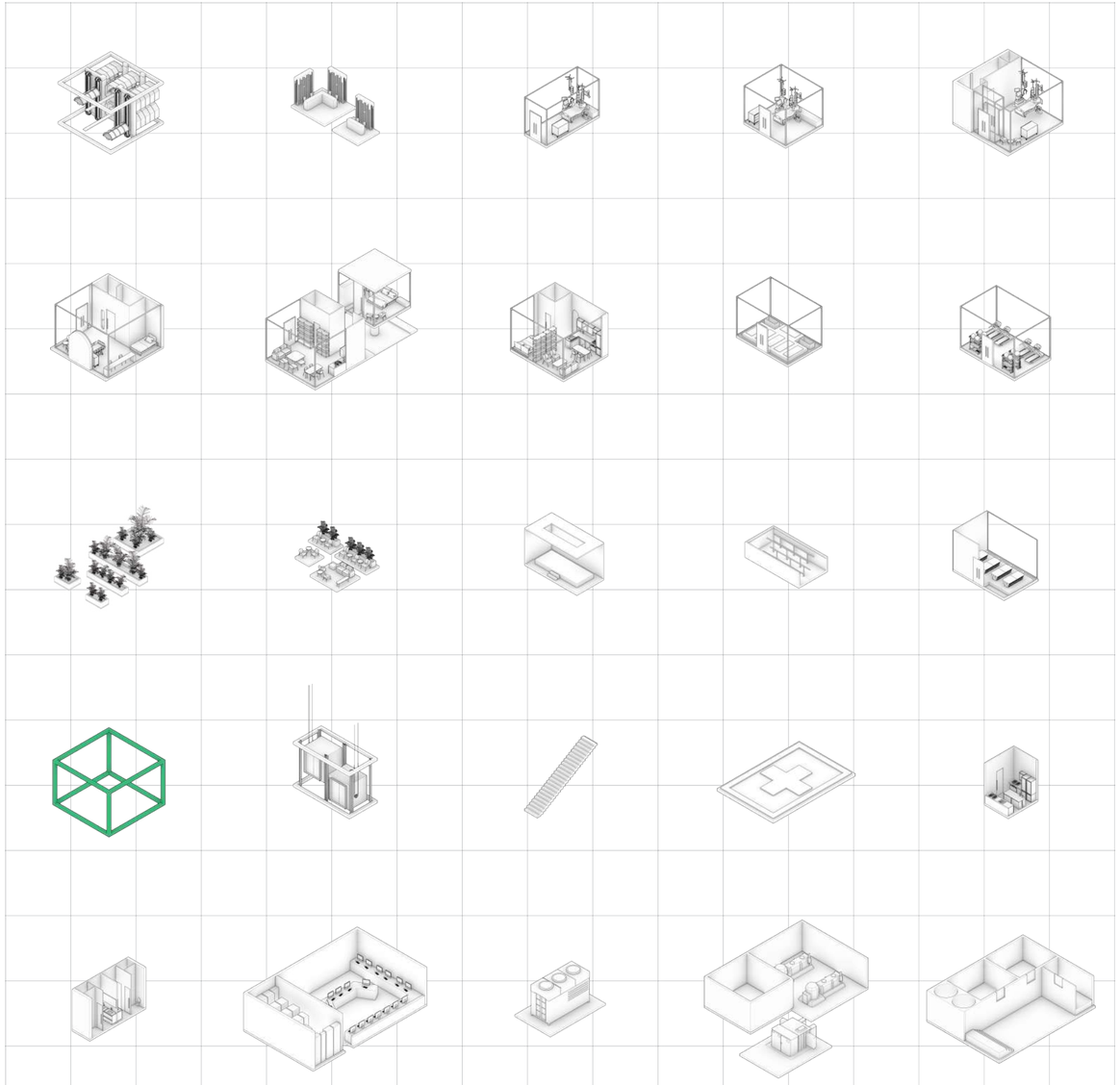

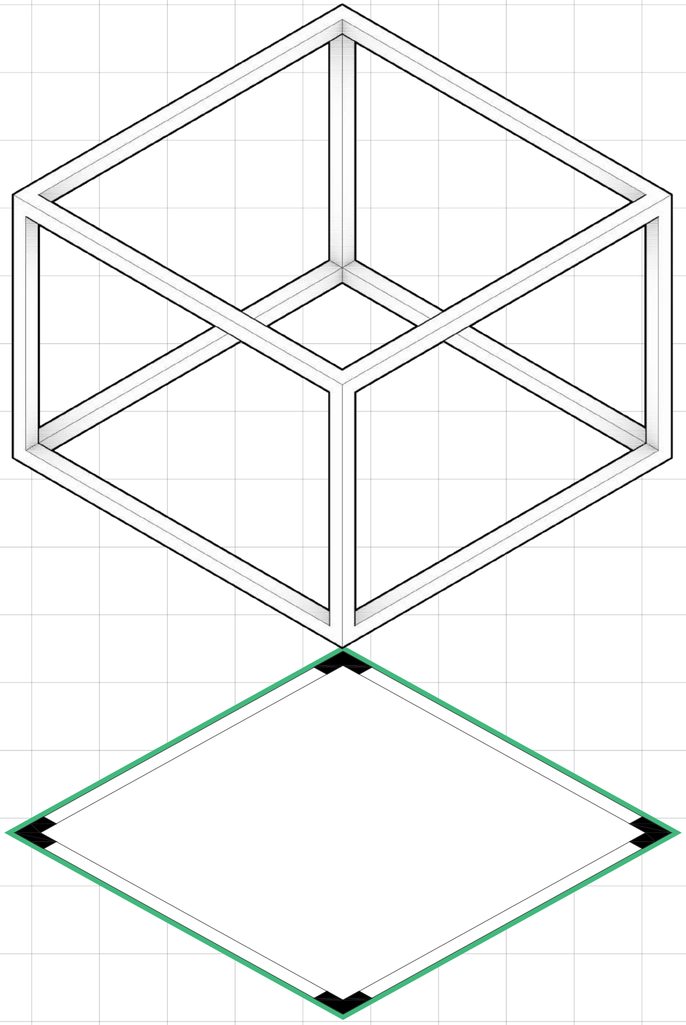

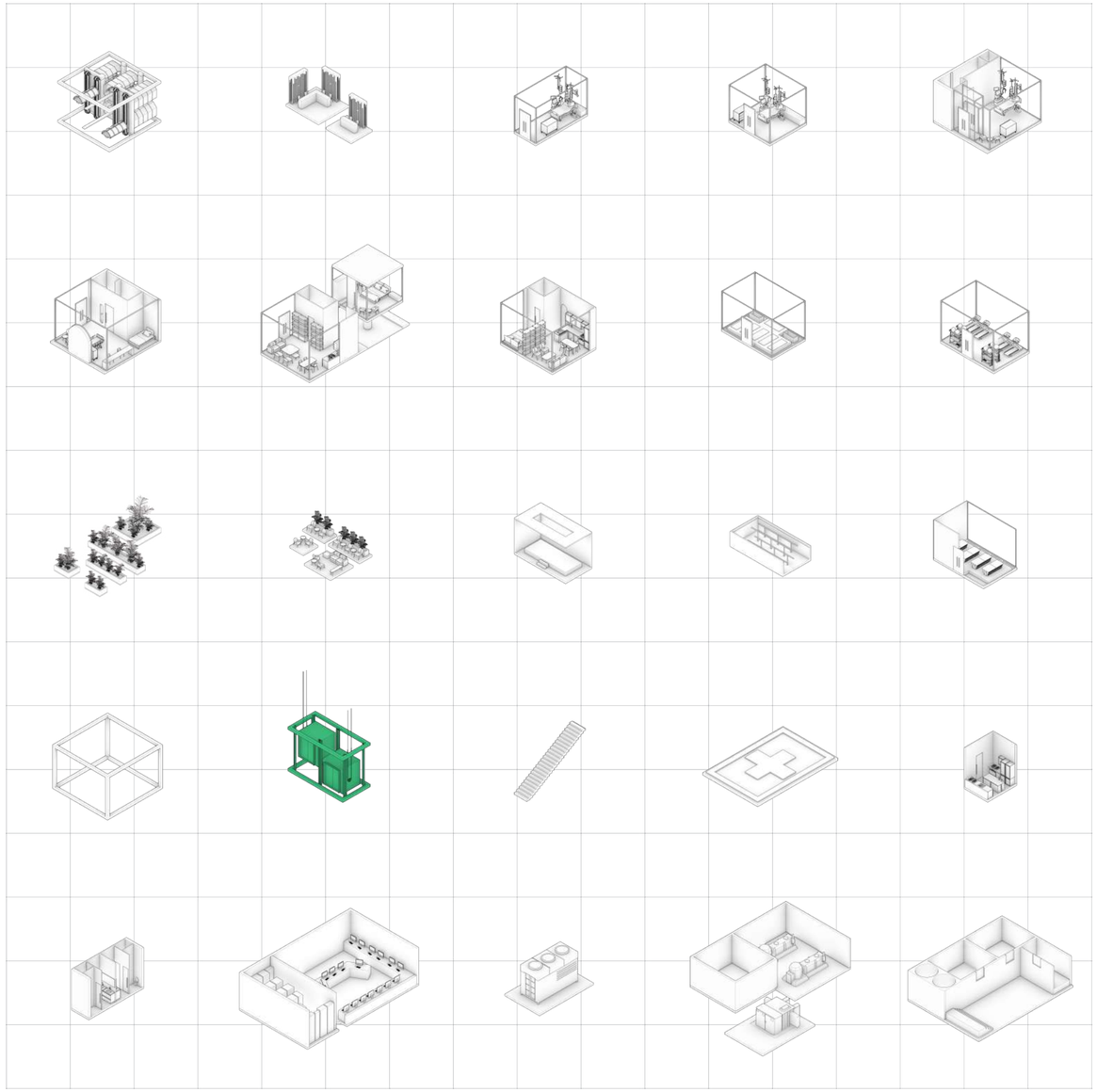

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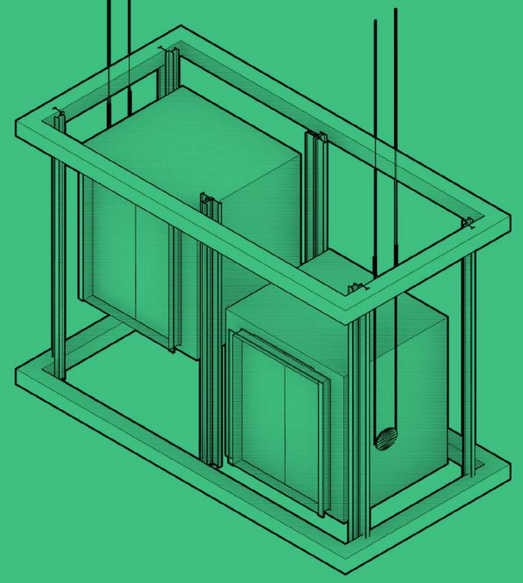

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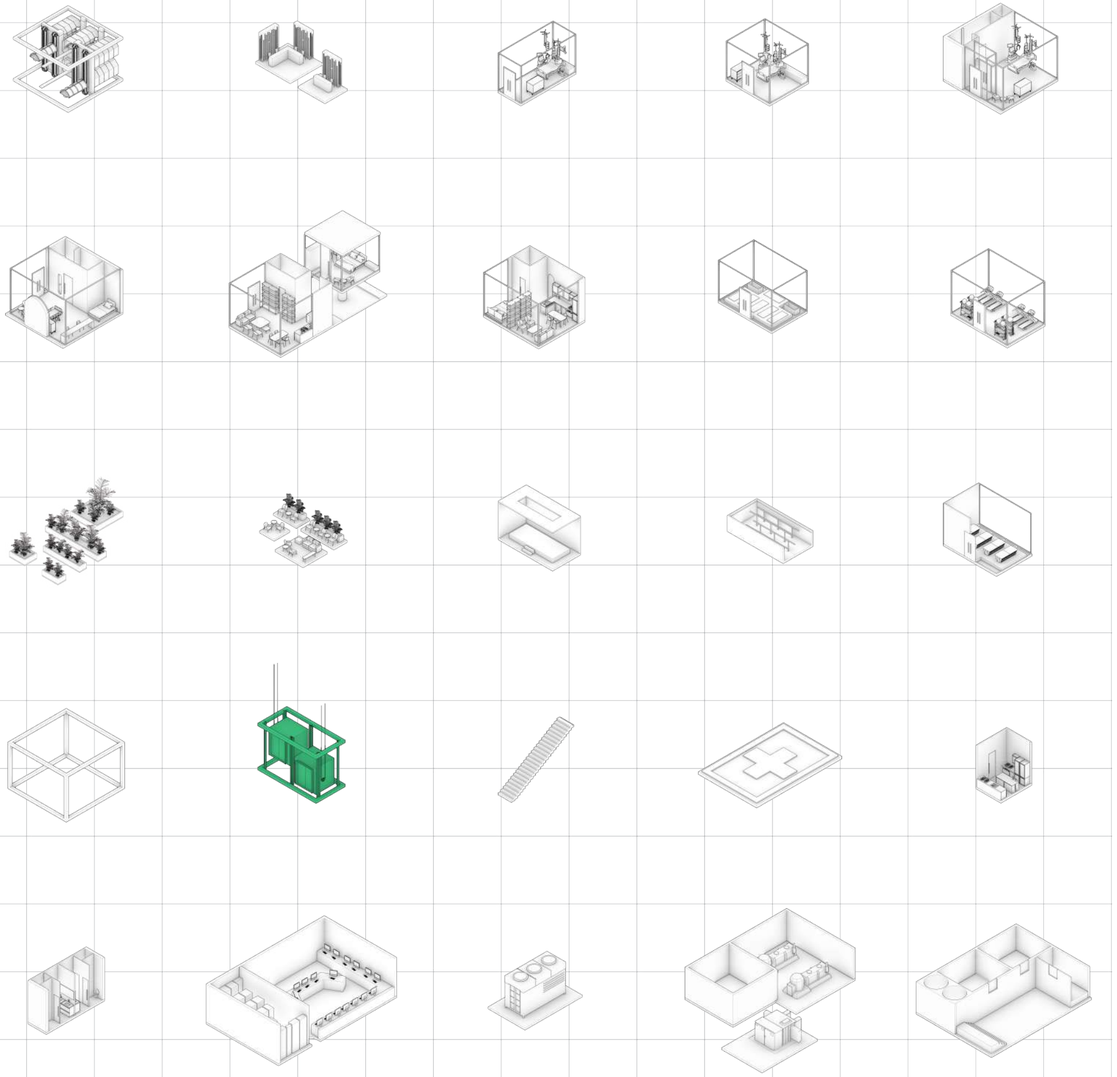

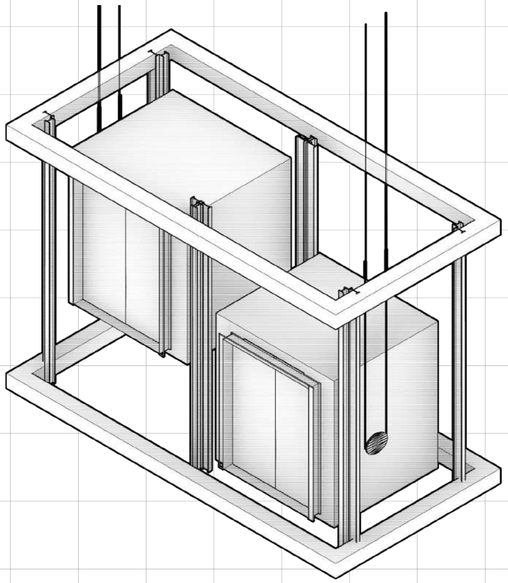

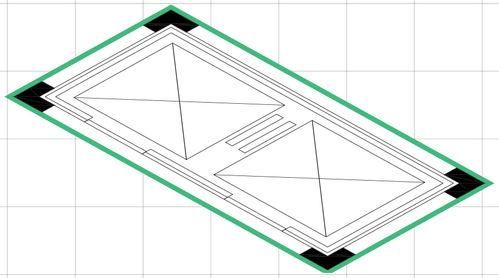

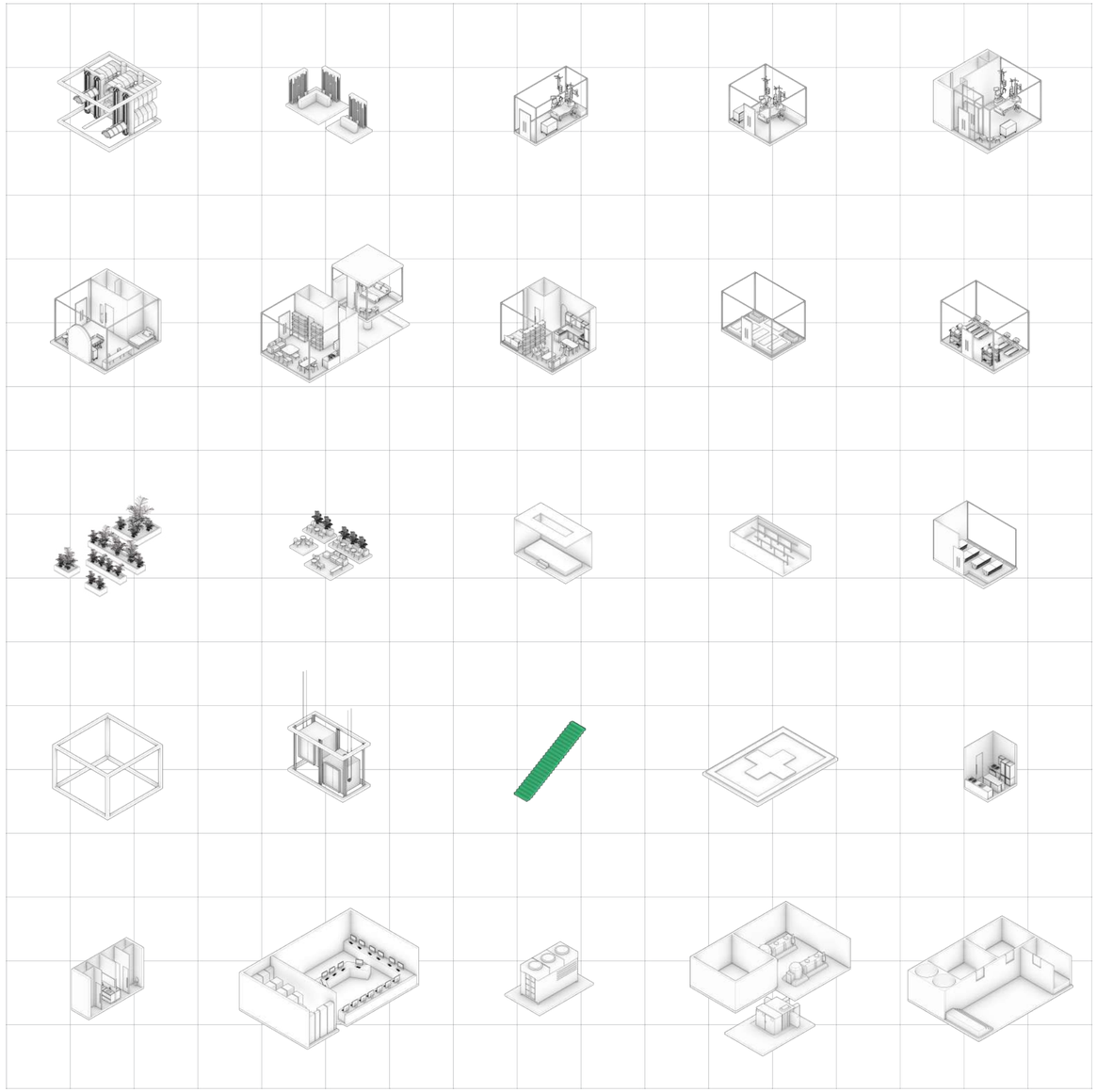

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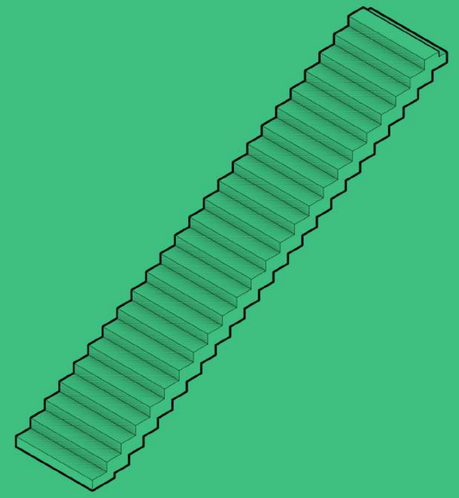

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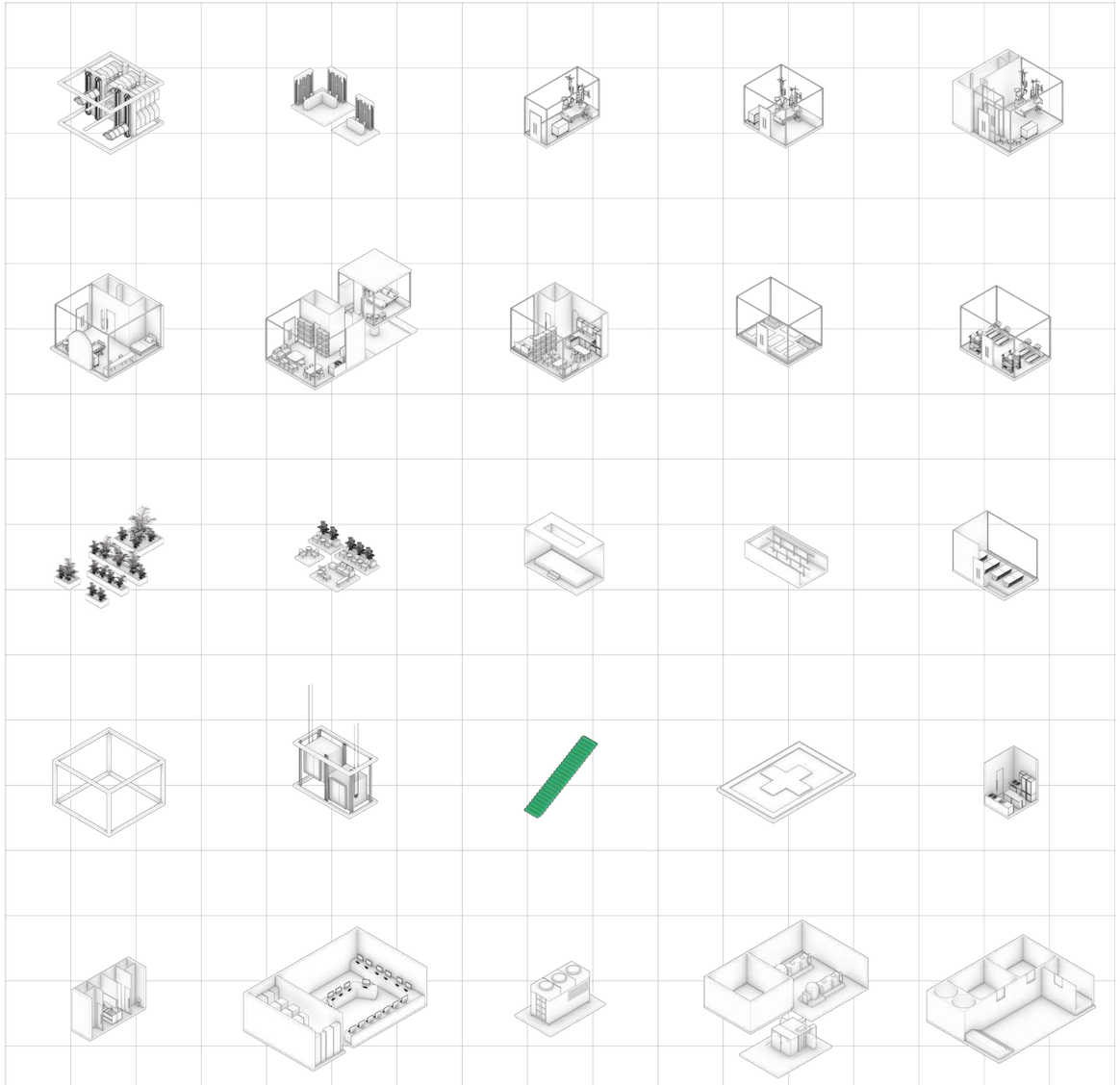

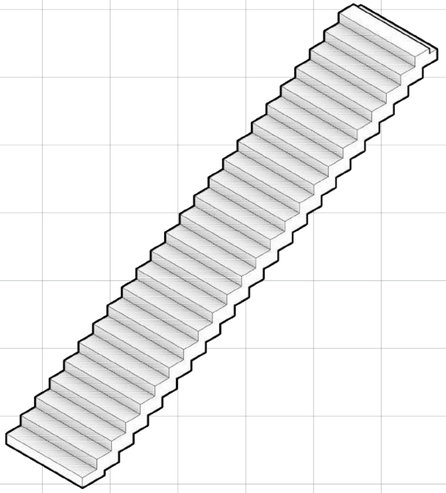

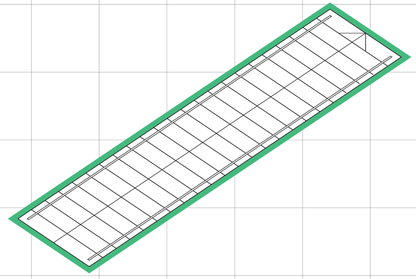

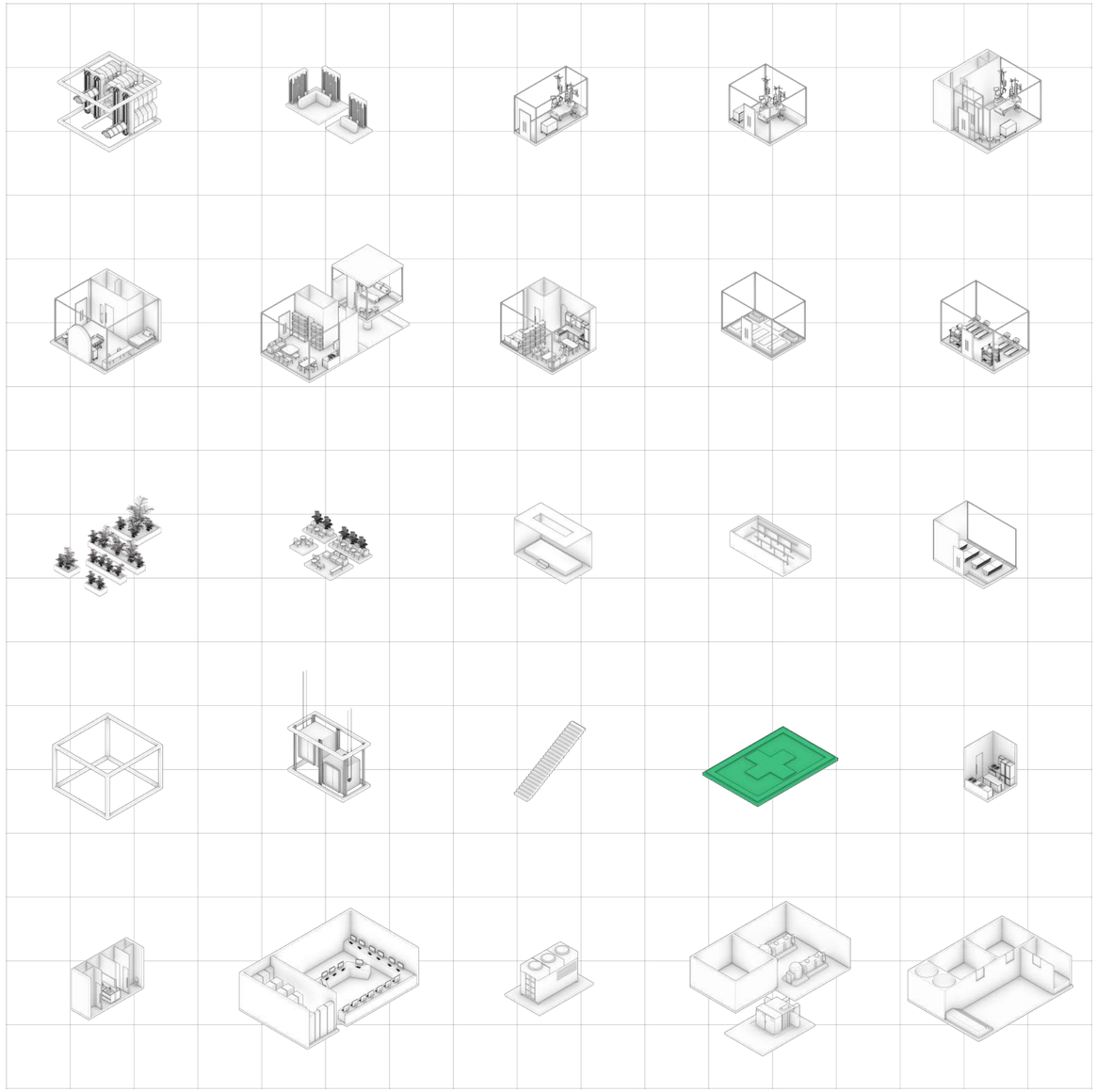

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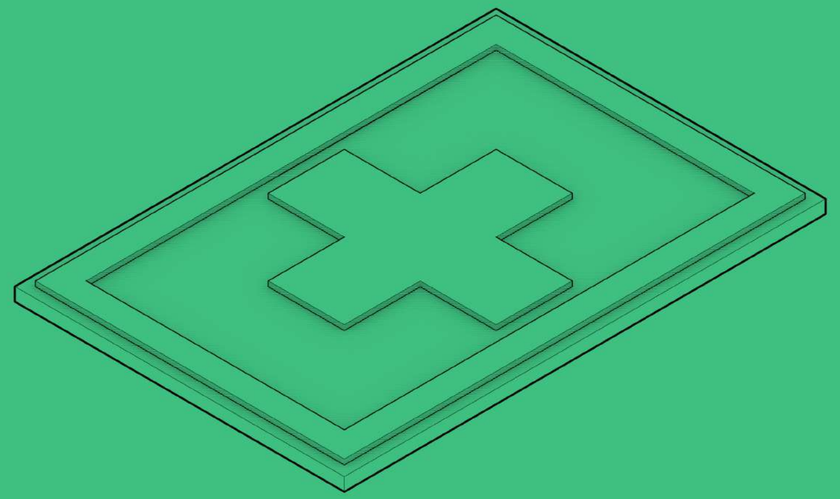
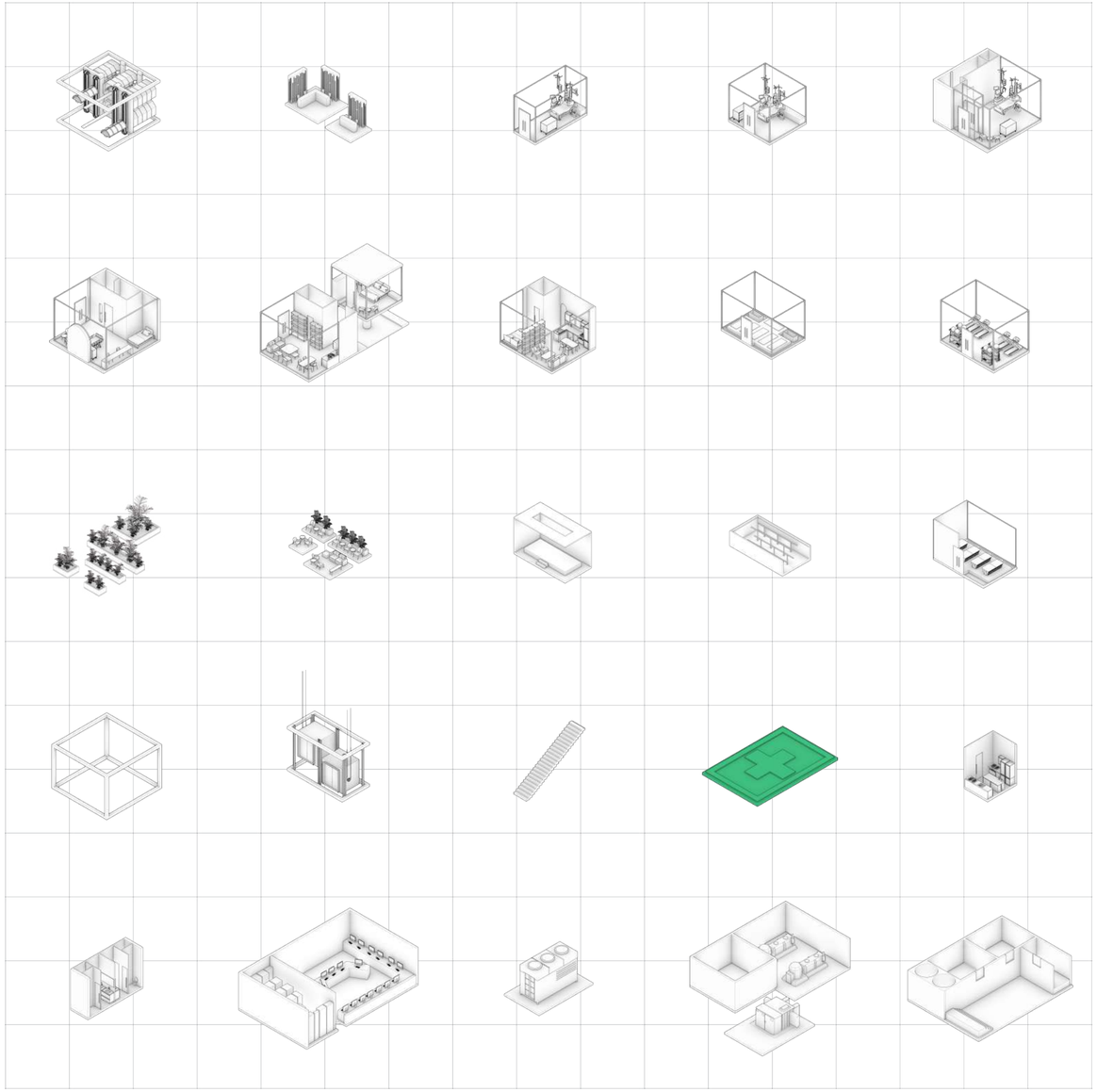
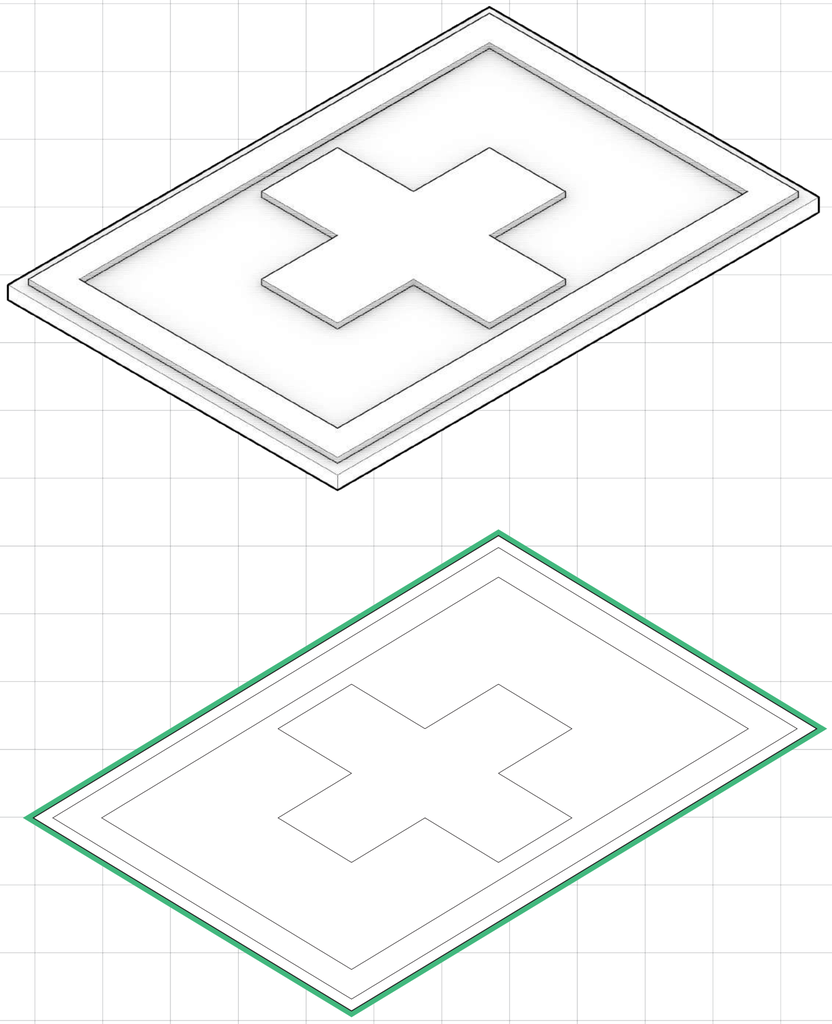
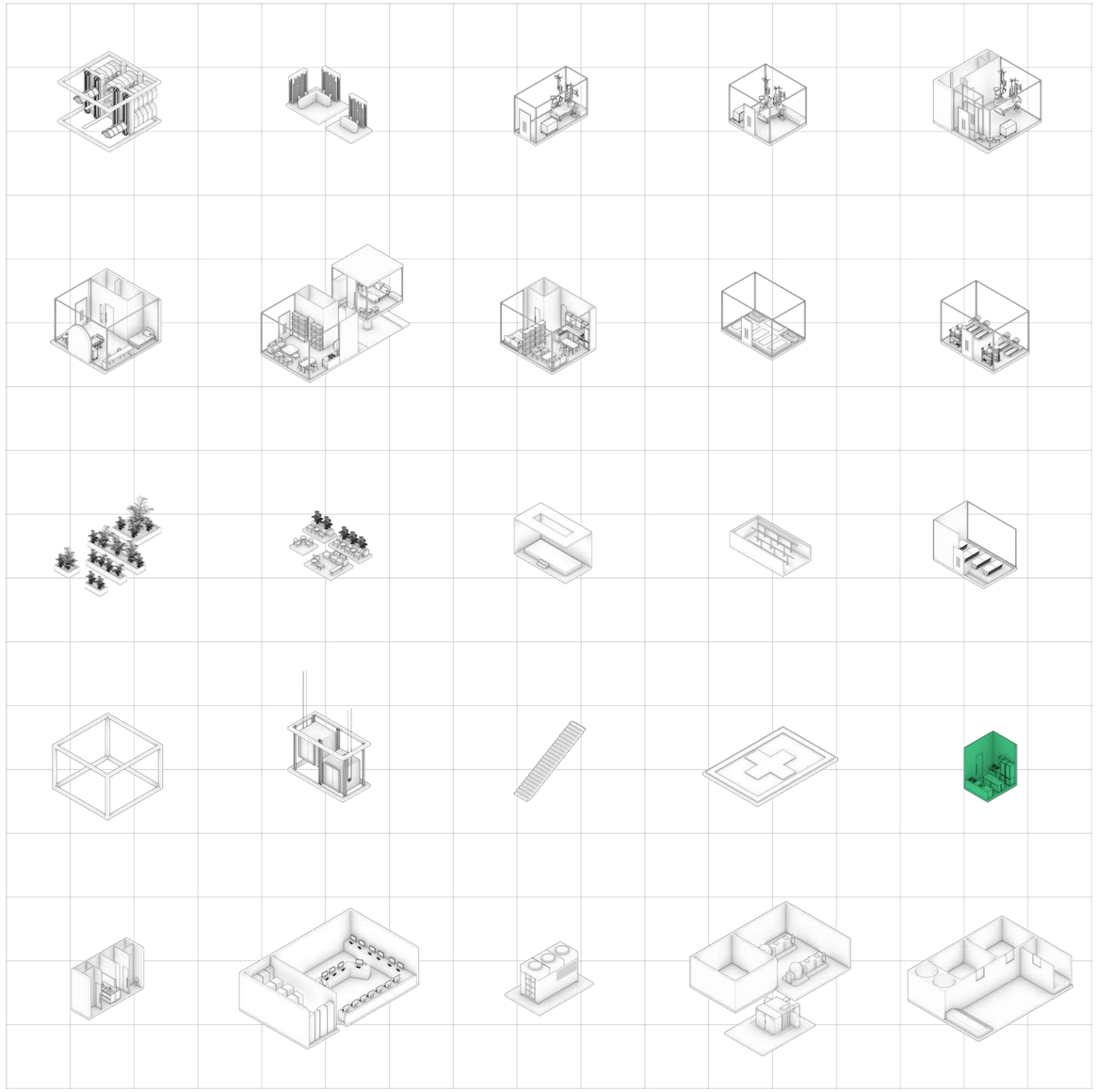


THE DRONE-PAD MODULE







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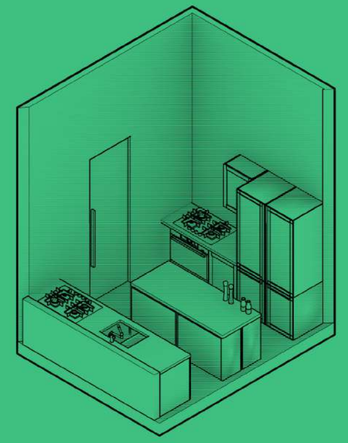
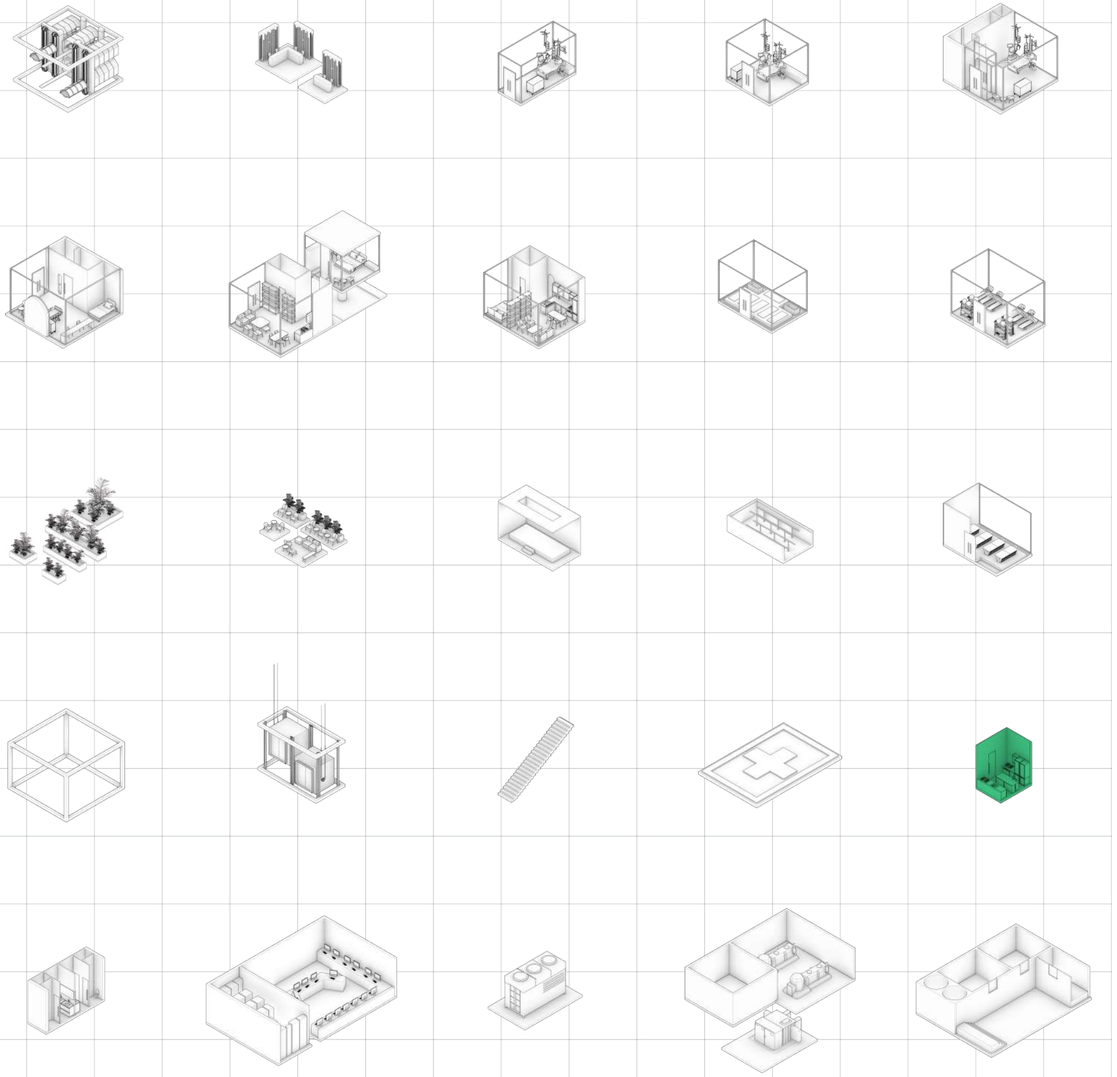
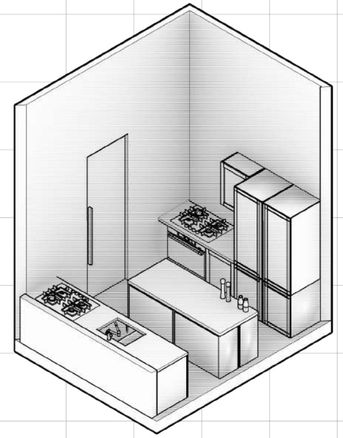
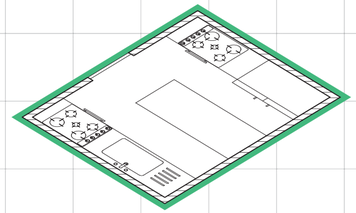
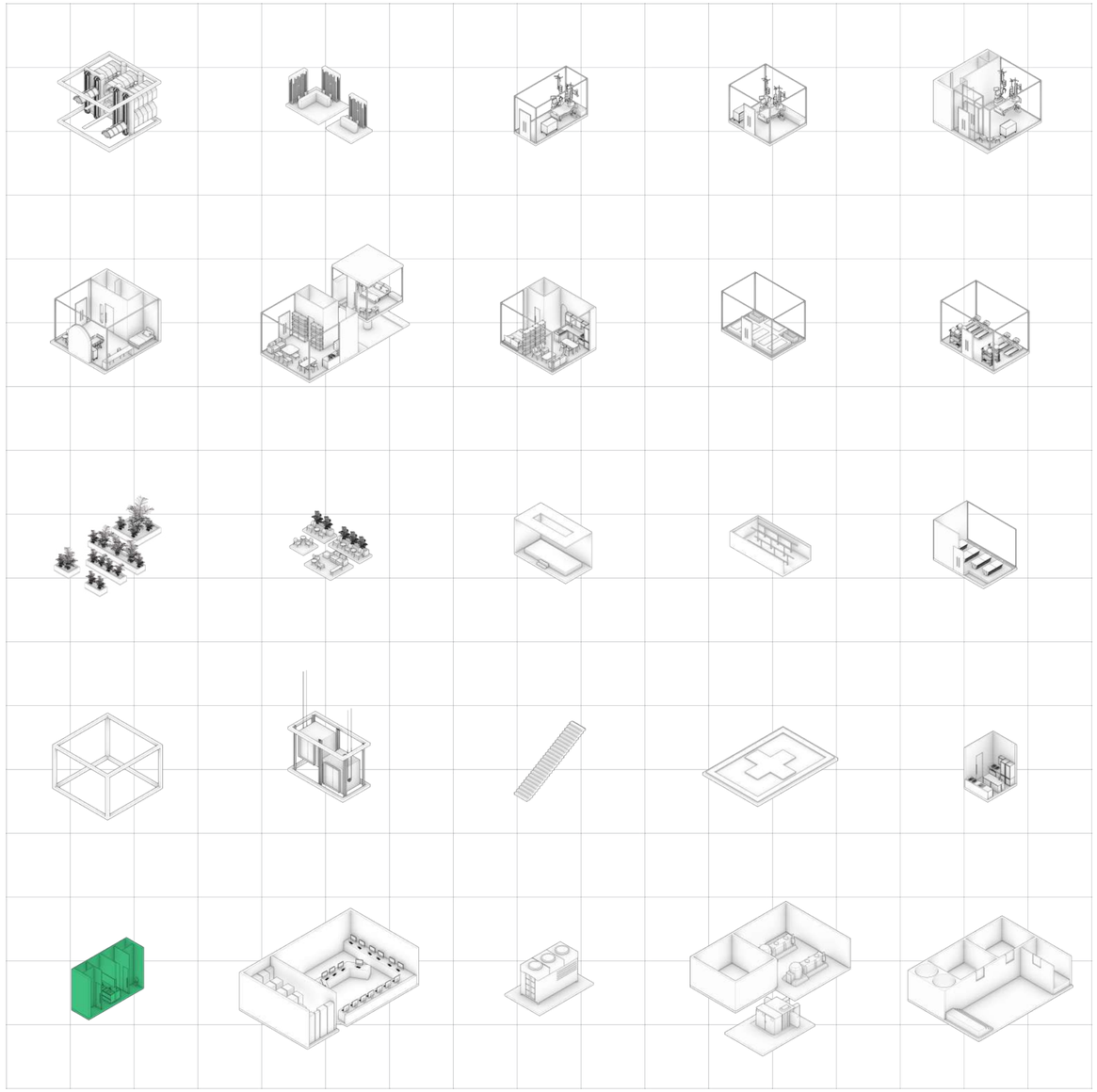


THE KITCHEN MODULE









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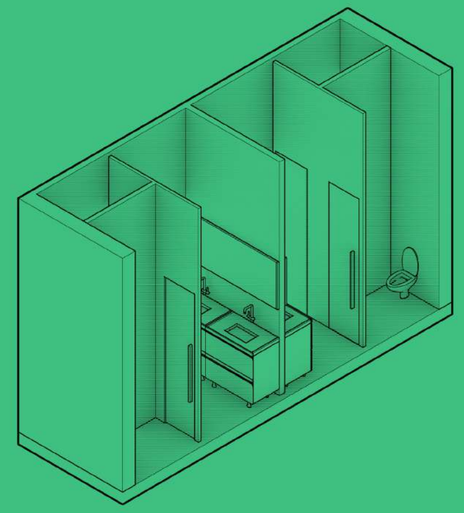
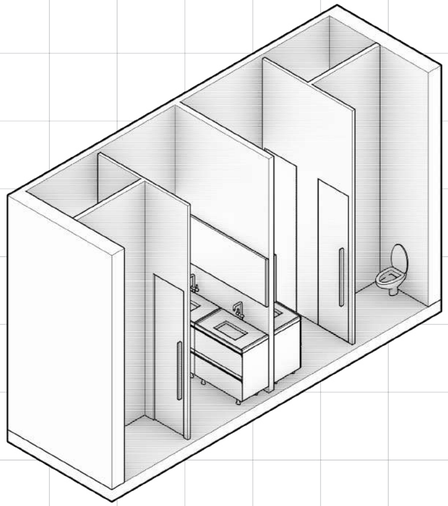
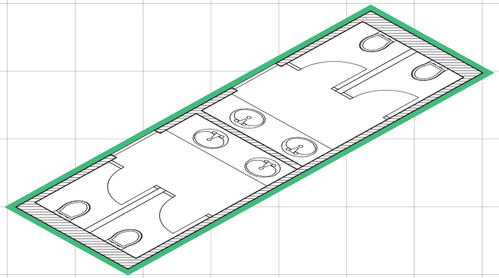
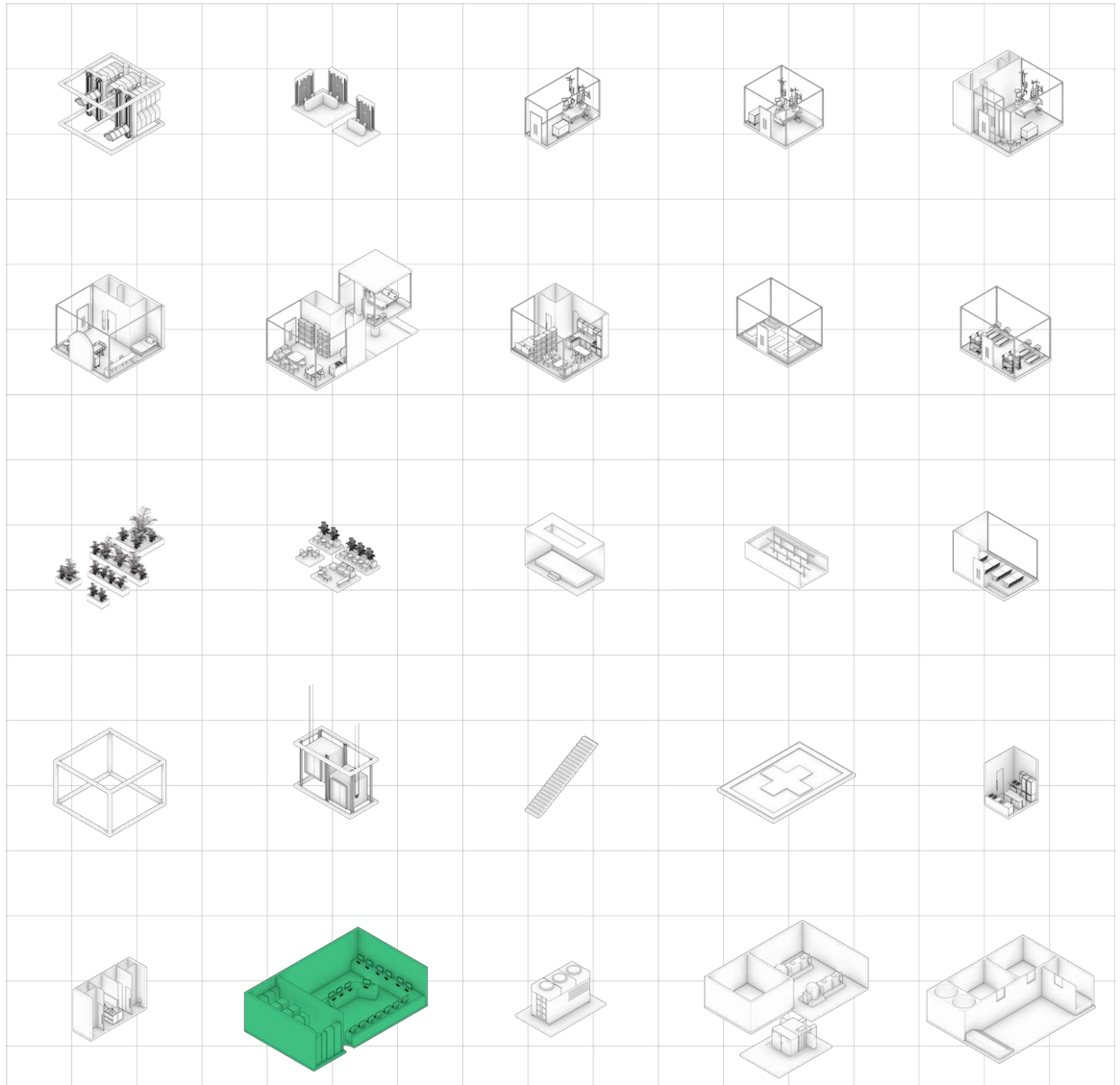


THE WC MODULE







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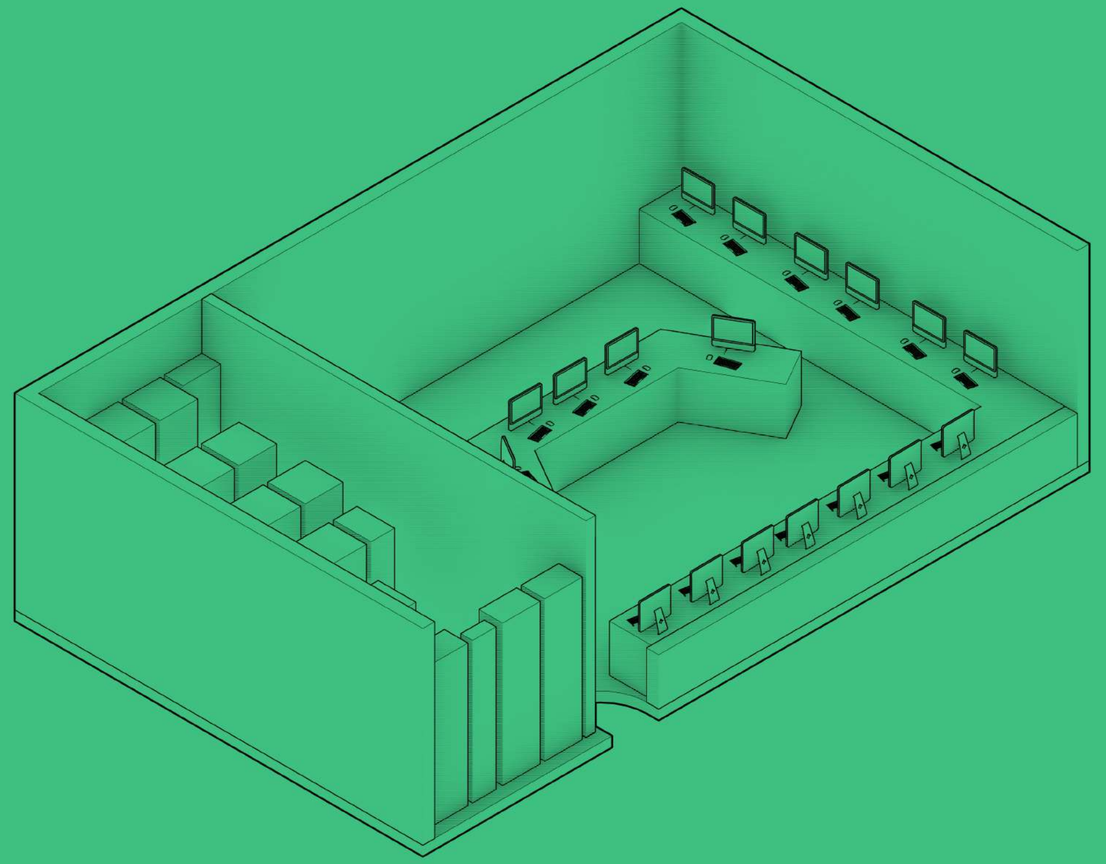
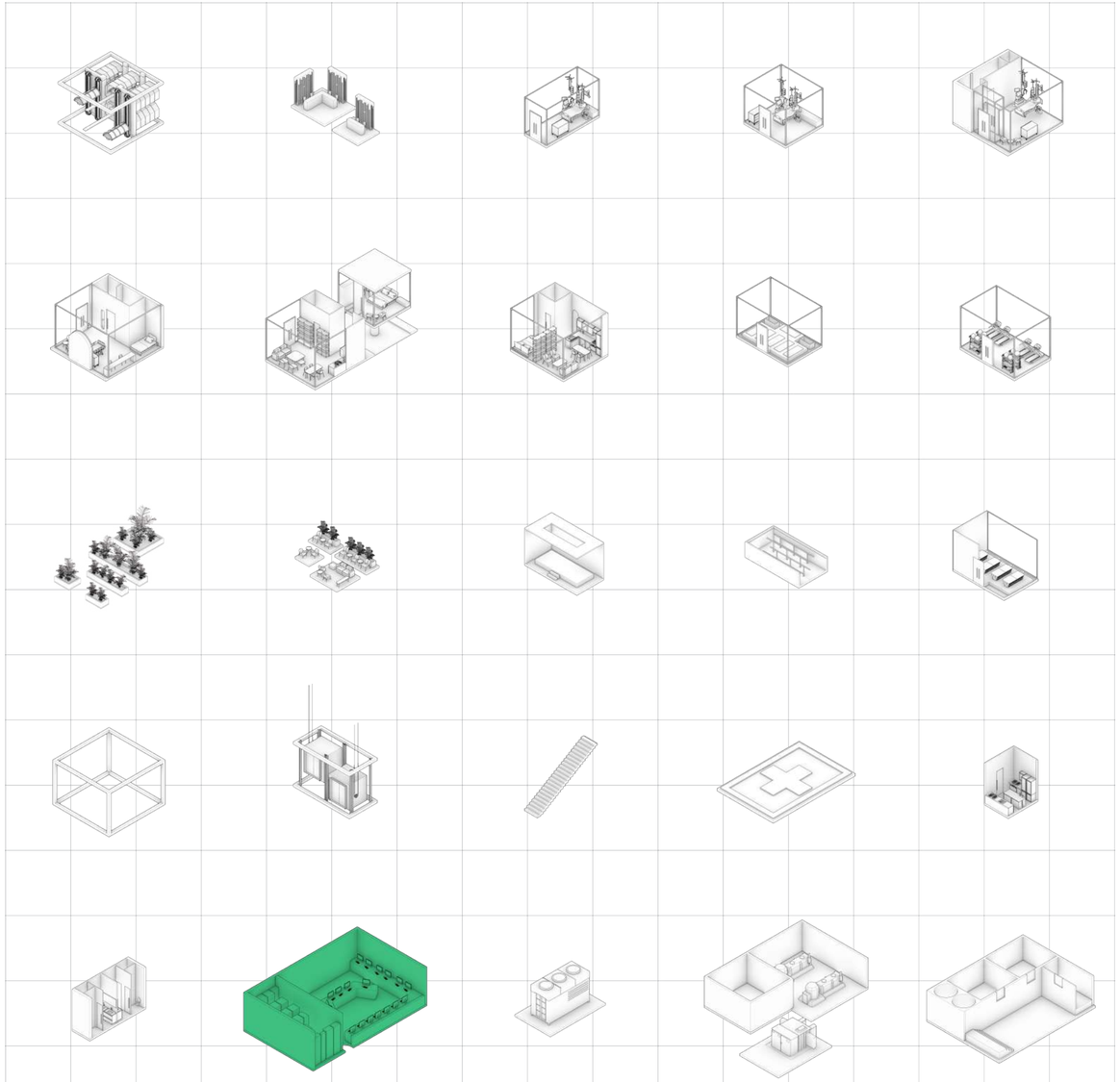
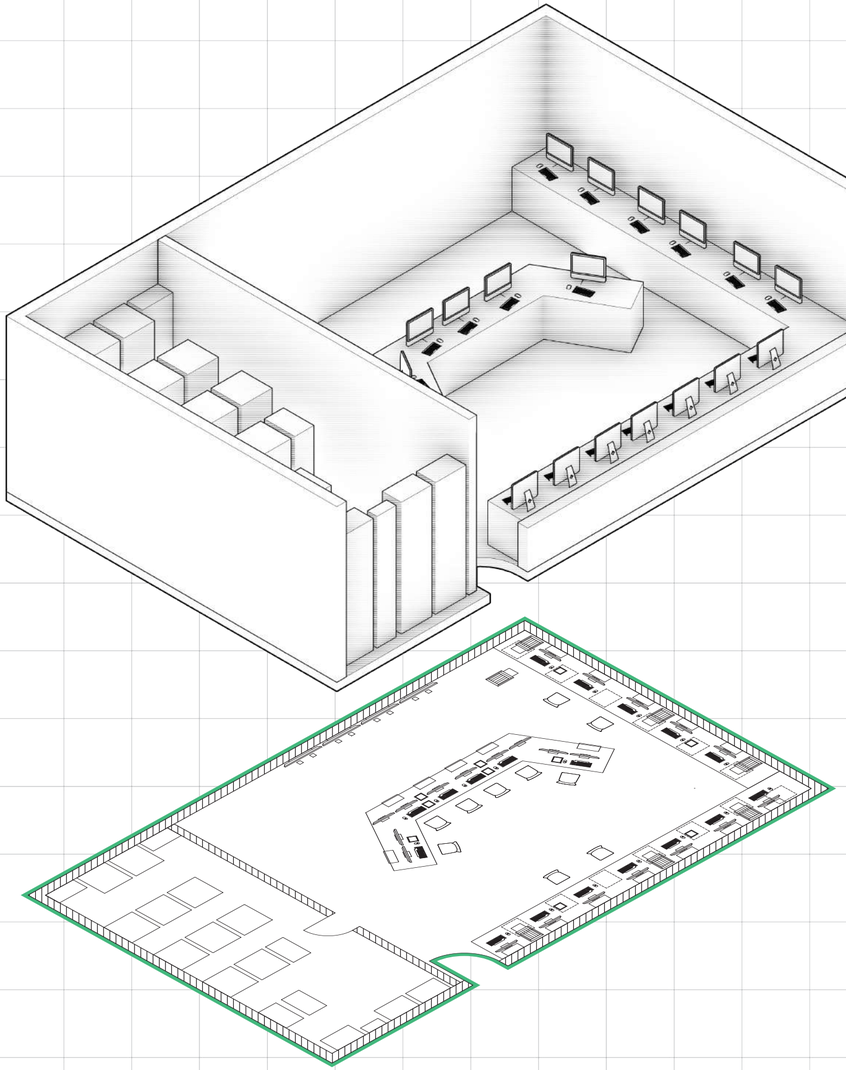
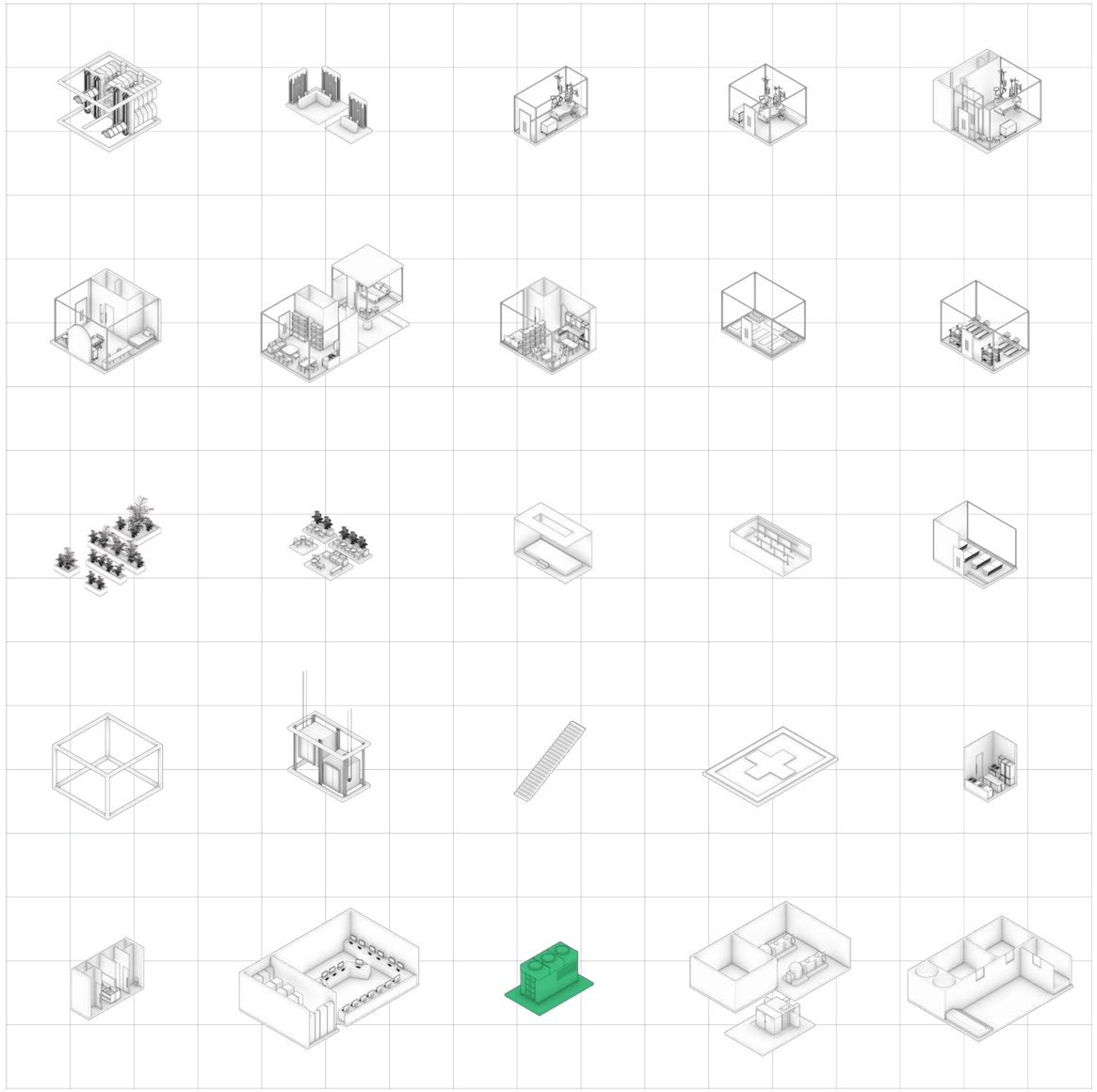


THE SERVER ROOM MODULE







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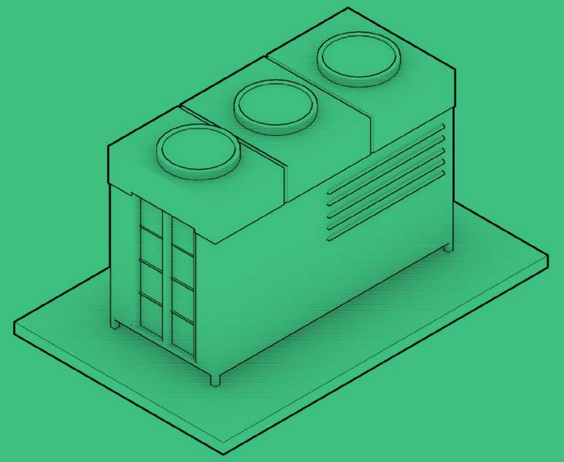
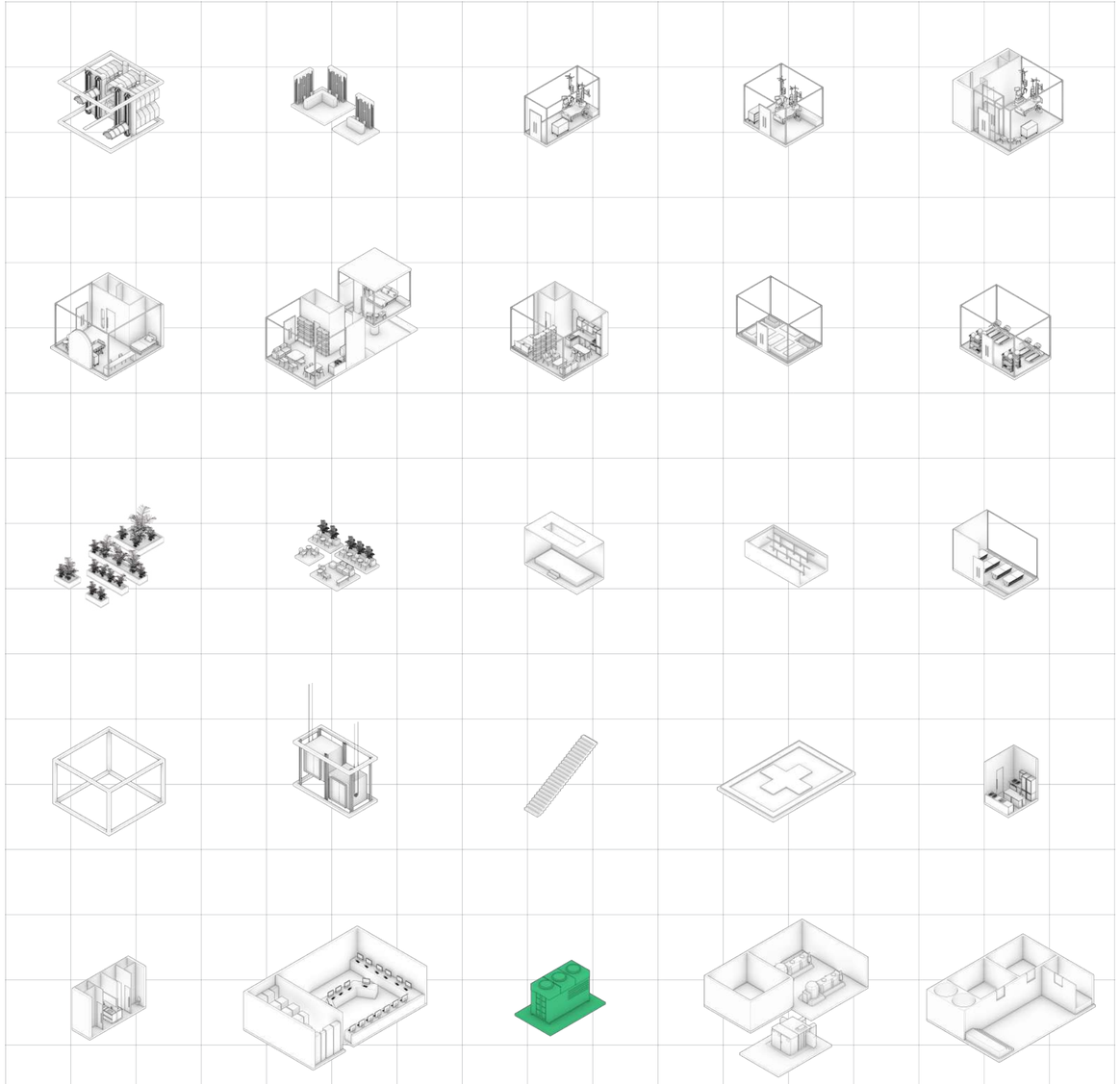
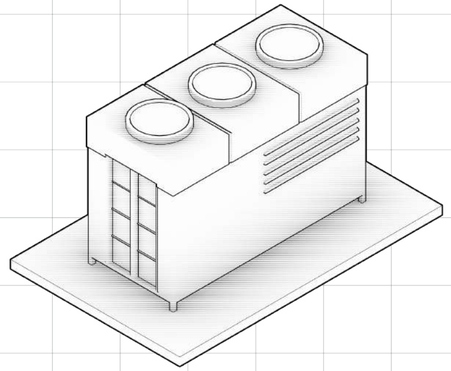
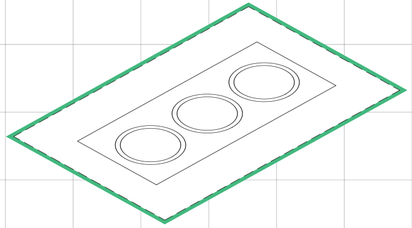
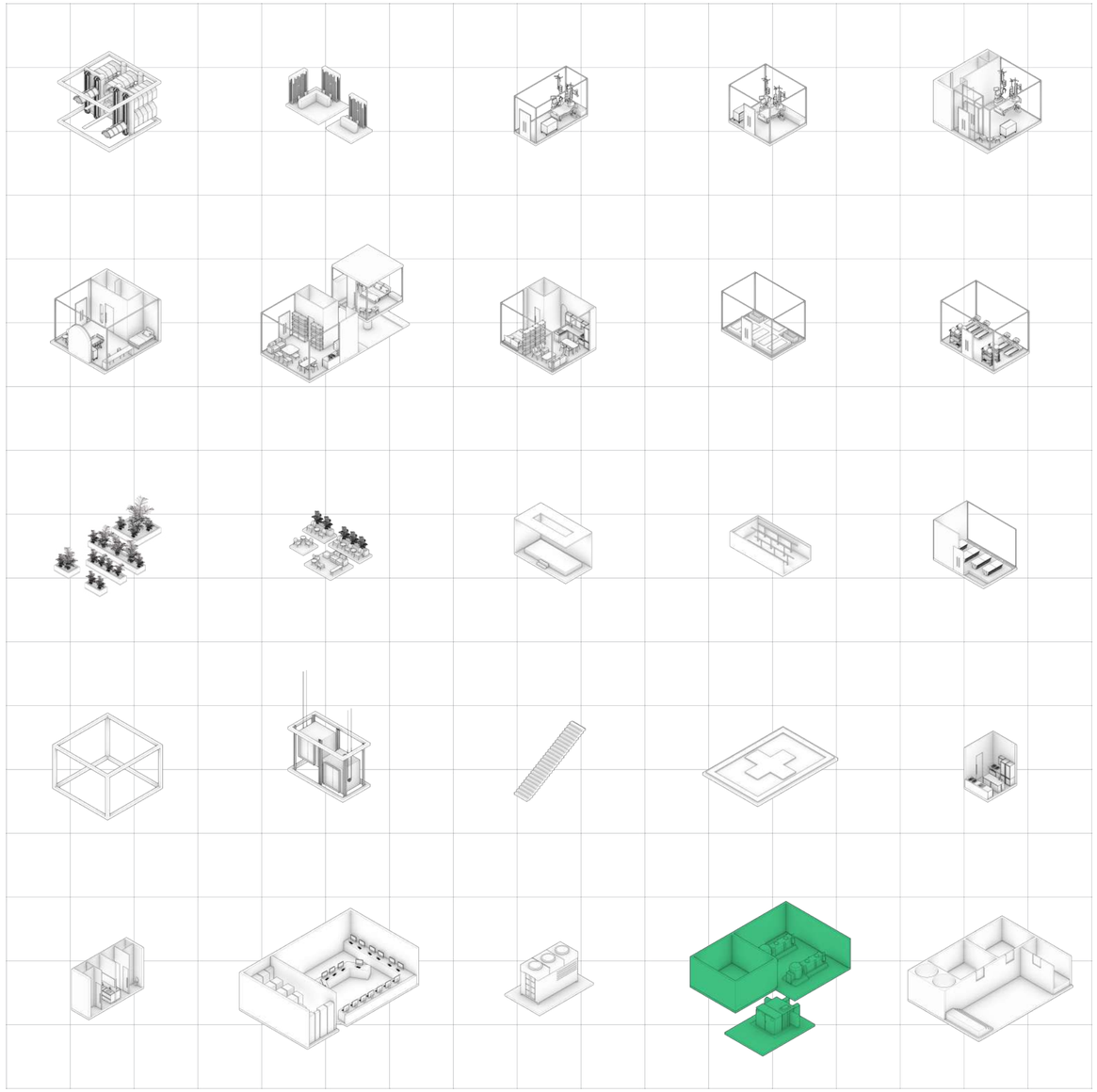


THE HVAC MODULE

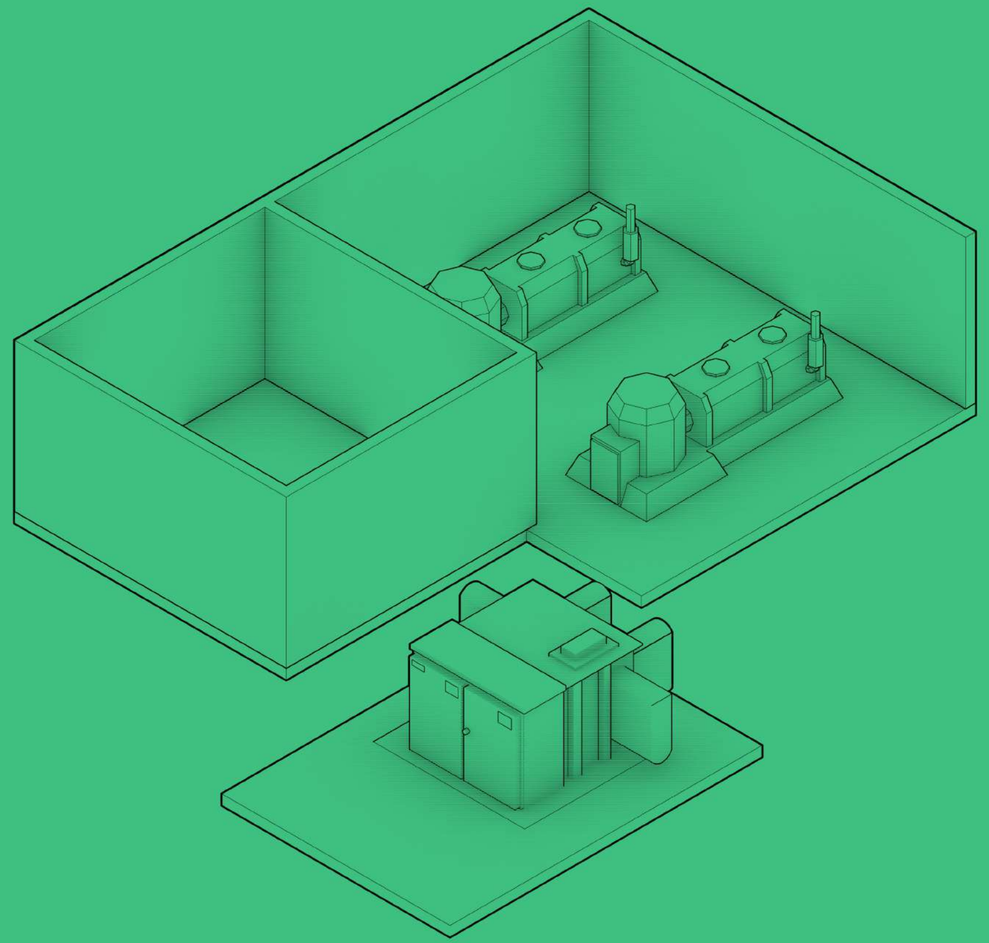








THE SERVICES PACK



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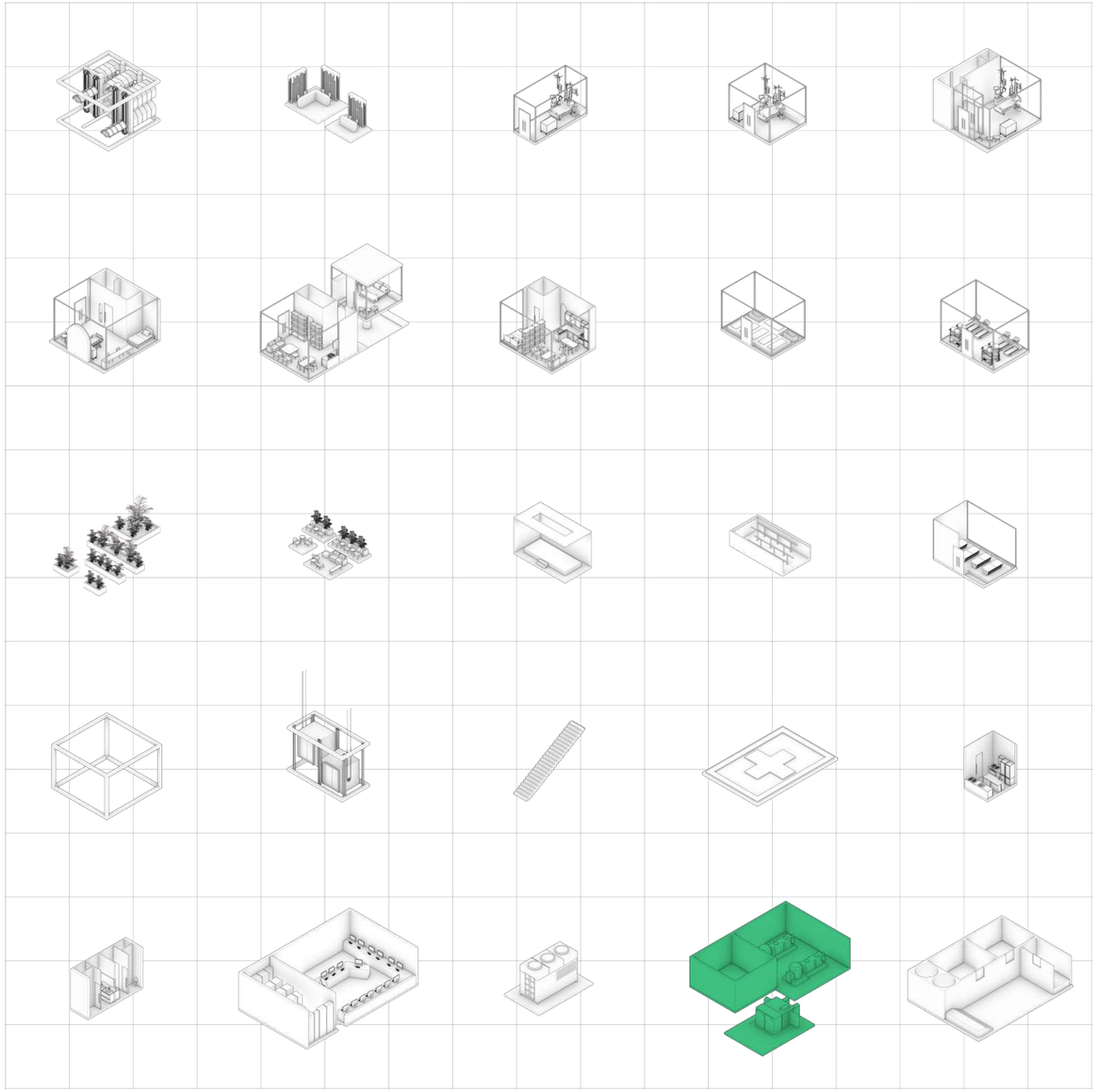

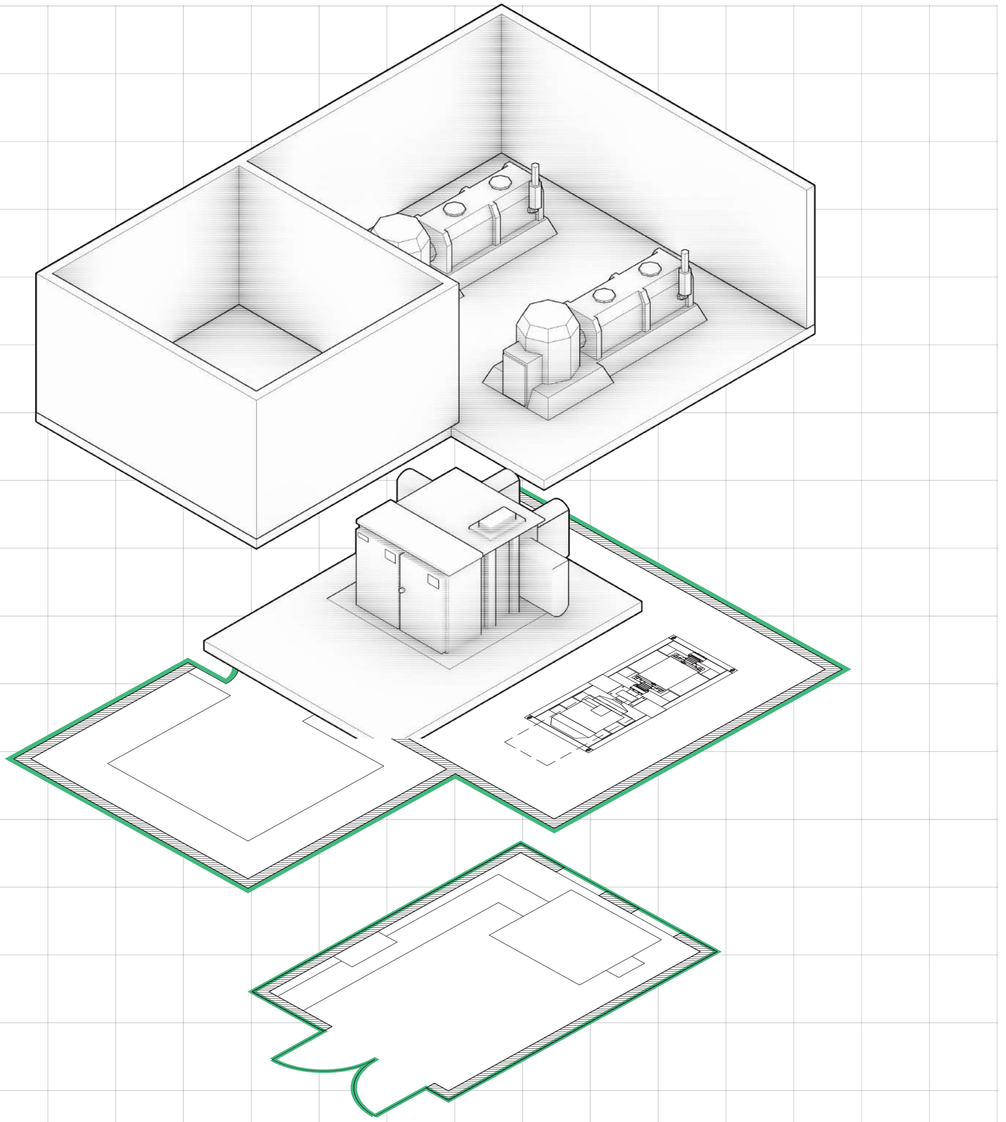

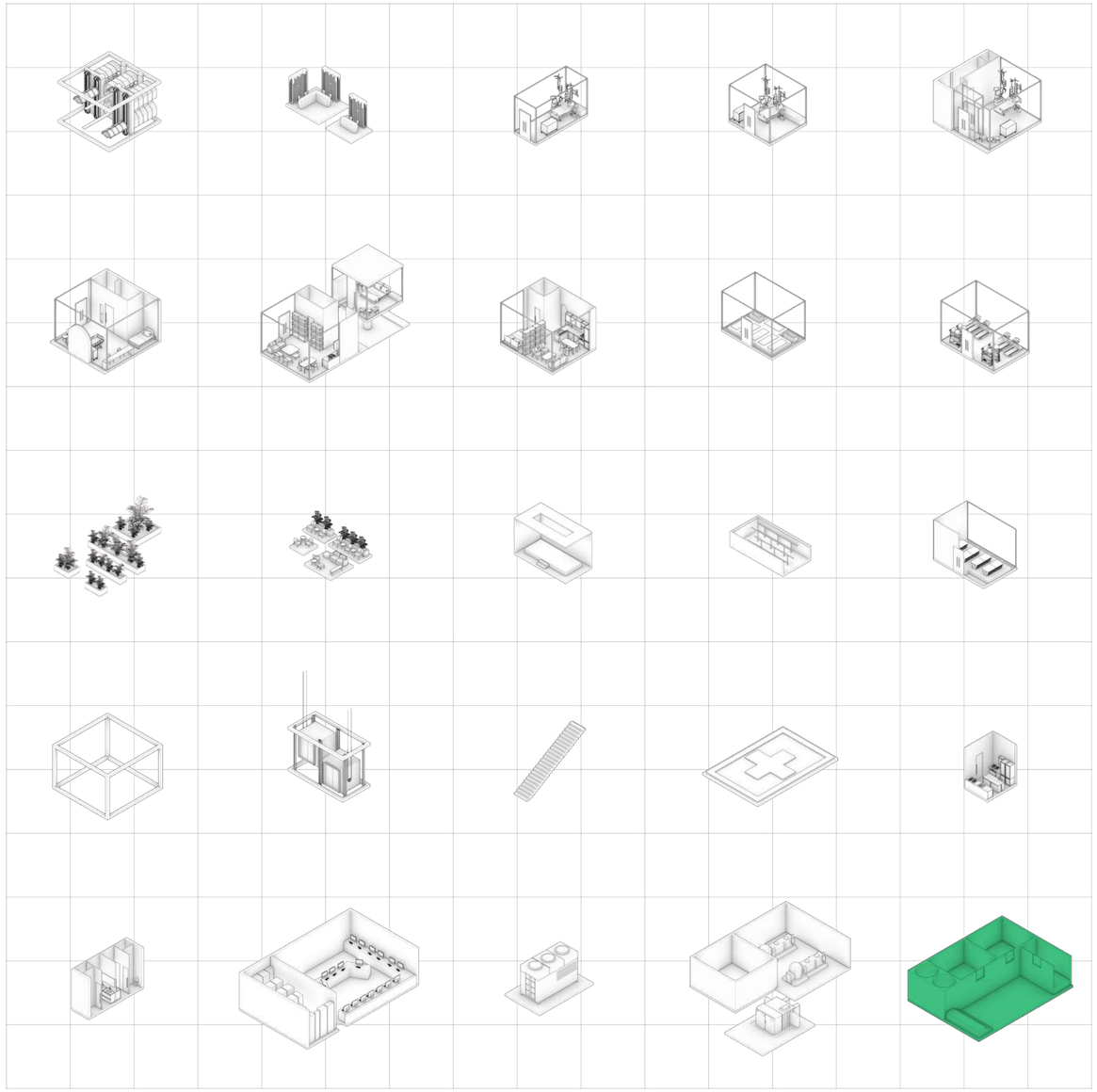

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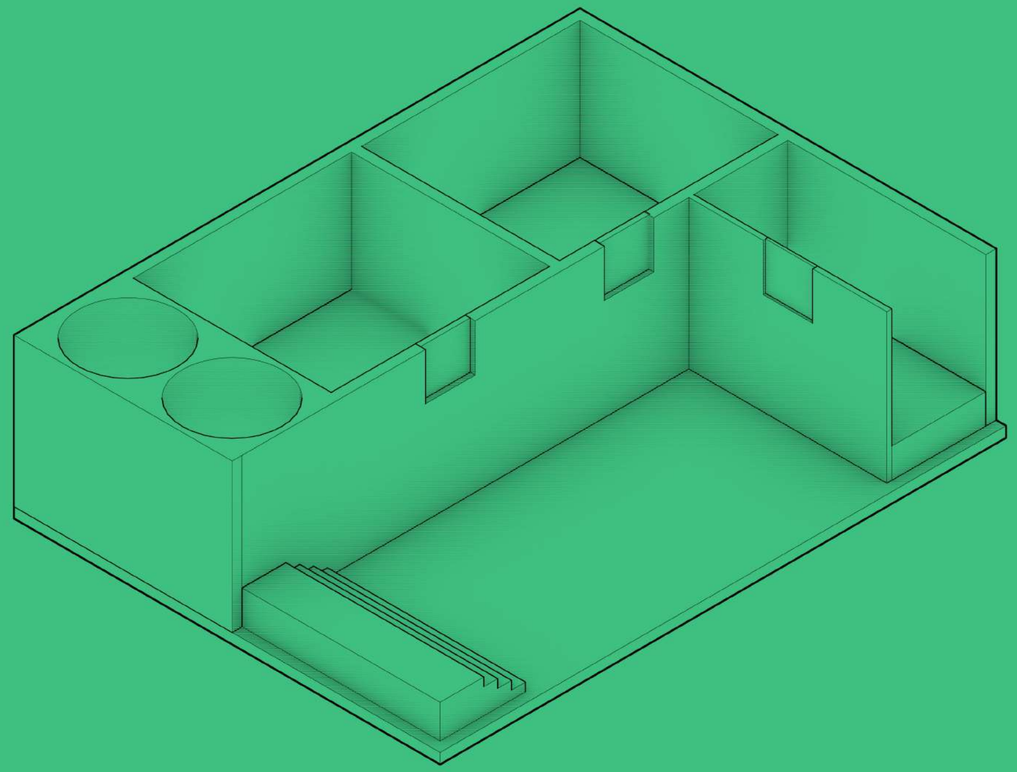

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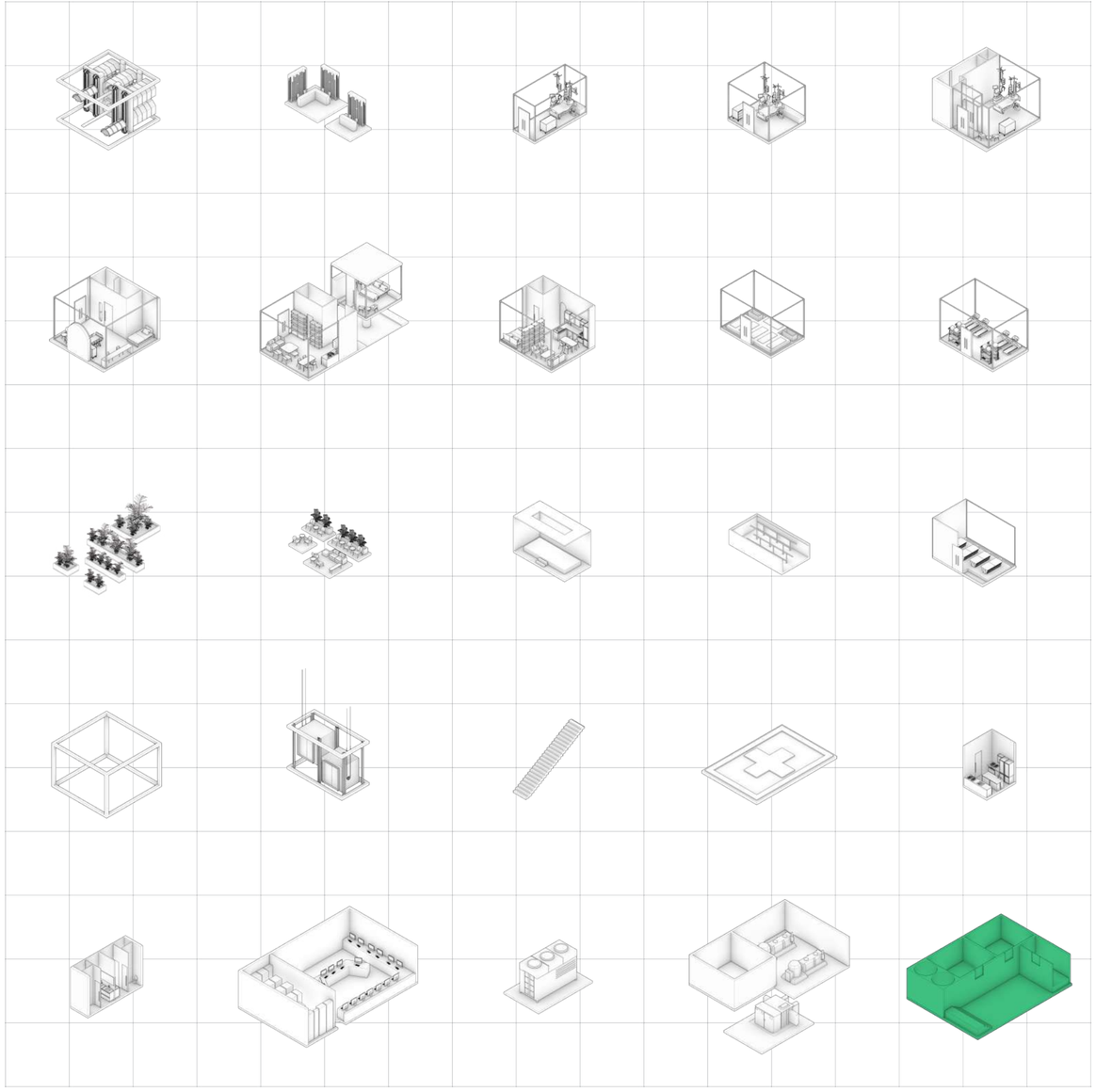
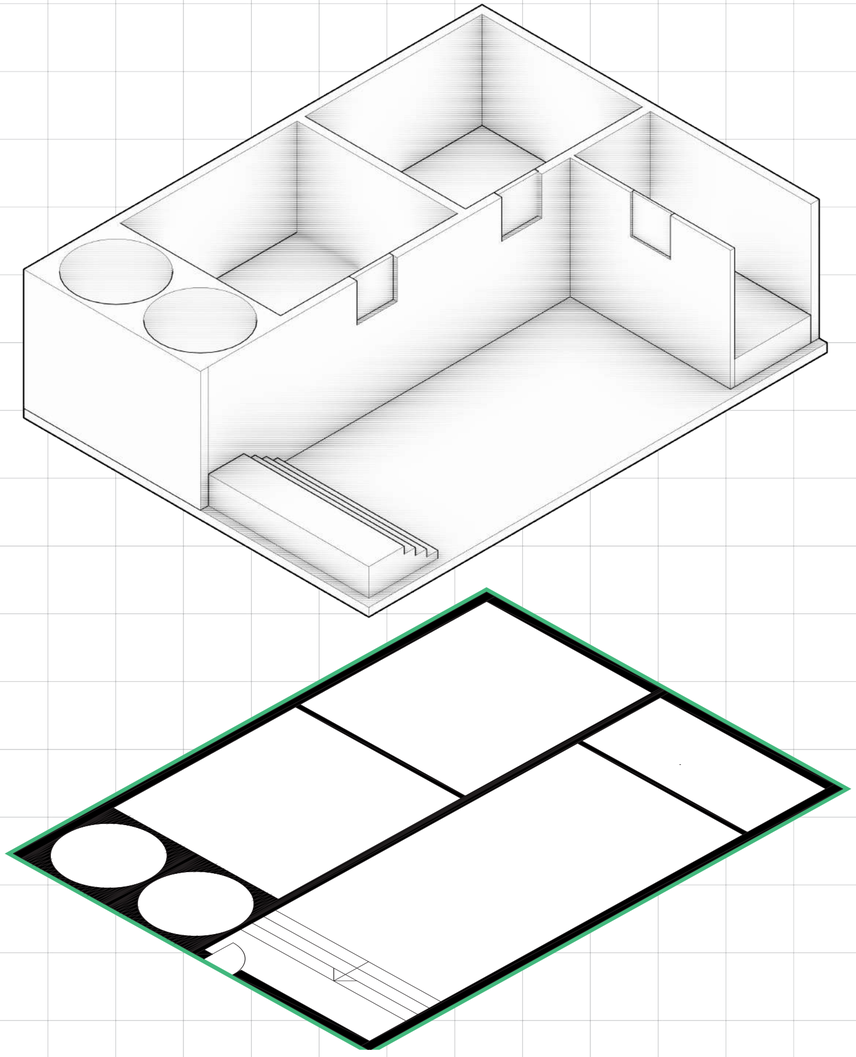
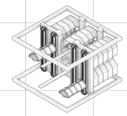
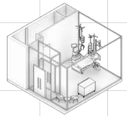
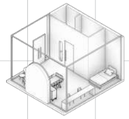
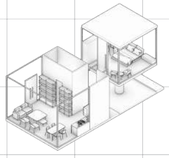
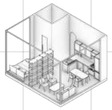
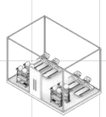
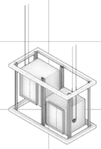


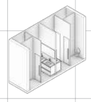
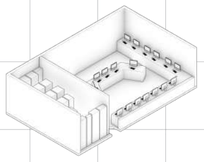
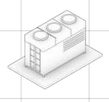
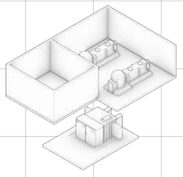
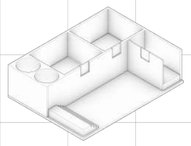




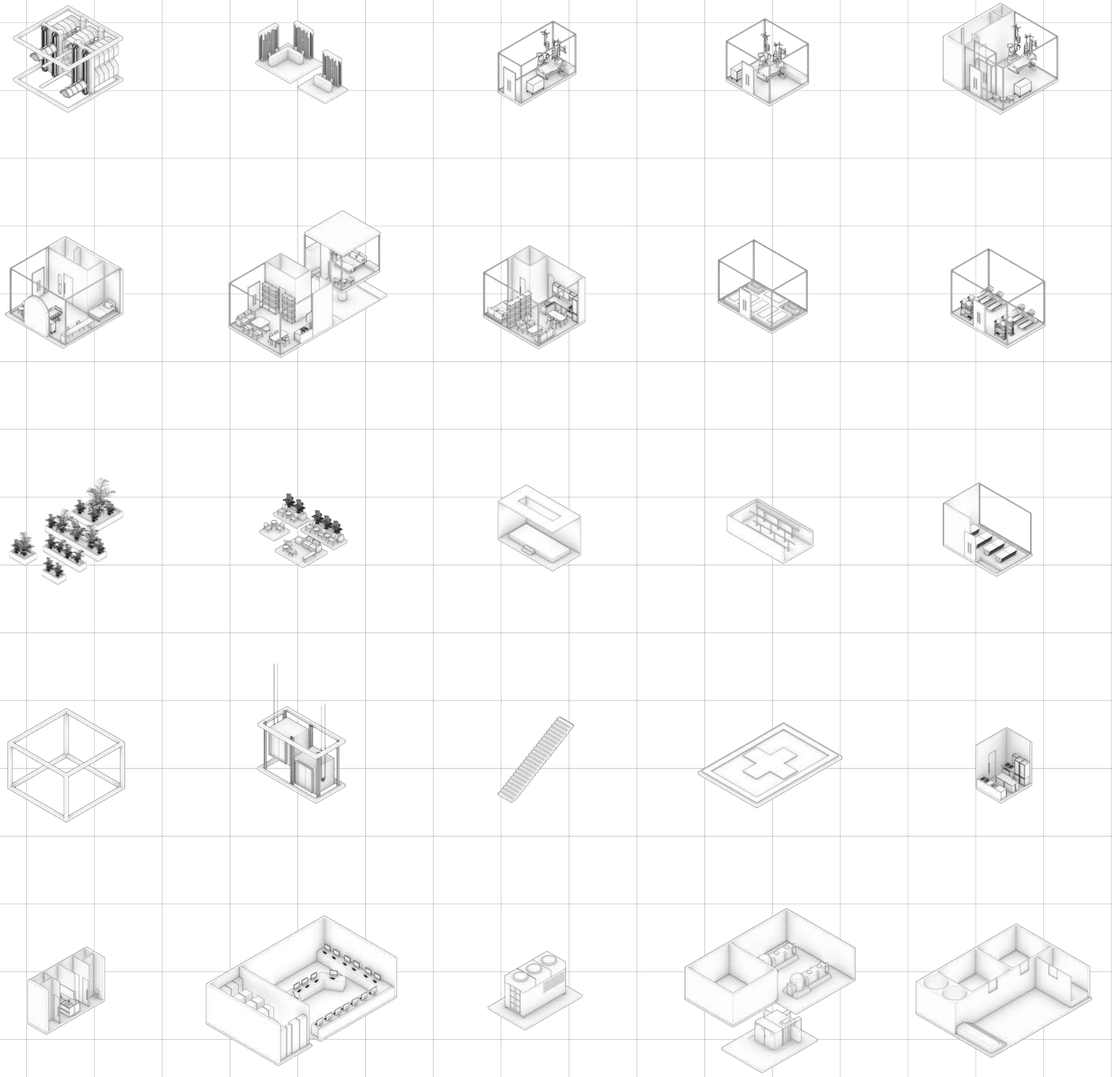









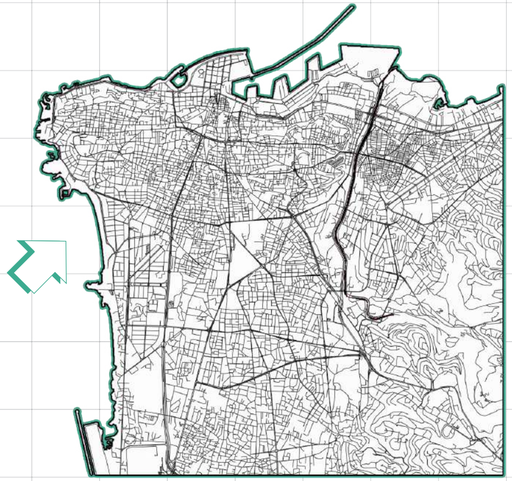






THE CITY

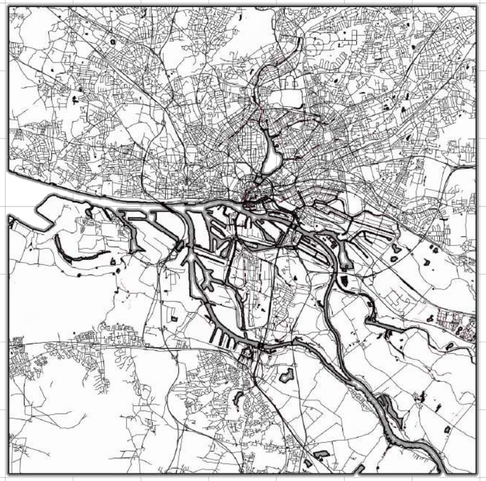


CHOOSE YOUR CITY

DUBAI

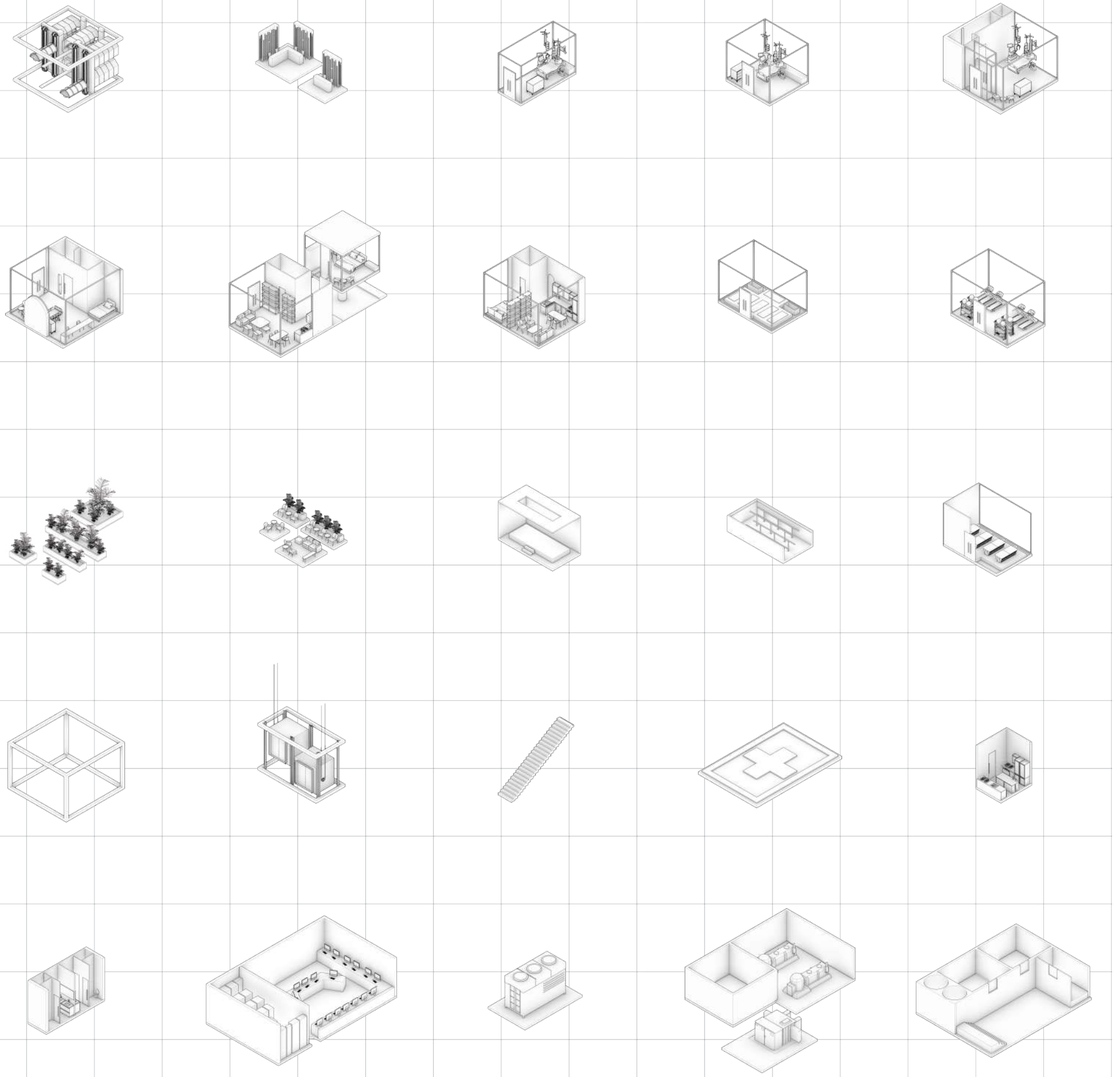


BEIRUT

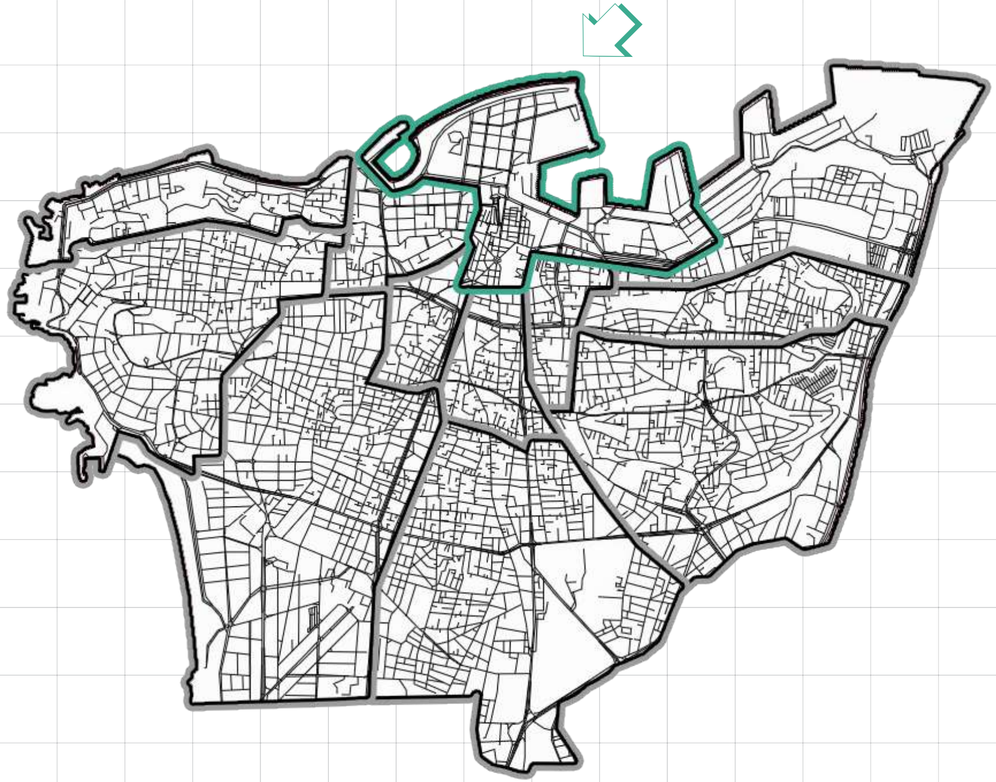


HAMBURG

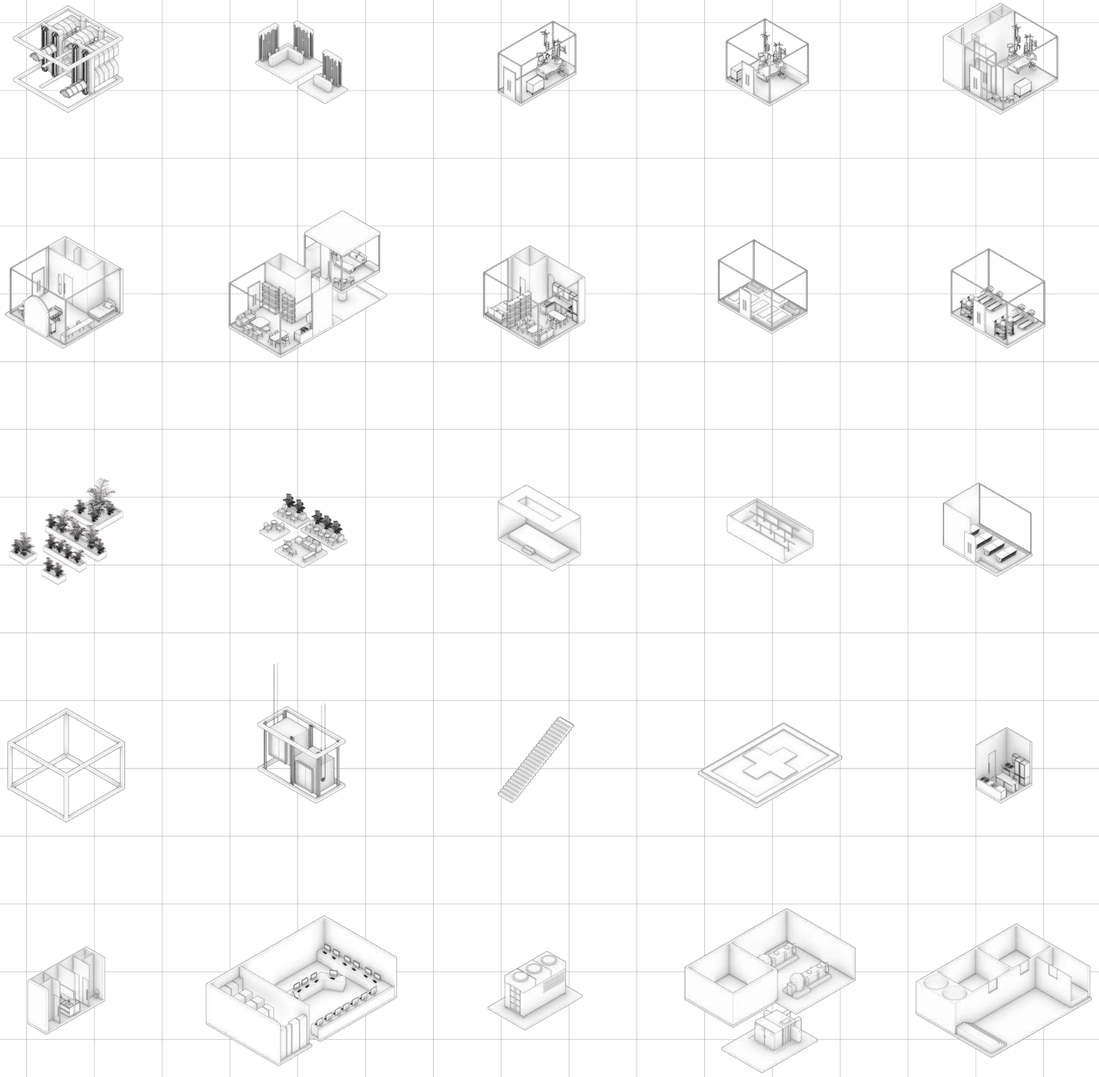
NEW YORK



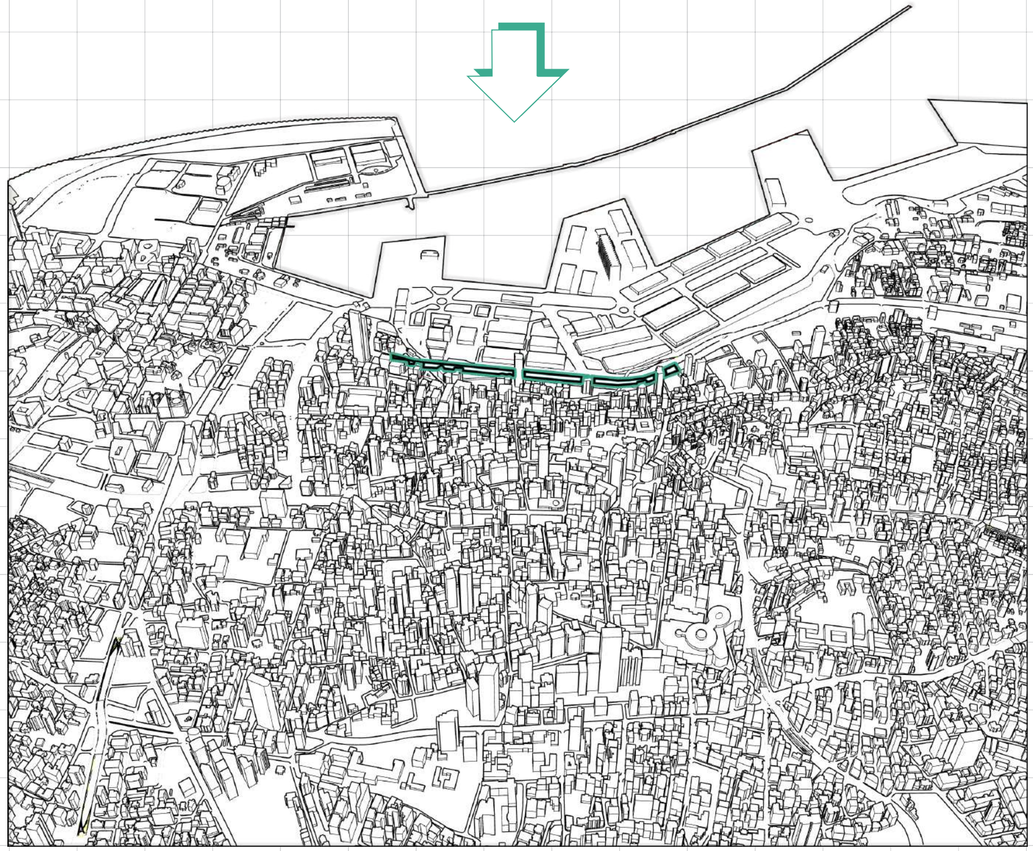
CHOOSE YOUR REGION



THE BEIRUT PORT REGION



CHOOSE YOUR INFRASTRUCTURE



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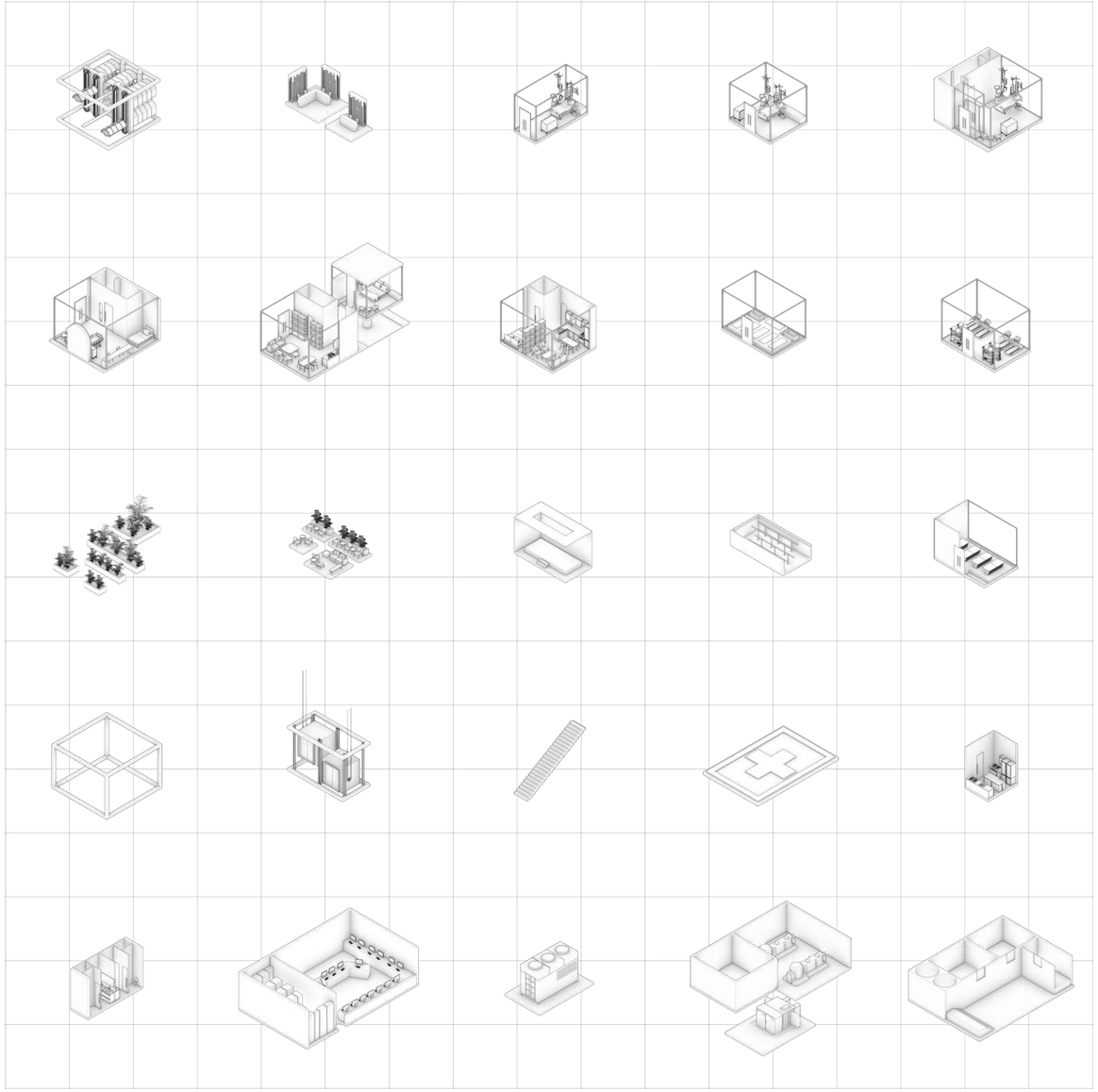

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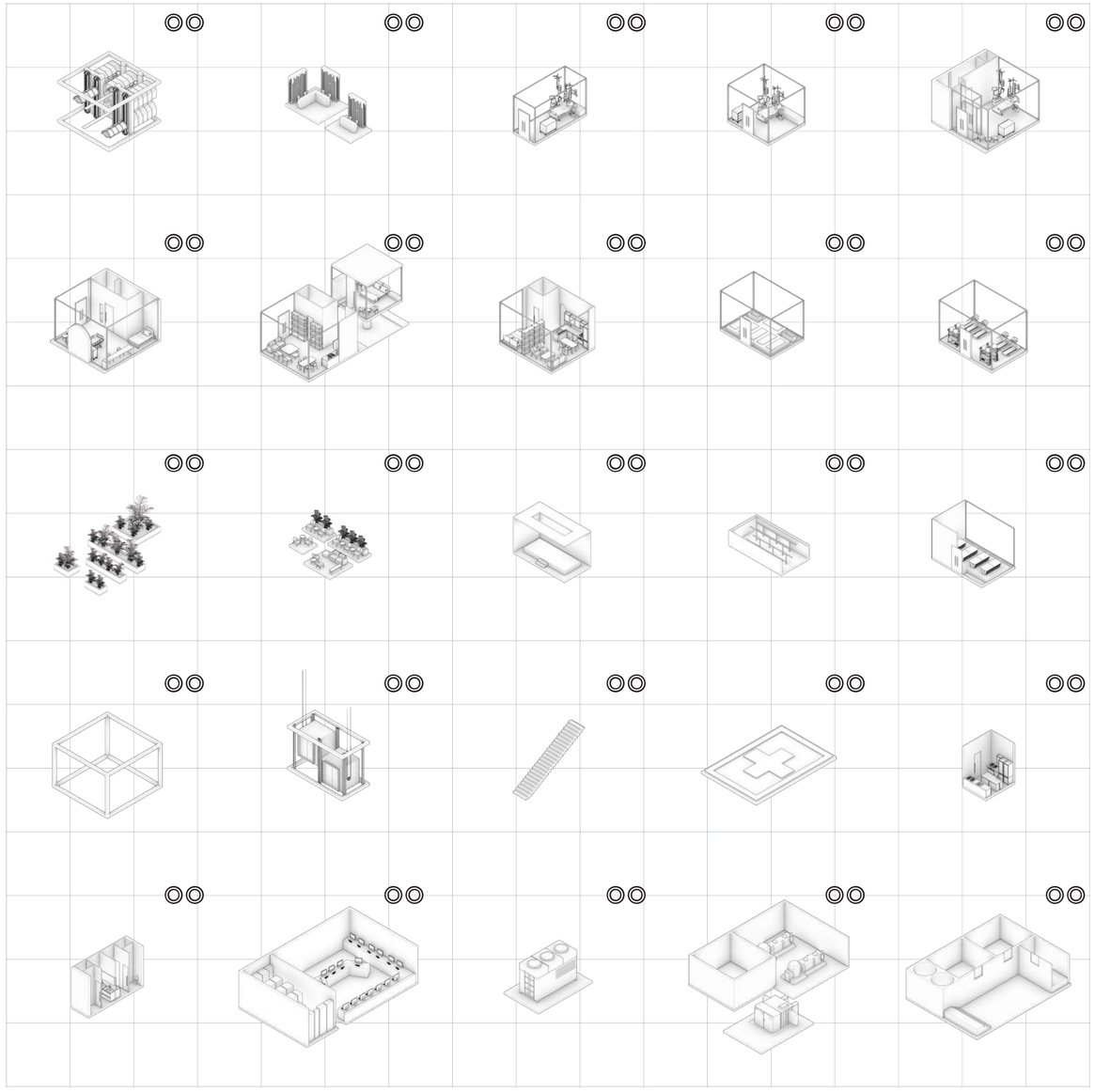

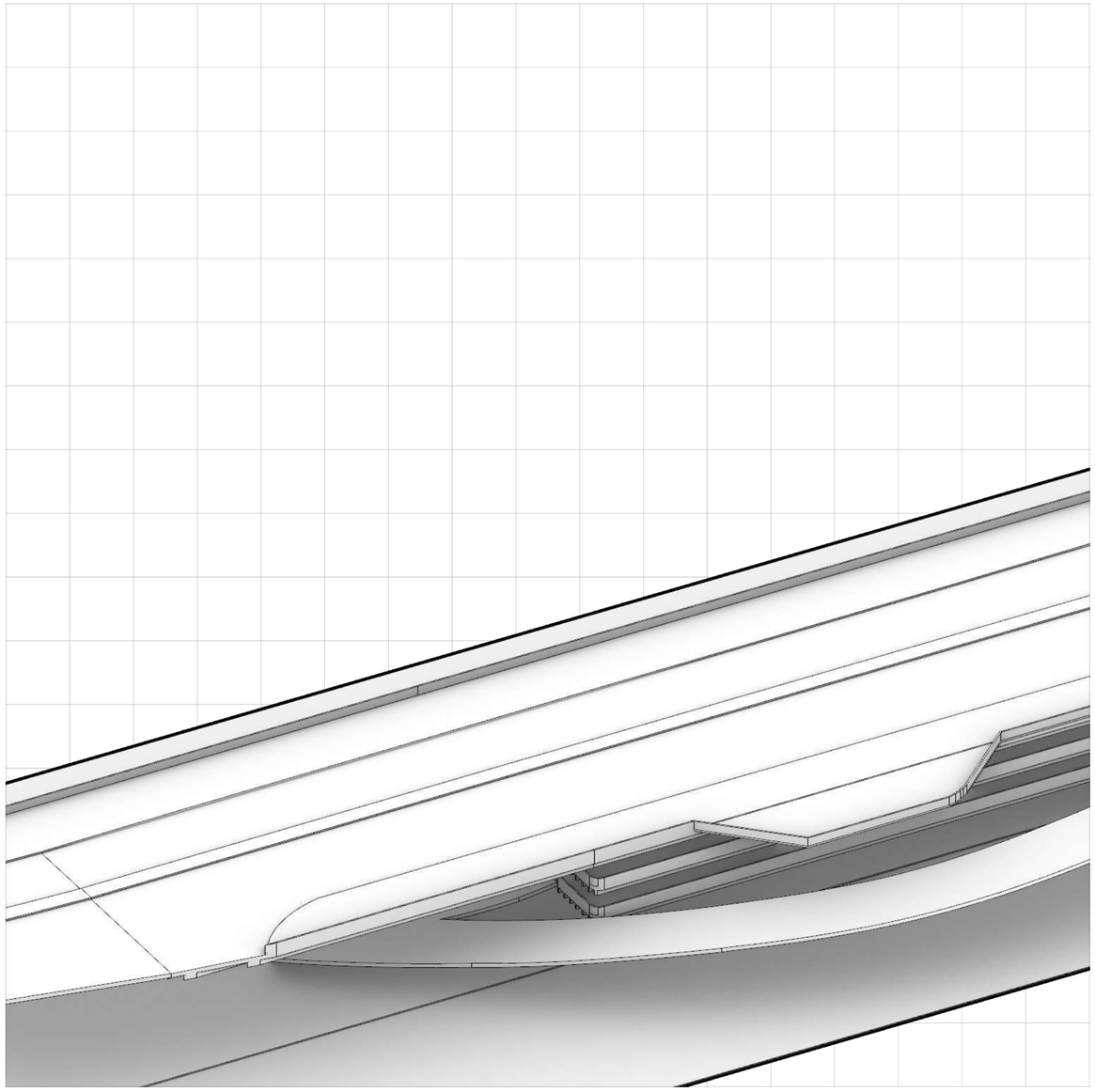

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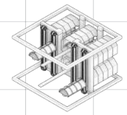

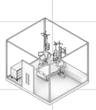
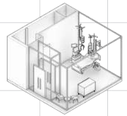

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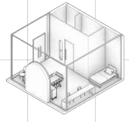
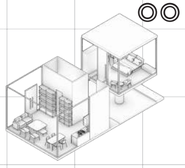
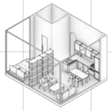

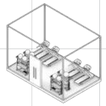

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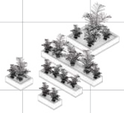

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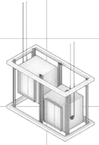

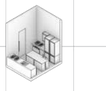

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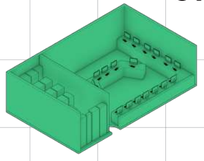

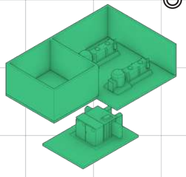
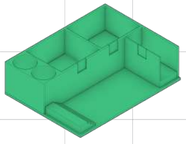

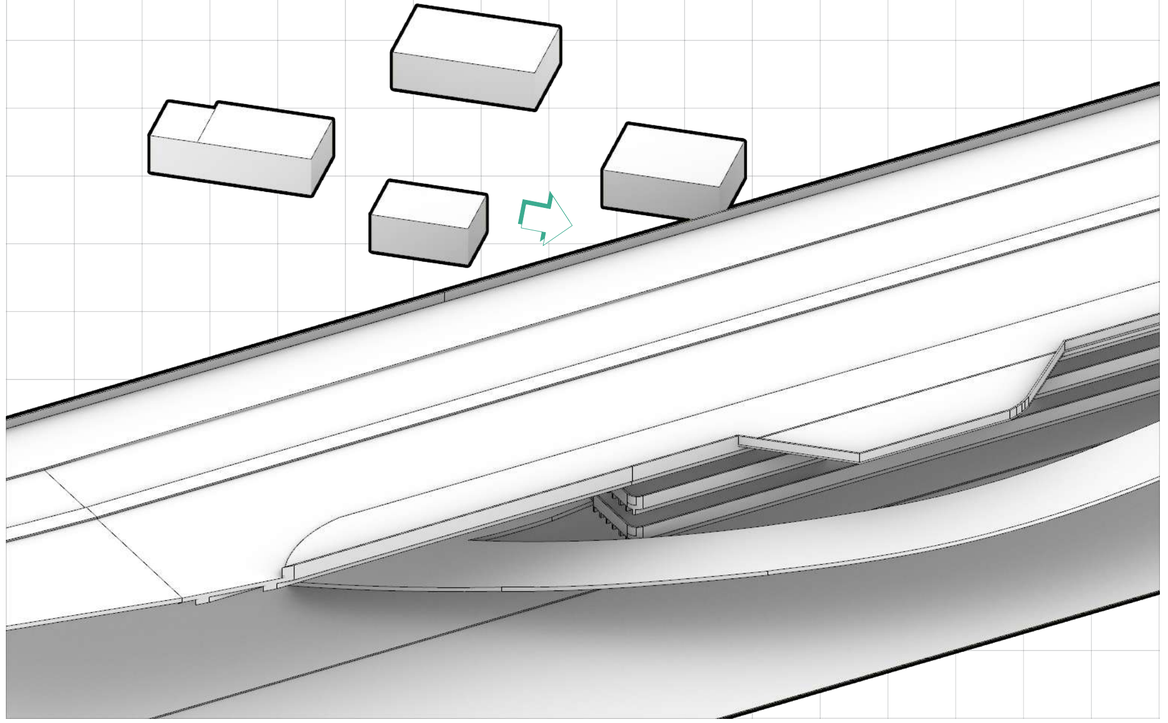

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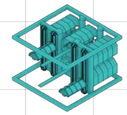

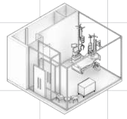

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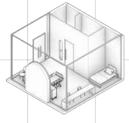
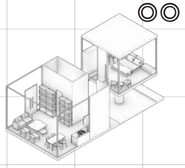
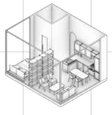

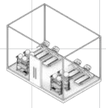

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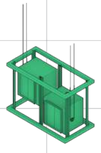

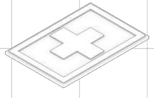

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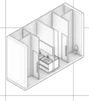
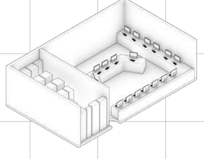
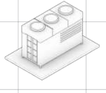
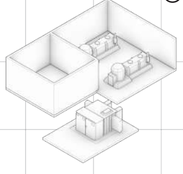
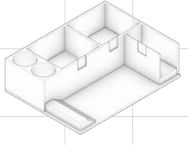

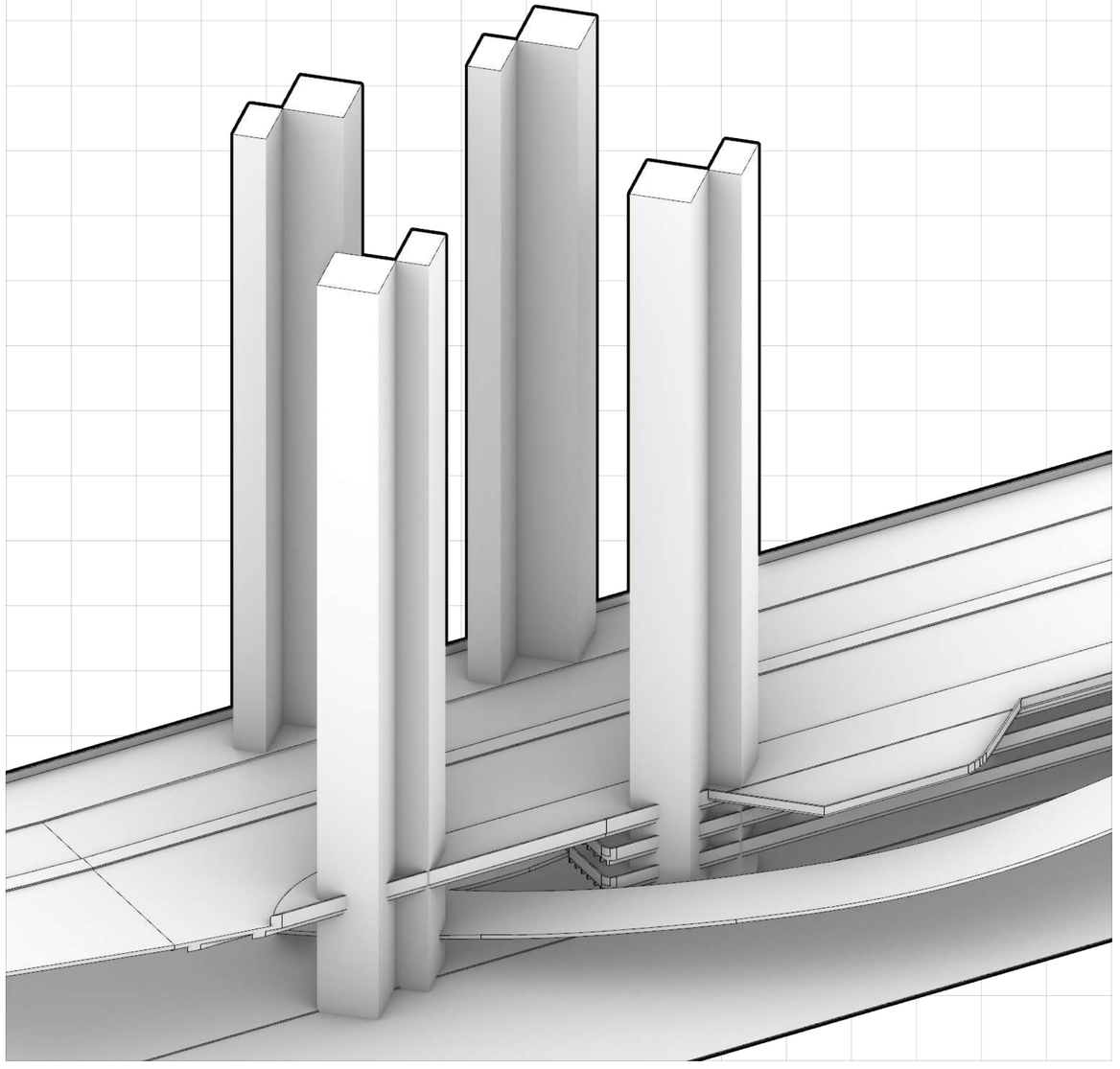

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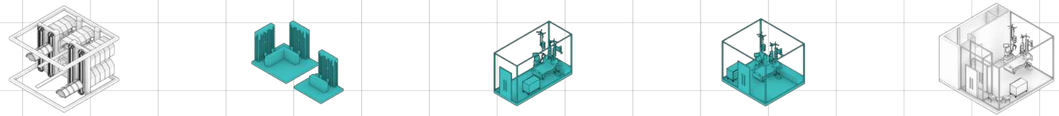

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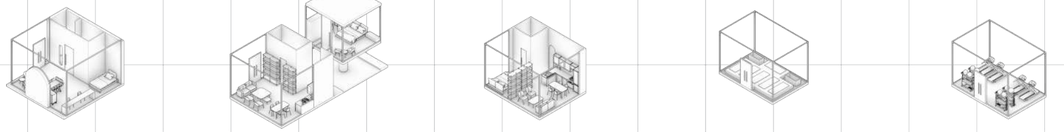

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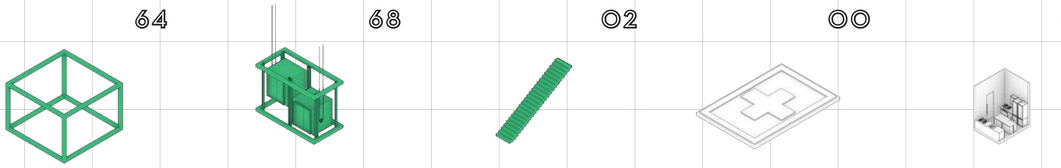

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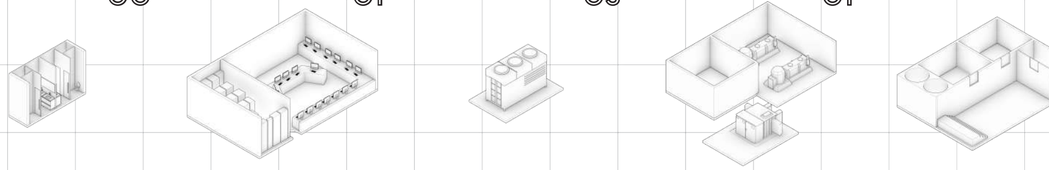

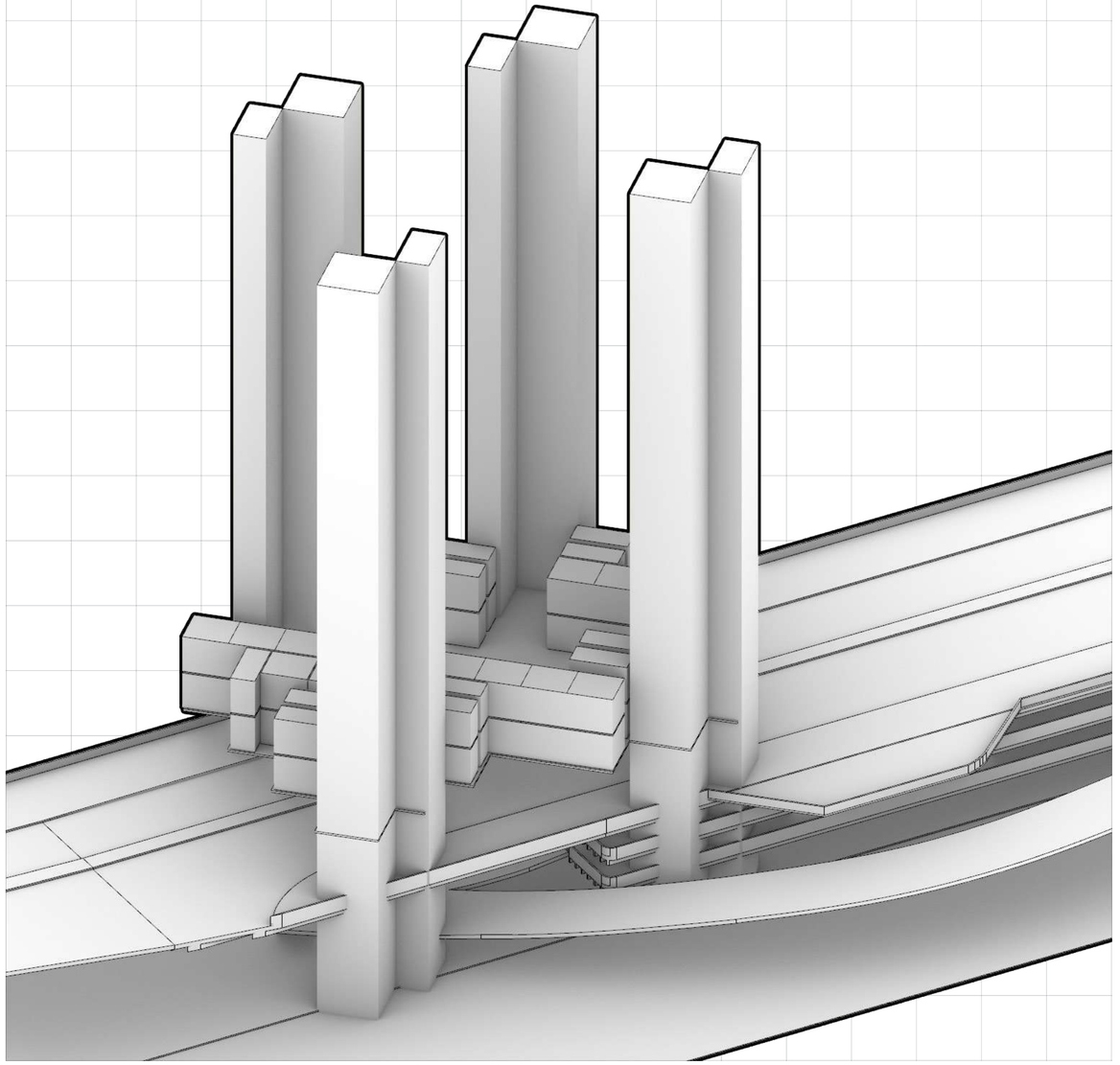

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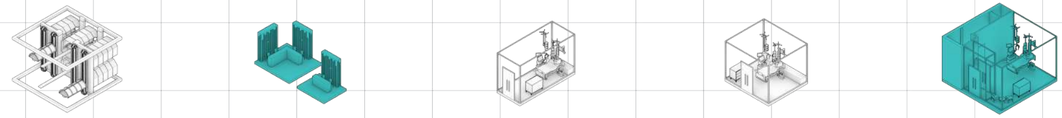

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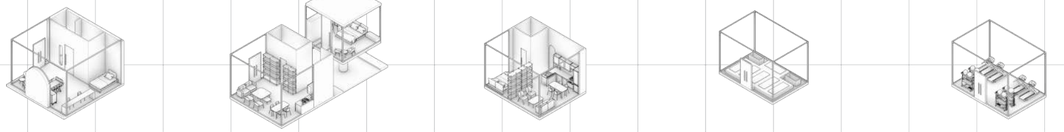

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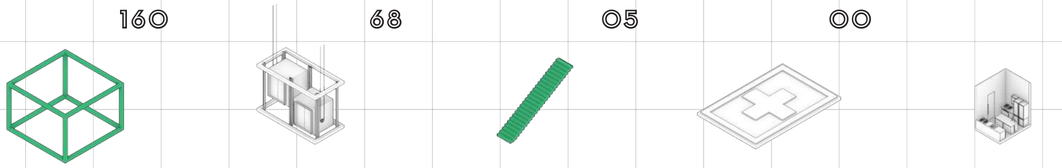

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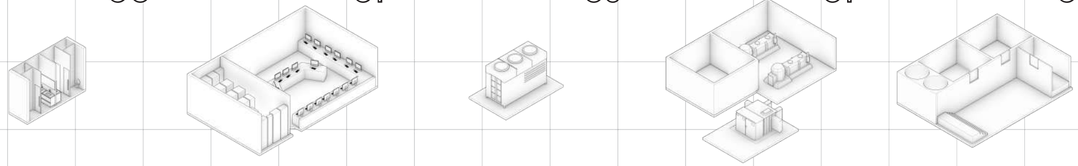

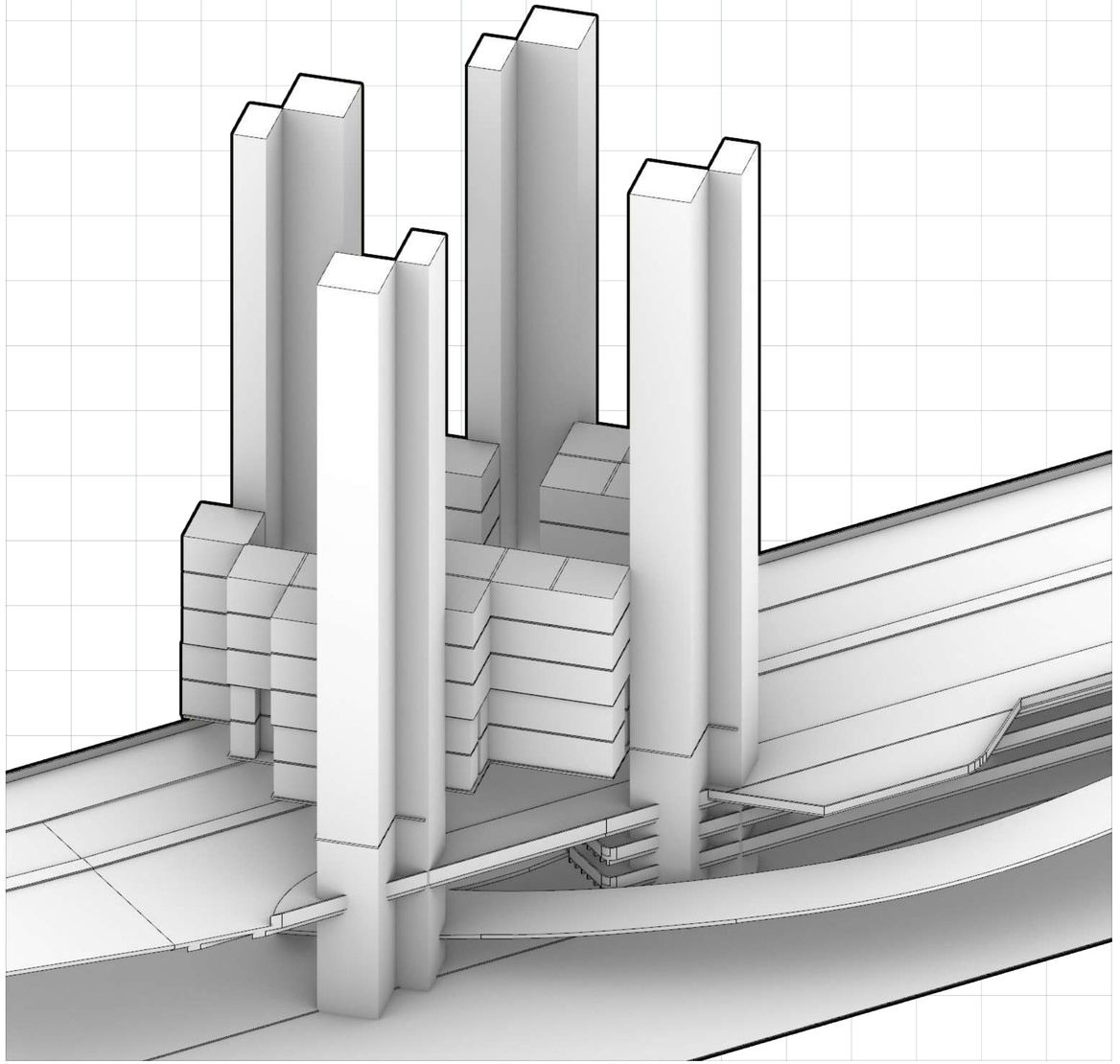

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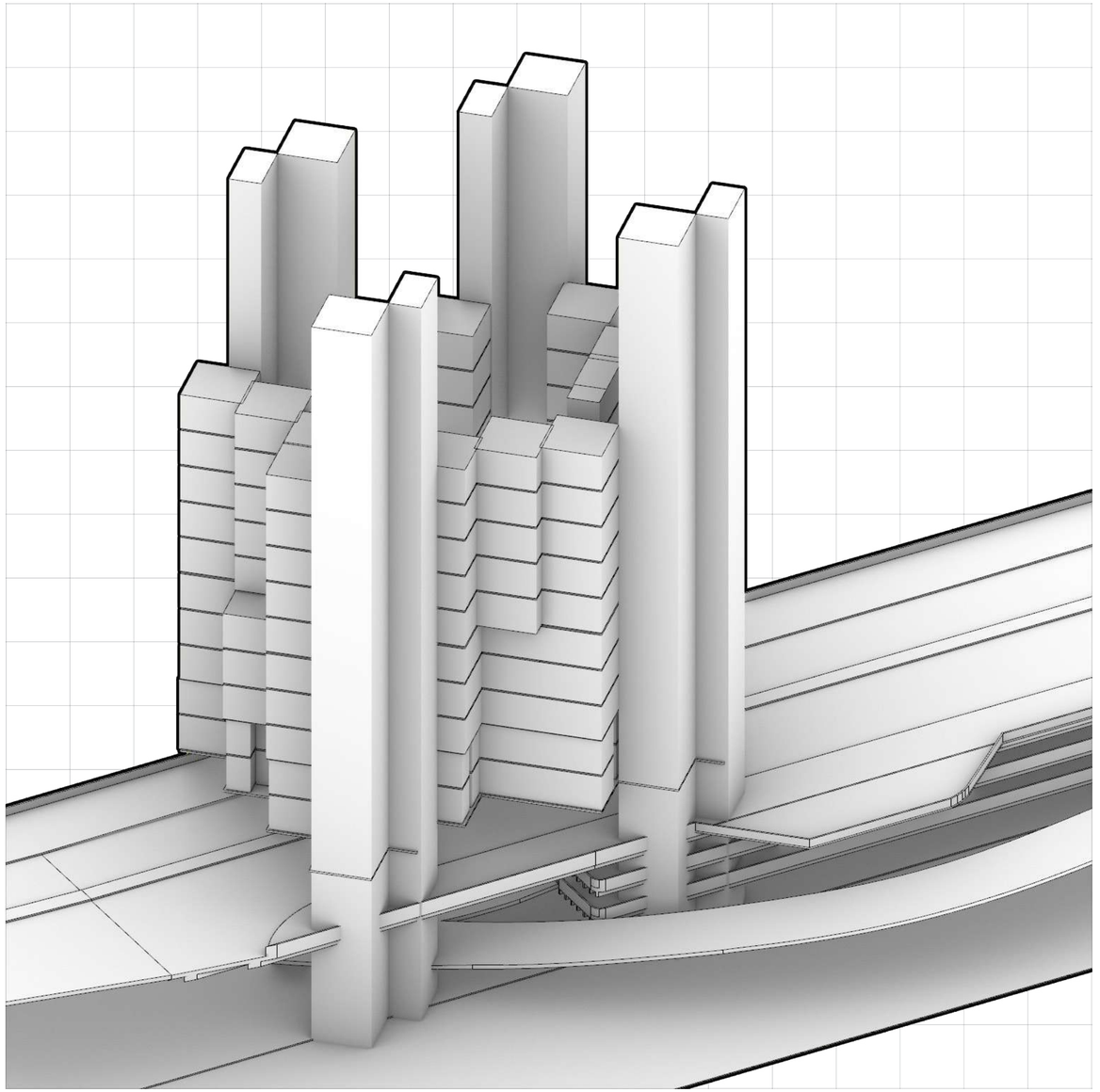

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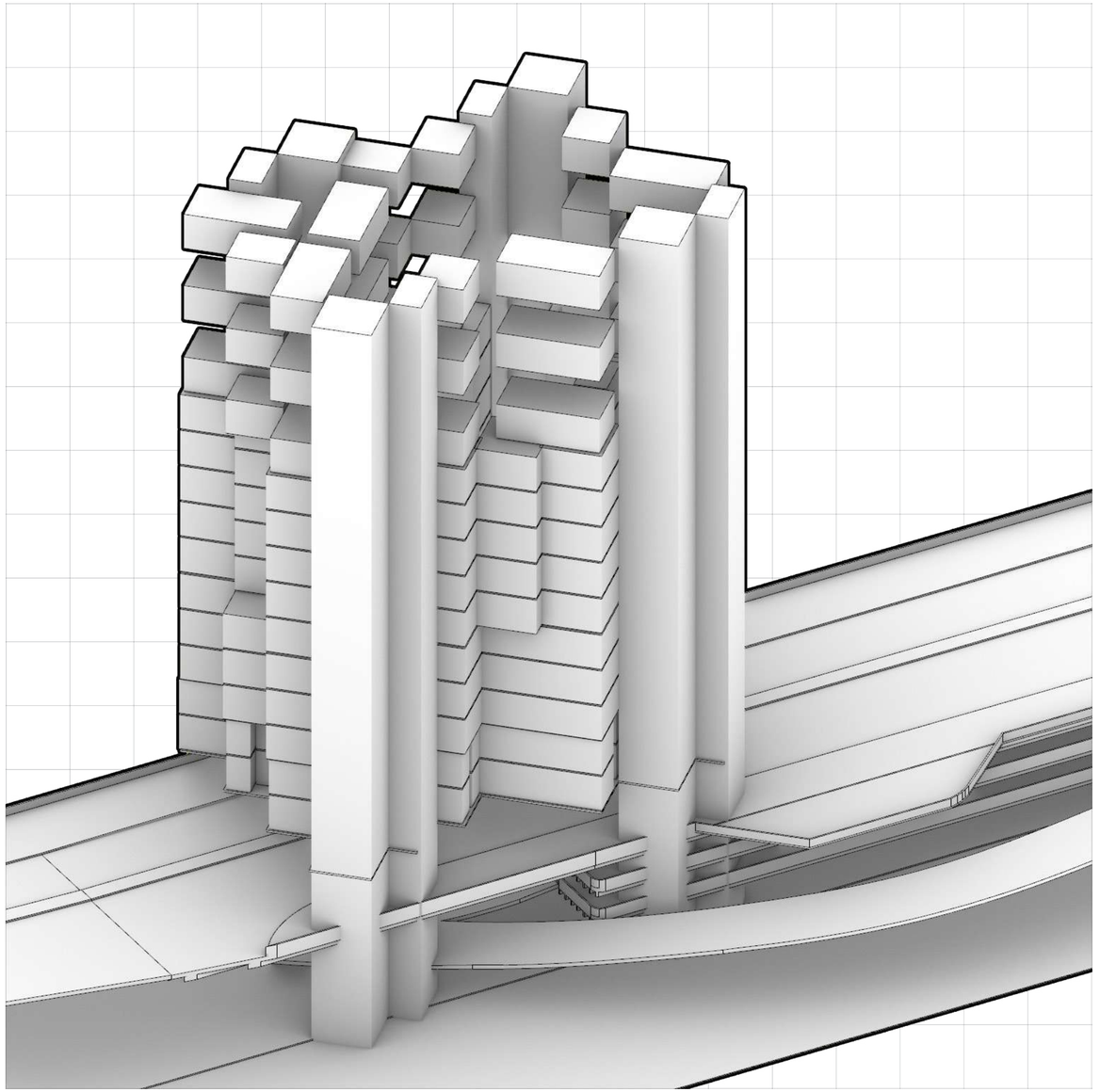

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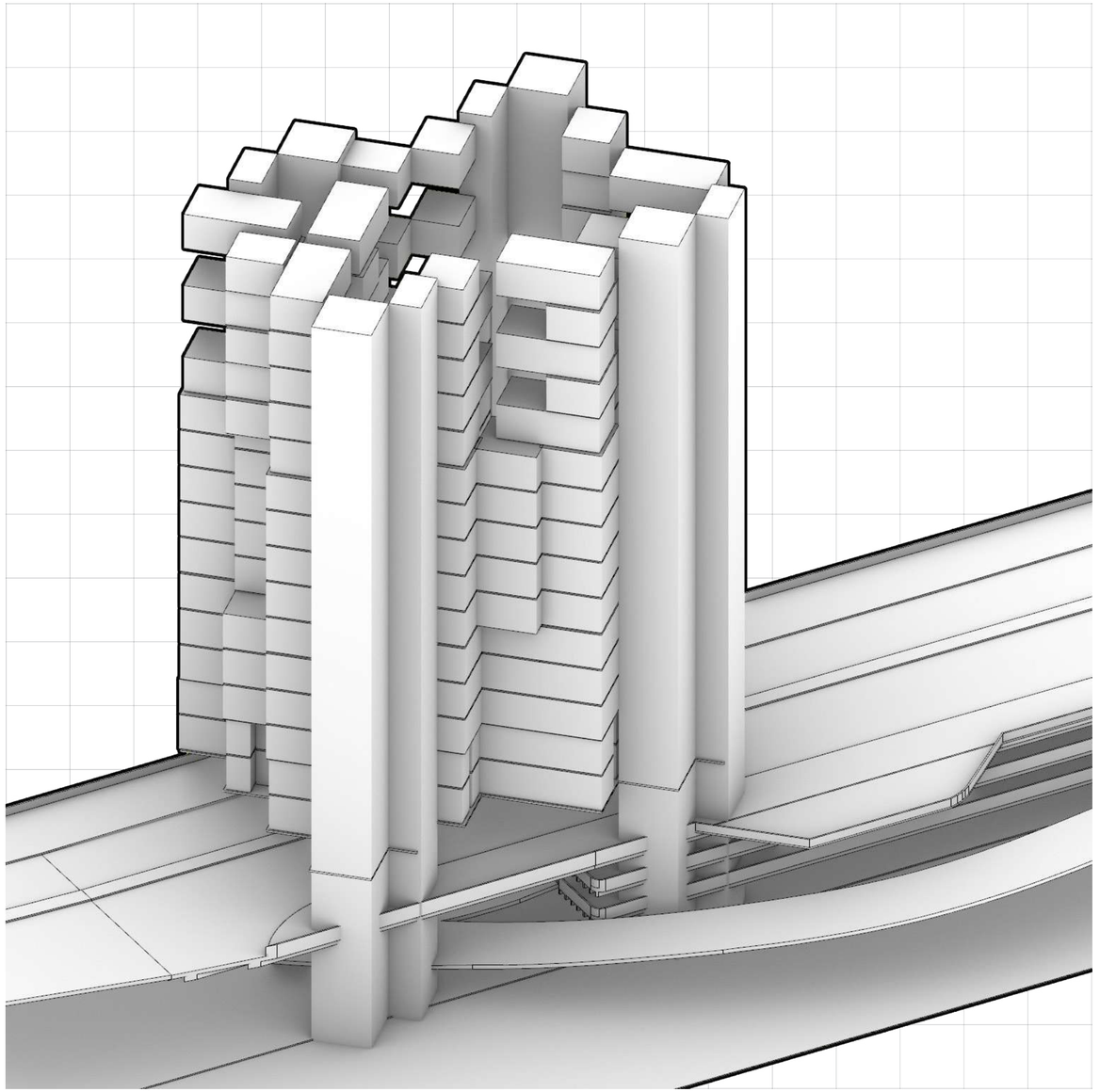

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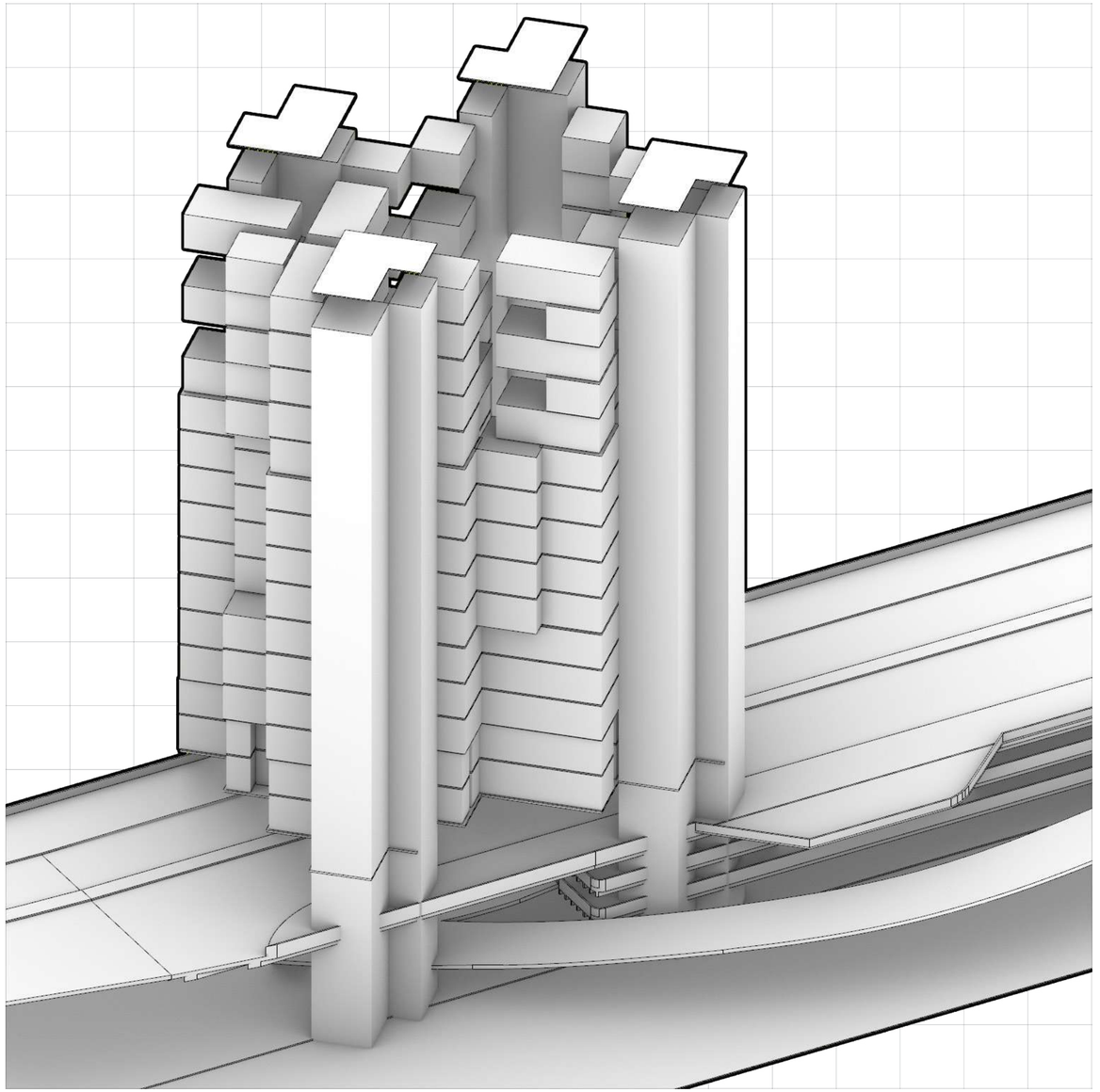

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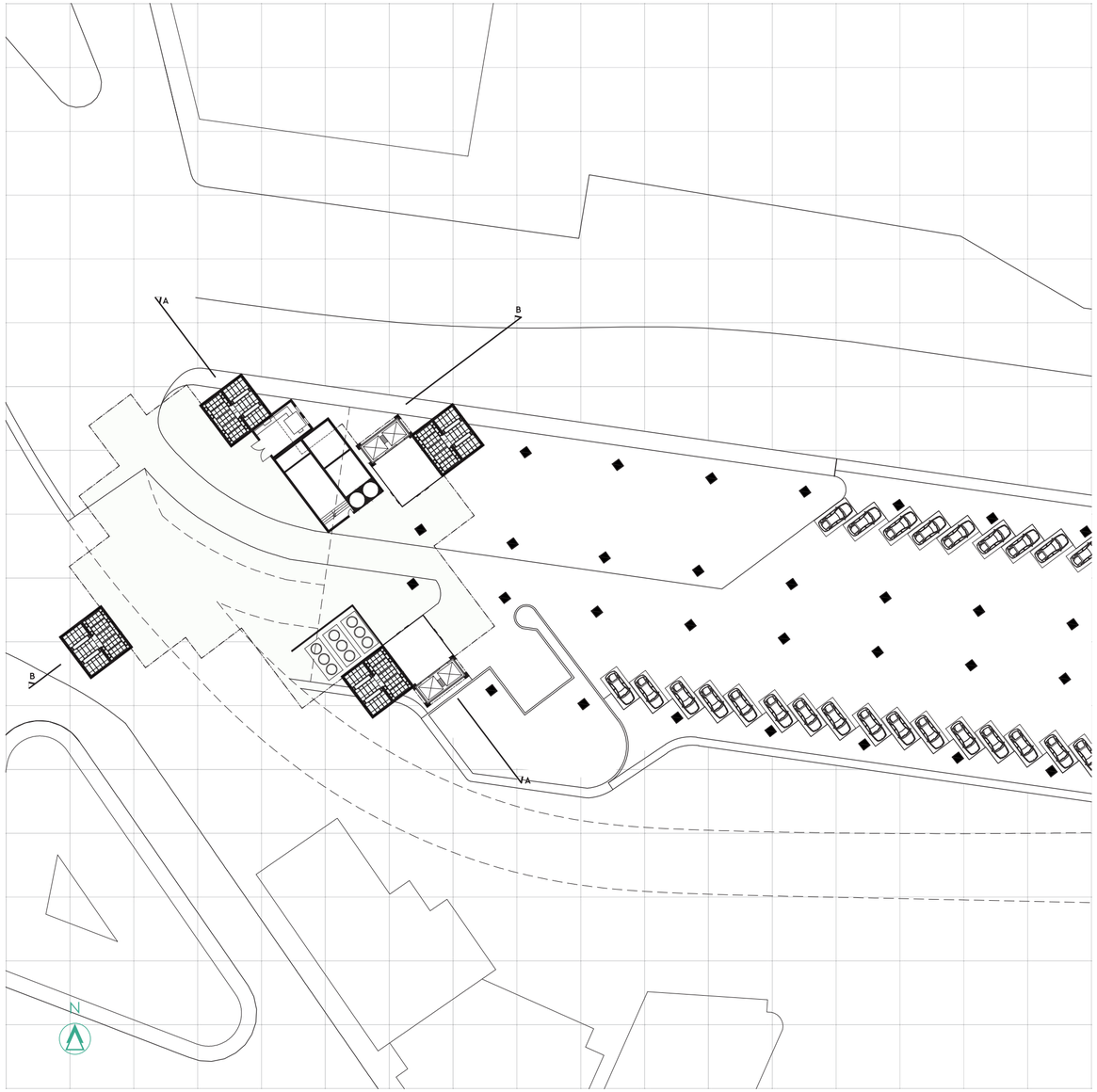
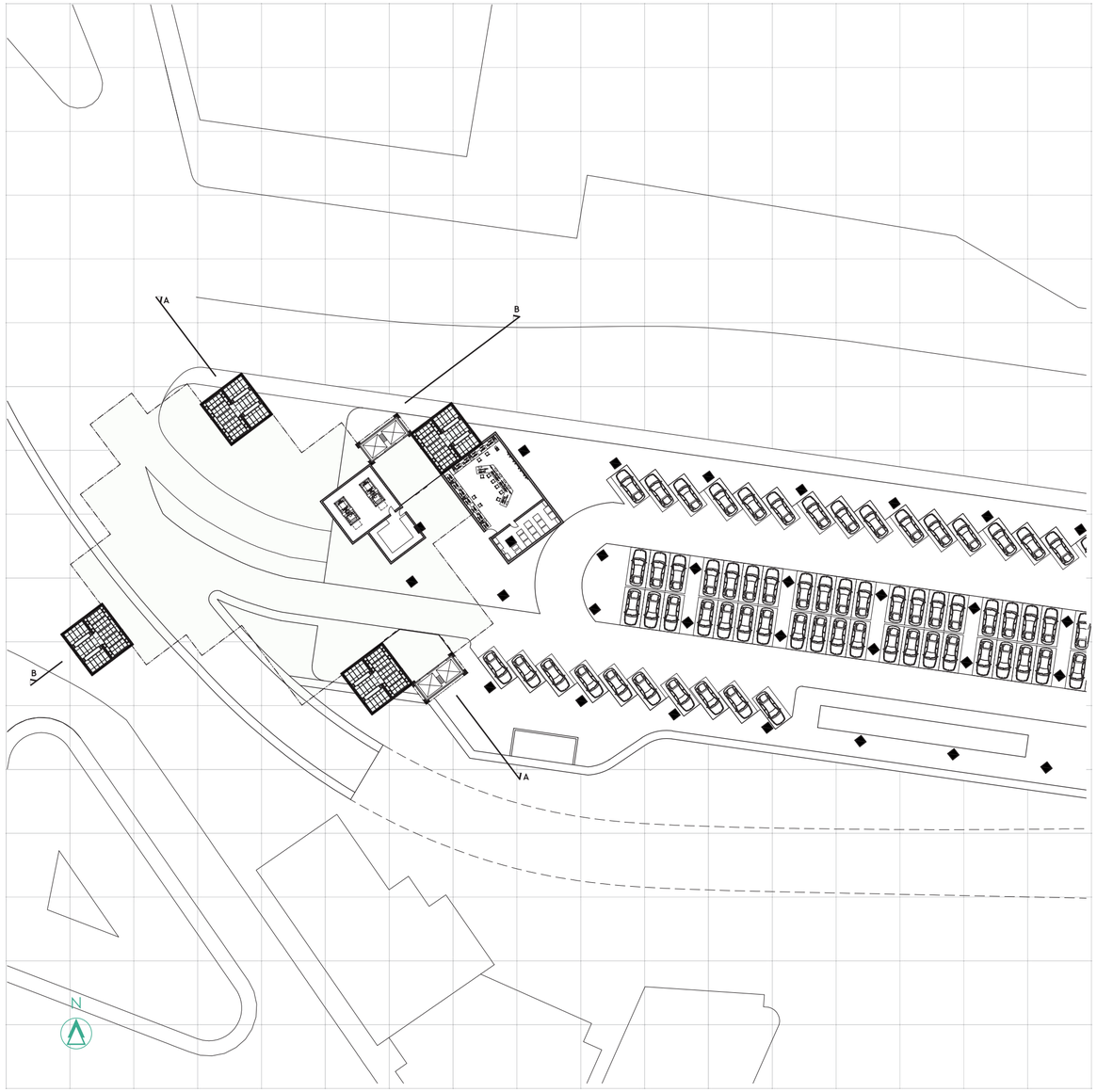
THE PILOT PROJ-ECT

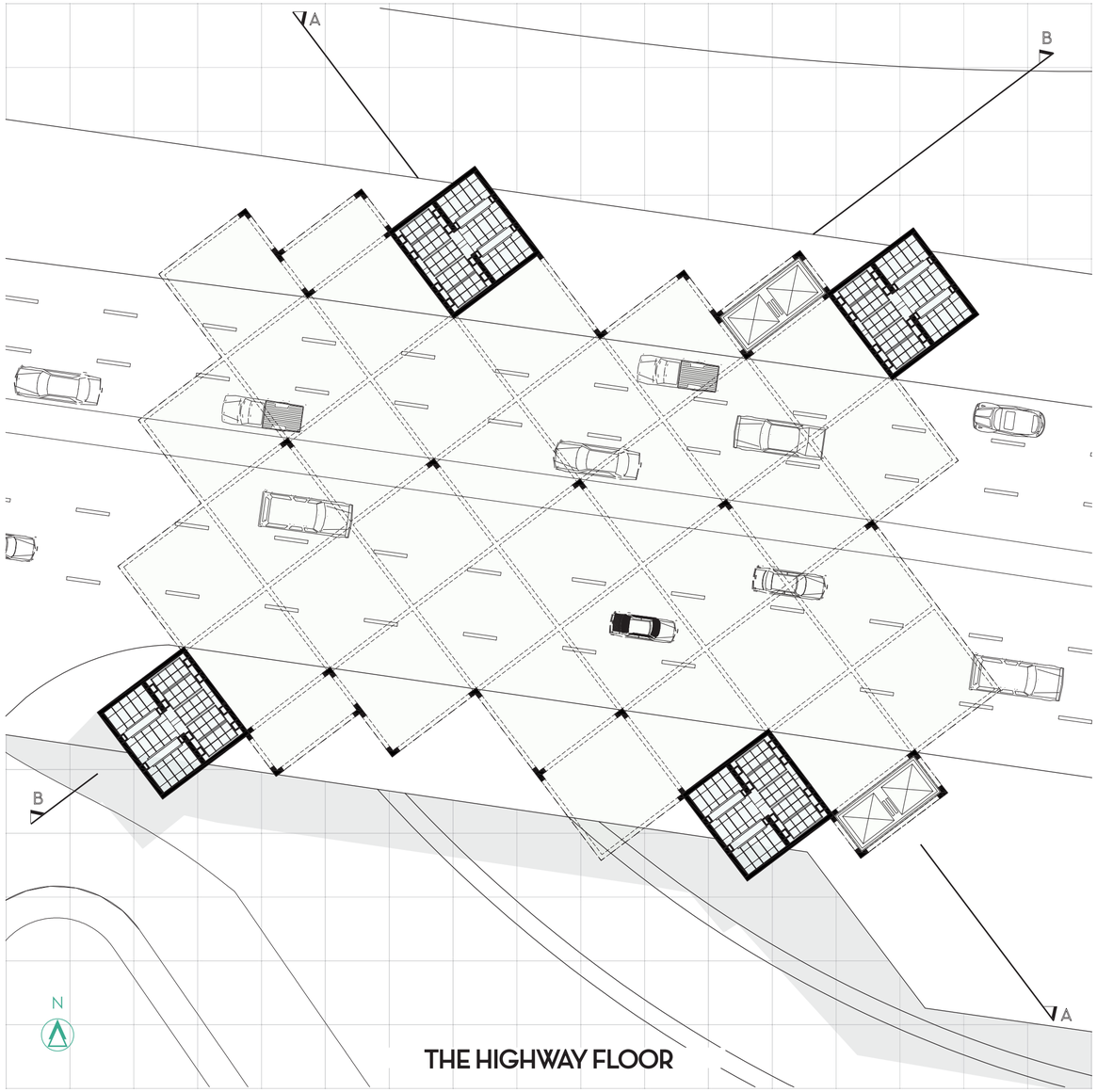
LOWER GROUND FLOOR SCALE 1/500



INTERMEDIATE FLOOR SCALE 1/500



GROUND FLOOR SCALE 1/250

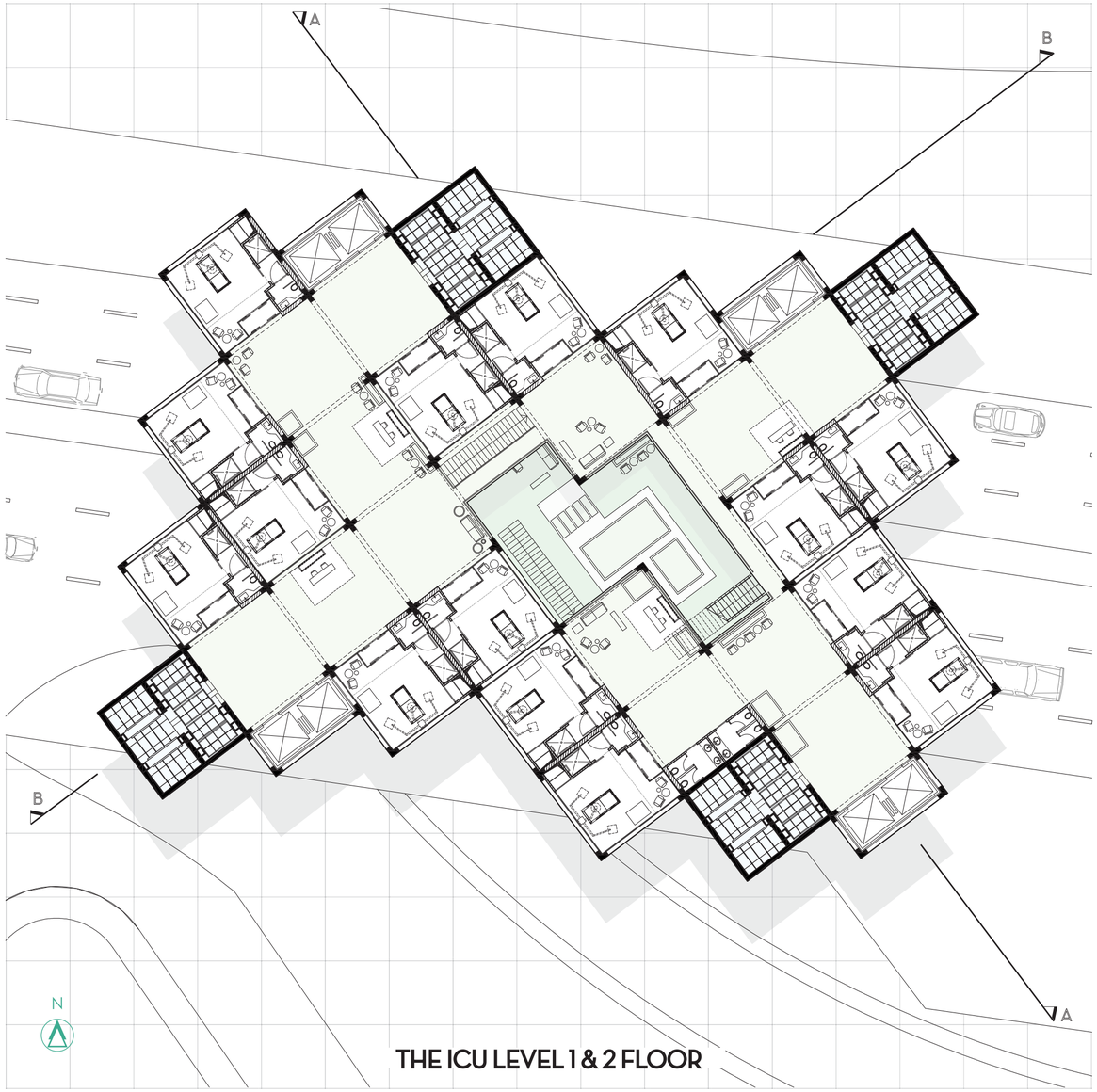


THE HIGHWAY FLOOR

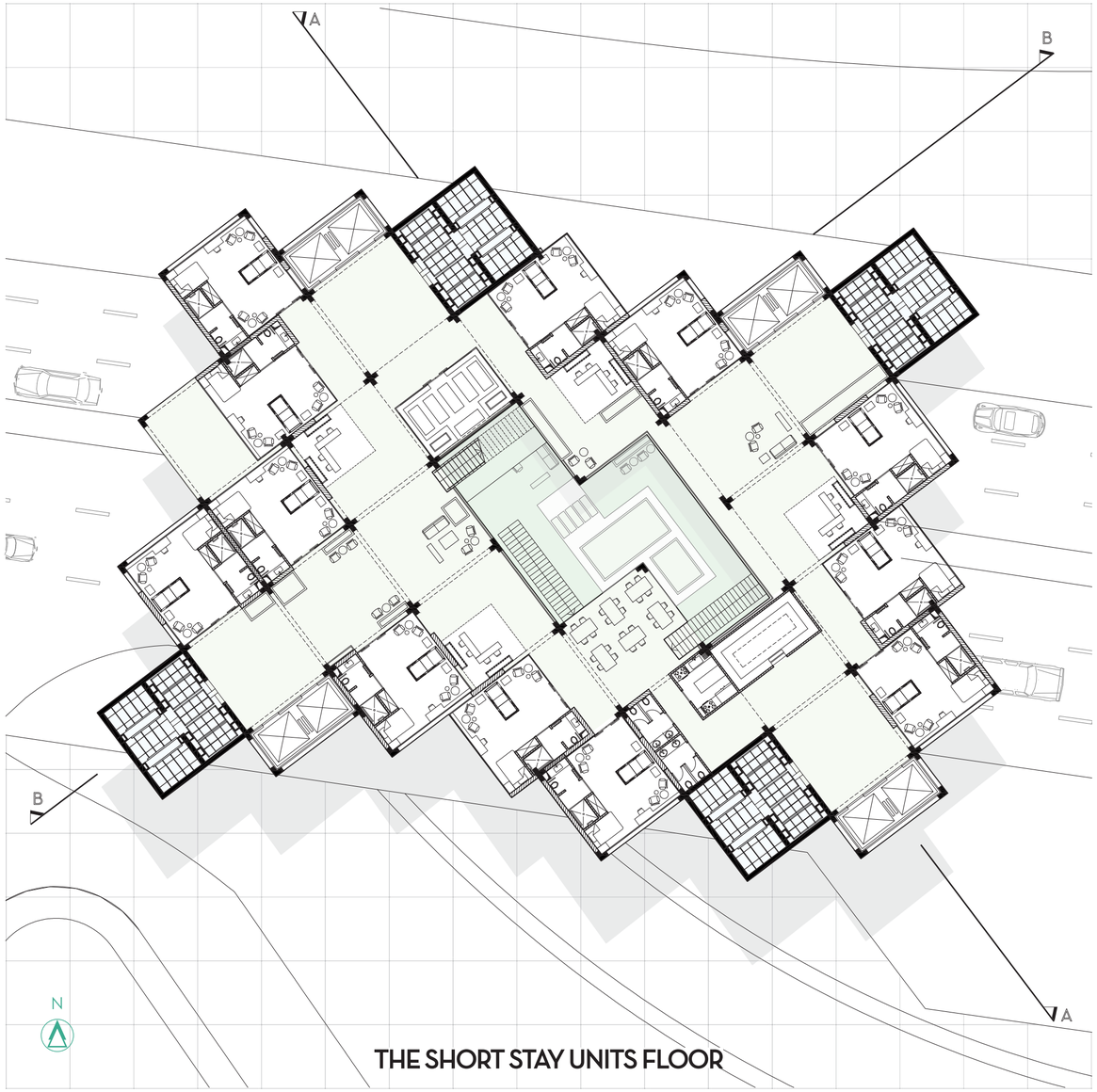
TYPICAL FLOOR PLAN LVL.1-2 SCALE 1/250

THE ICU LEVEL 3 FLOOR

TYPICAL FLOOR PLAN LVL 3-4-5 SCALE 1/250

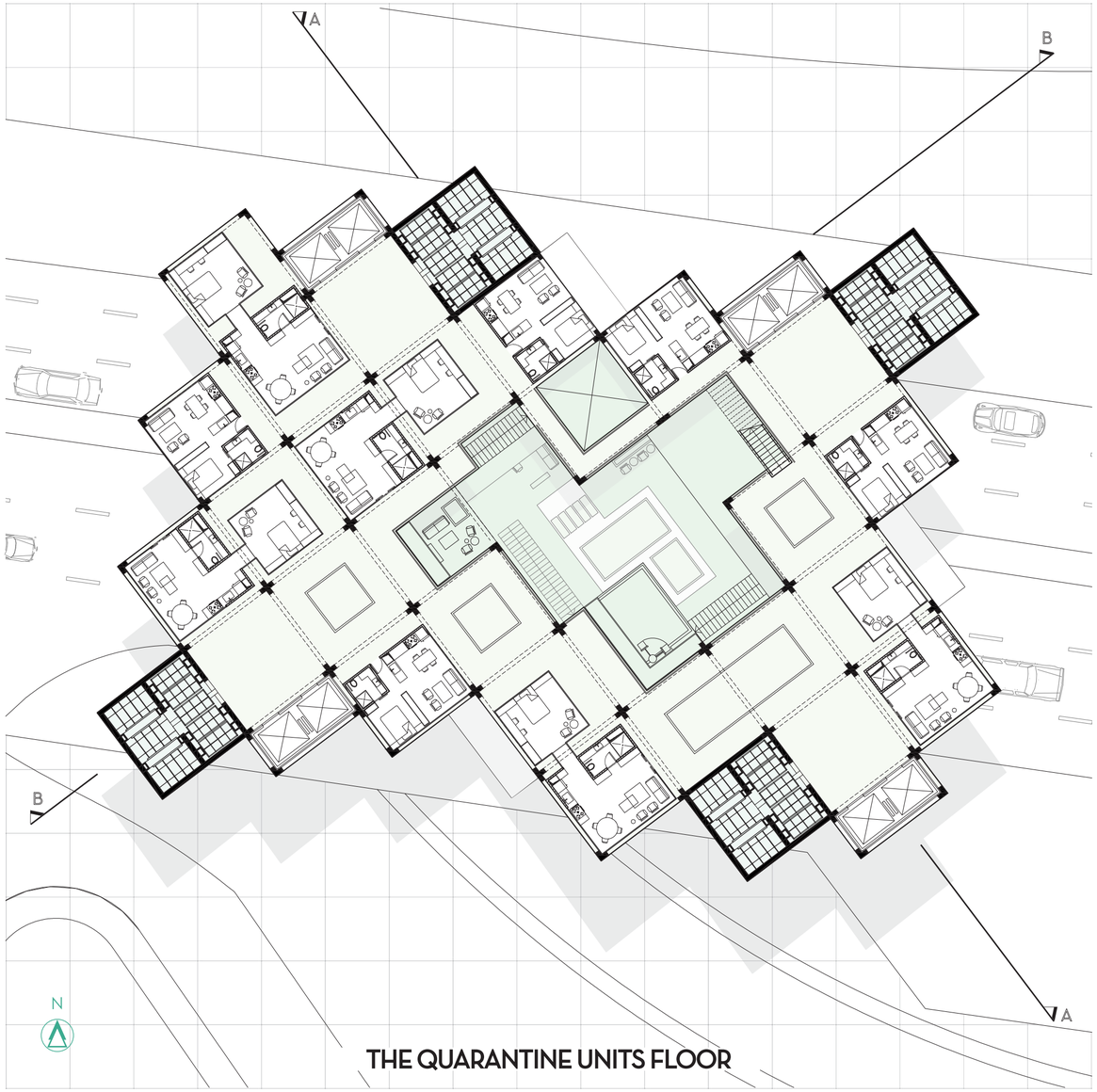


THE ICU LEVEL 1 & 2 FLOOR



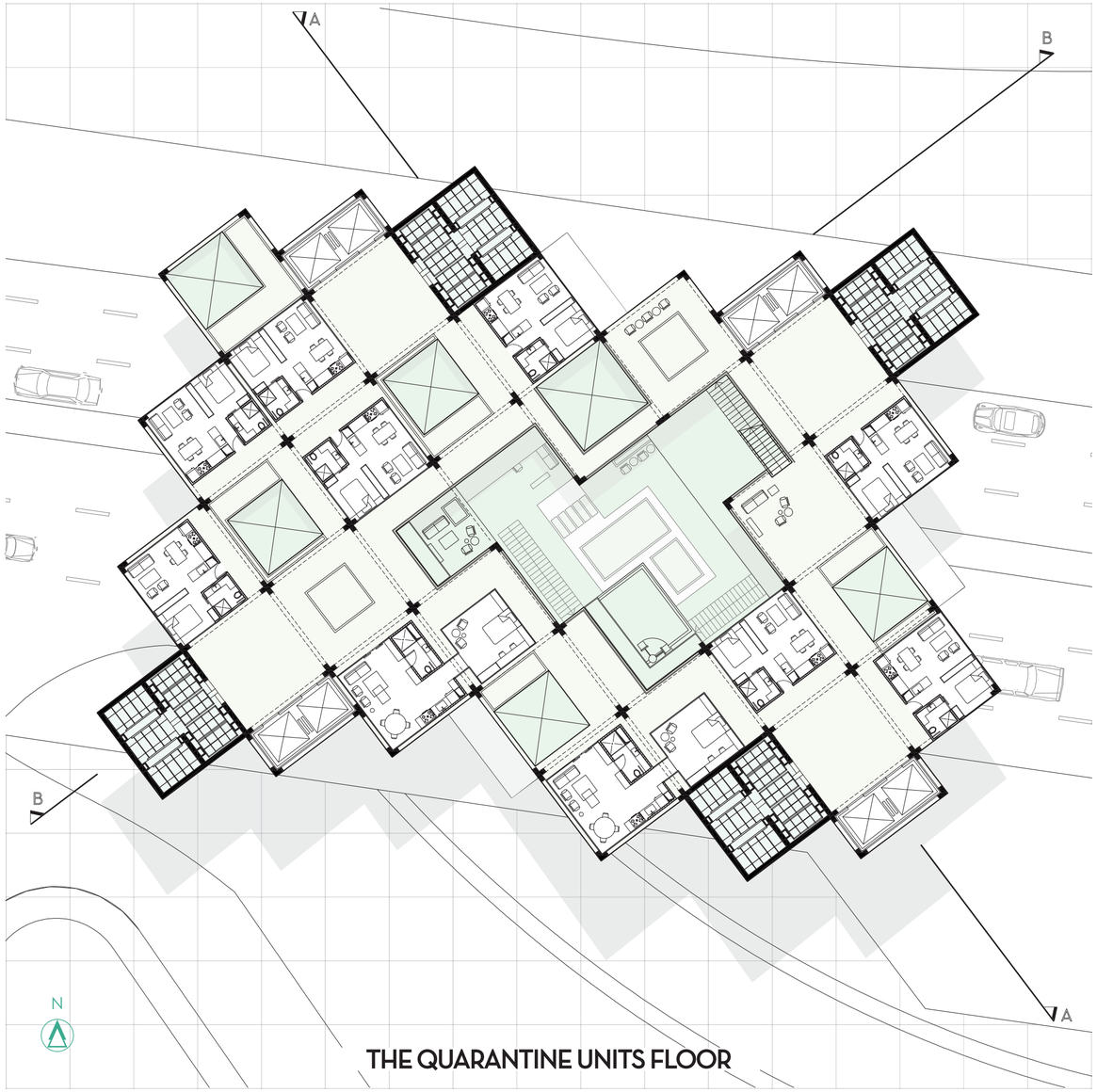
TYPICAL FLOOR PLAN LVL 6-7-8-9-10 SCALE 1/250

THE SHORT STAY UNITS FLOOR



TYPICAL FLOOR PLAN LVL 11-13-15 SCALE 1/250

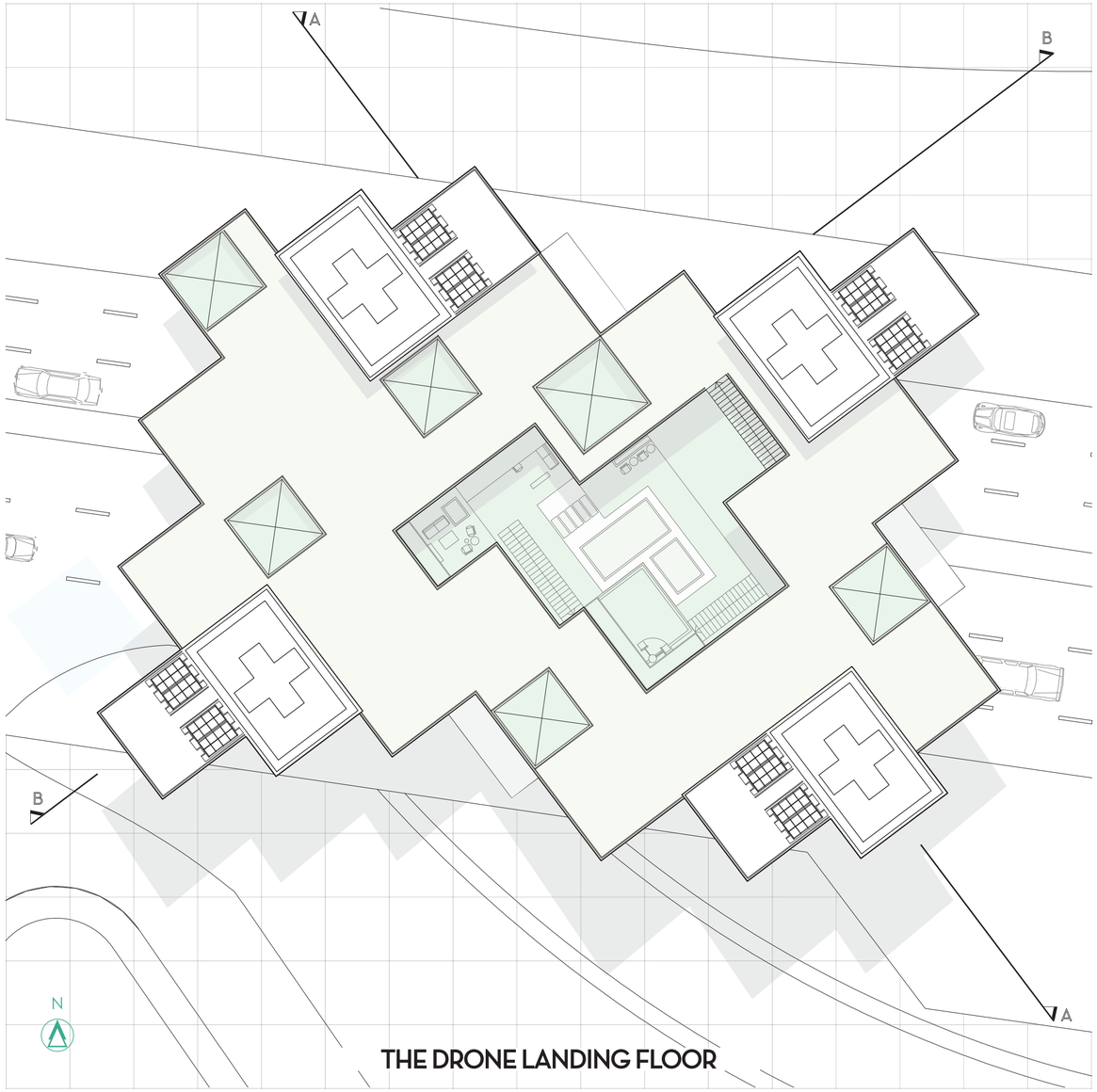
THE QUARANTINE UNITS FLOOR



TYPICAL FLOOR PLAN LVL12 - 14 SCALE 1/250

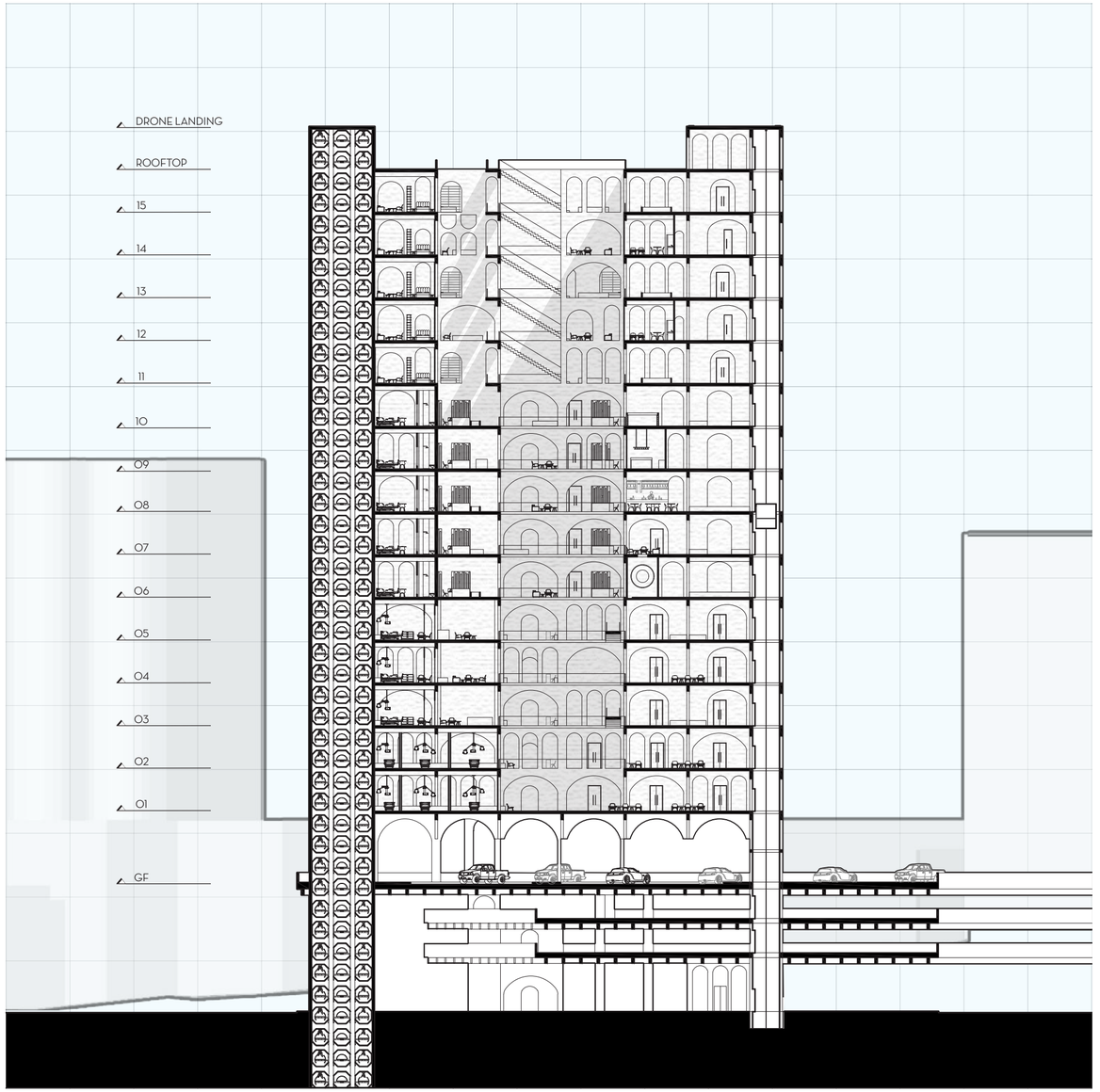
THE QUARANTINE UNITS FLOOR

ROOFTOP PLAN SCALE 1/250

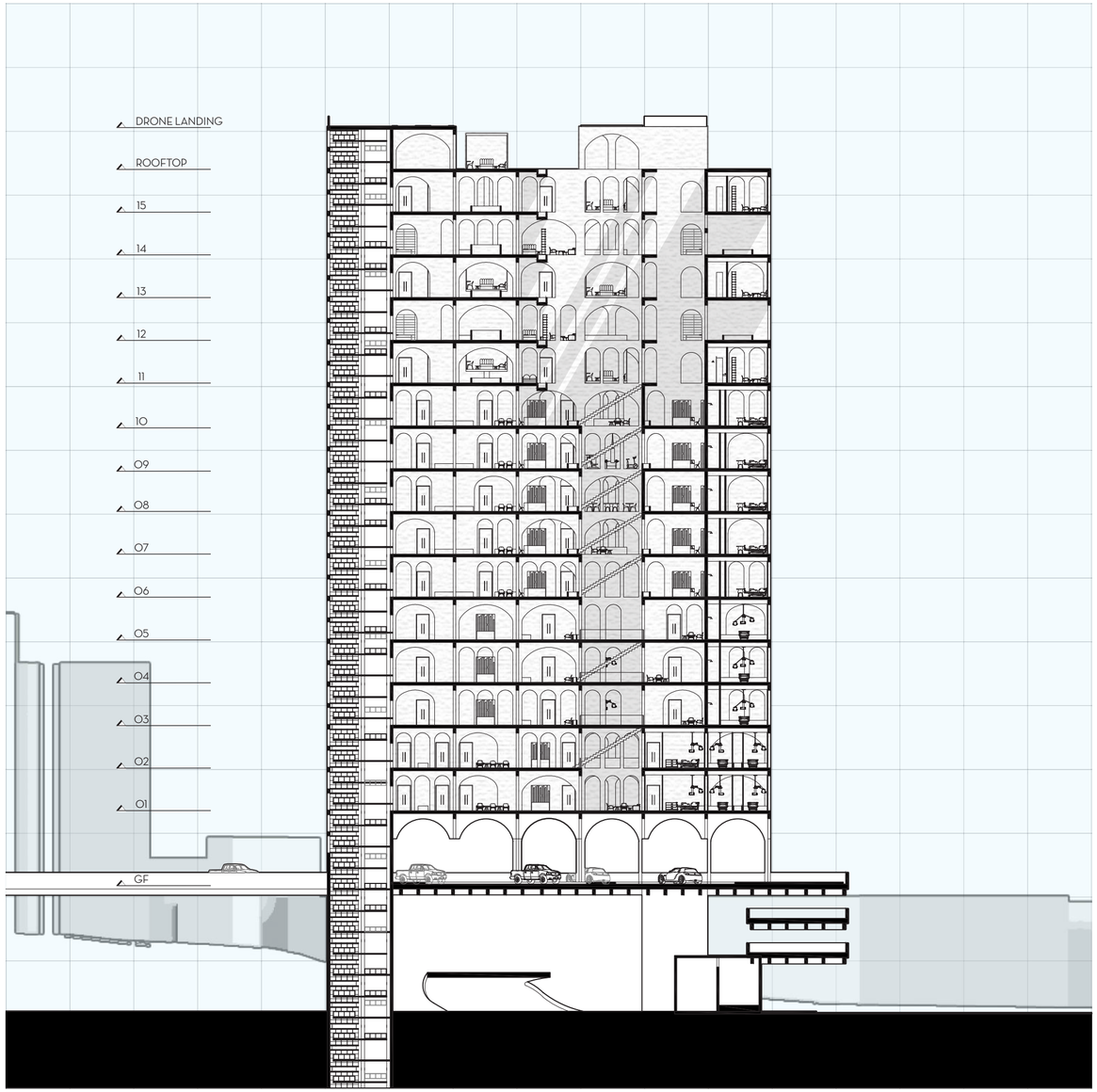


THE DRONE LANDING FLOOR

SECTION AA SCALE 1/400



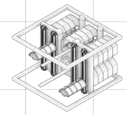
SECTION BB SCALE 1/400

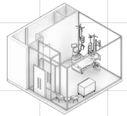
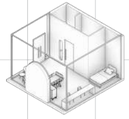
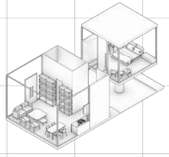
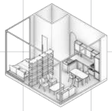


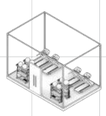
STREET VIEW

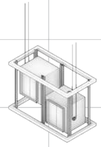
DRONE VIEW

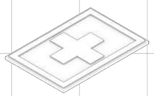
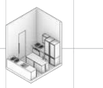
ATRIUM VIEW

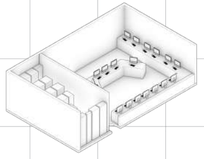
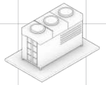
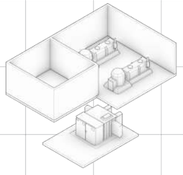
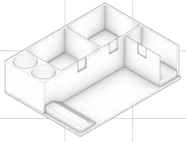






YOUR PROJ-ECT !

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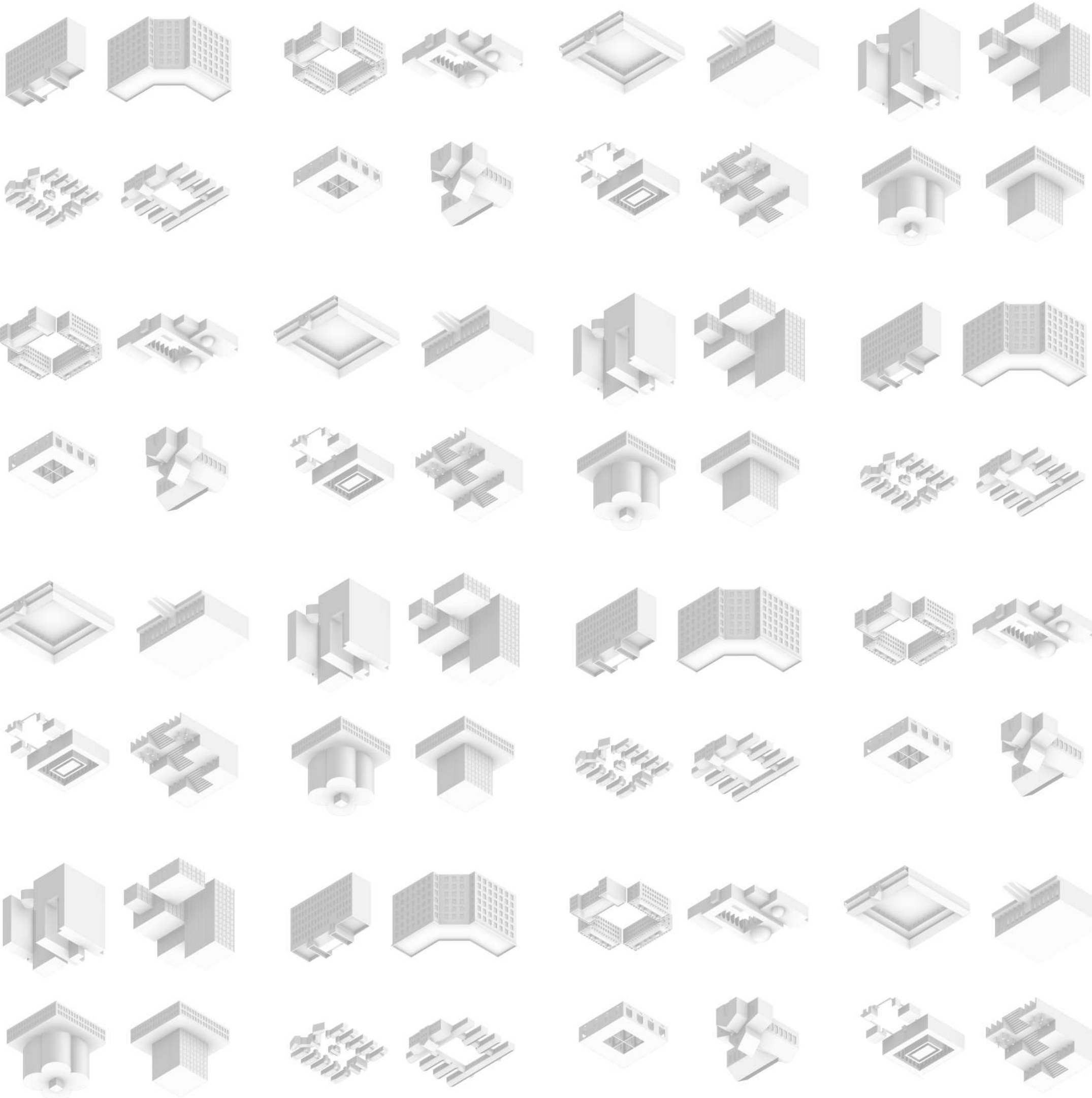
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