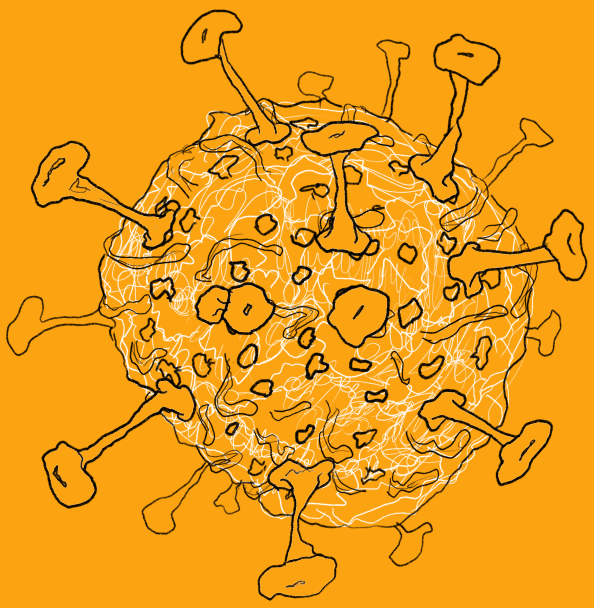

# 5 POINTS OF COVID ARCHITECTURE

Xin Zhong

Master of Architecture, Graduation Project

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# 5 POINTS OF COVID ARCHITECTURE

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Bachelor of Arts. Mount Holyoke College, 2018

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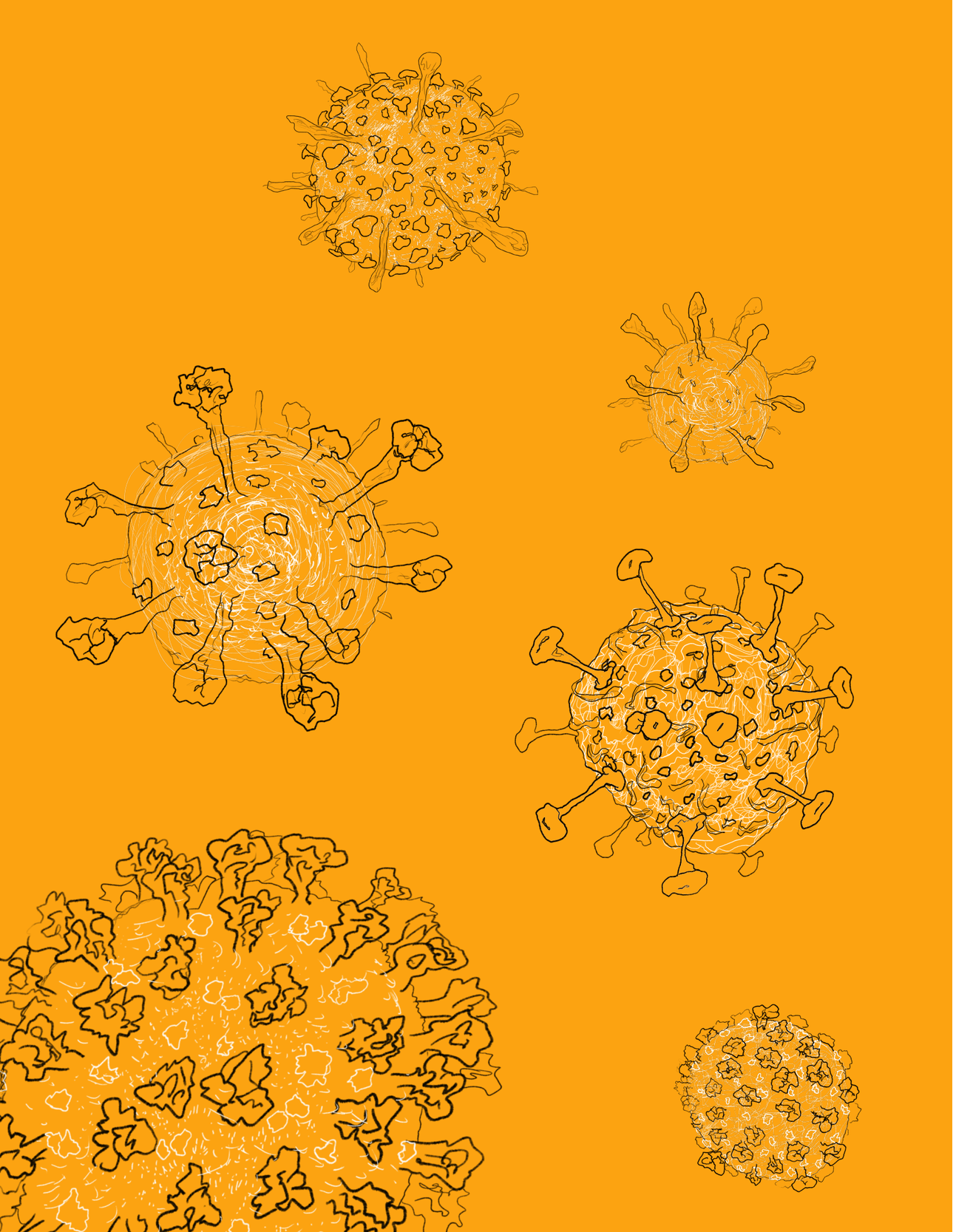
## Abstract

Pursuing hygiene is a survival instinct of all living creatures, including human beings. As human civilization developed, people learned to make tools, construct shelters, preserve food, treat diseases... The hygienic rules are no longer merely to keep us alive. From the most fundamental hygienic rules, there came health, comfort, privacy, and taboos, There isn't anything absolutely dirty, only matters that are out of place. To people living in different cultural and geographic backgrounds, and different time period throughout human history, the definitions of "out of place', cleanliness and hygiene can be drastically different. These different hygienic rules shape the built environments into different forms. European cities built before the discovery of microorganisms were very different from those built after the discovery. Beatriz Colomina argued that 20th-century European modernism was shaped by tuberculosis. The cure for this disease, fresh air and sunlight therapy, and the diagnostic technique, X-ray, gave the architecture large windows, round corners, transparency and smooth materials.
Looking at history and analyzing the mechanism behind the changes, this project intended to imagine architecture shaped by a different set of hygienic rules, from the private dwelling unit, to a building, and to a city.



## Thesis Statement

If COVID, a disease so different from tuberculosis, becomes the driving force, how should the guiding principles of architecture change accordingly? I've listed 5 points of COVID architecture: porosity, bubble, distancing, anteroom, and cross-species companionship. This project explores architectural visions of an imaginary city built to fulfill these 5 points.



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AND...

The COVID-19 pandemic. My design project is based on you.

## Introduction

If I were asked to recall the happiest memory from my childhood, the first event I can think of would probably be playing in the forest and pasture right next to my grandparents' countryside home with a couple of close friends. I don't remember their names, but I clearly remember that we could stay outside for more than 10 hours without re-entering our houses (or even the town). We played with mud, fallen leaves, nontoxic insects, and dried cow dung (which has no odor at all, only a fresh scent of grass). When we needed to release ourselves, we dug a hole that followed the shape and dimension of a common squat toilet. None of us felt bashful when digging the holes and peeing or pooing in front of friends (we would cover our excrement). And none of us thought mud, fallen leaves, or nontoxic insects were dirty.

I cannot remember what changed me, but one day, some years after I left my grandparents and moved into the city to live with my parents, I realized that I was scared of spiders and dragonflies,  and was disgusted by mud. And of course, my new friends and I did not release ourselves together (we would walk to the bathroom together, even holding hands, but enter different toilet stalls). I was stunned by the fact that I had made a 180-degree change and started to think about the reason behind this: I was scared of bugs because I thought they would bite and poison me, or spread disease; my friend and I started to be disgusted by seeing and smelling the excrement from other people, even closest friends. In sum, both insects and excrement (and the action of excreting) were dirty.



At 16, I went to a high school in Costa Rica, a tropical country with uncountable insects and reptiles. My daily encounters with these little "dirty" creatures changed my perception again, I would only be scared and disgusted by the poisonous ones. At the same time, I found that I no longer went to the bathroom with my friends. The travel to the bathroom (being exposed to other people's sight) became unclean.

I realized that my definition of dirty and clean is always changing.

Is it just for me? Or does it apply to everyone throughout history?

We know that people invent new things and improve old ones to fulfill their needs. The need for fresh air ventilation made people puncture holes on walls,  the need for cleaning oneself made aqueducts and baths, the need for moving liquid waste away from living quarters made sewage systems. Going back to my personal experience, I have seen the squatting public toilets with no partition panels, once dominant in China, gradually disappeared. They were replaced by ceramic squatting toilets inside individual stalls. And then, American style public toilet (ceramic sitting toilets, high water level, bowl inclining to the back,  in a private stall) appears more and more in the shopping malls and airport in Chinese cities. Some people advocate the American toilet, praise it as the more modern, advanced, civilized toilet; while more people hate it in the public realm because sitting on the toilet that has been touched by strangers' butts is essentially touching their butts with one's own butt, very gross, very unhygienic.

If the definition of dirty and clean is changing, will the built environment

change with it?

And this year-long project of dirtiness, hygiene, health, diseases, and of course, architecture, began...

Figure 1: Author. Dirty Childhood. 2021.

Made from an old ragged bed sheet, used coffee ground, toilet paper core. When we ("we" means I and a couple of my friends) were small, we did not have the same notion of cleanliness and dirtiness as we have now. We did not mind mud, old water pipes, layers of fallen leaves and bushes. We also didn't mind going to the bathroom and pooping with our friends. Friends' excrement and smell are much cleaner than the ones of strangers and enemies.

## Chapter 1: Pursuing Cleanliness,  a Survival Instinct

In a human-centric environment, one might be told that only human beings know how to behave, including cleaning in a certain way. Pets are dirty, don't let them get too close to you. At least, that was what the elder members of my family taught me. However, if a person ever kept a pet and really observed its behavior, one would notice that these animals naturally know that they should clean themselves and how to perform the process of cleansing. Cats lick their fur, bury their excrement; dogs lick themselves too, and they bathe in rivers; some birds, such as parrots, shower in water puddles and light rain; chickens and some rodents (hamster, chinchilla) take a sand bath. These animals do not have such a complex set of aesthetic and courteous rules as human beings. Their cleansing behaviors are a key to survival: cats always try to cover their smell, leave a minimum trail of existence to the predators, birds bathe to soften dirt on feathers and to make preening easier.

Virginia Smith claimed in her book Clean: A History of Personal Hygiene and Purity that "There can be no disputing the link between cleansing and survival. Survival is the main aim of the organism"[1]. Here, the word "cleaning" refers to a multi-level, multi-meaning activity that appears naturally inside and outside of a living being's body. There is the microbiological cleansing starting in the cells that removes poison and metabolic waste, and the homeostatic self-defensive system that connects the body to the external world and protects the body from external

Figure 2: Author. Bathing Parrot, Chinchilla, Dog and Cat. 2021.



dirtiness[2].

The latter involves the brain processing neuro signals generated by sense organs. The brain detects danger, tells the body to defend itself by avoiding, attacking, or cleansing (washing with water, vomiting and etc.). It has complex psychology involved. What we hate, fear and disgust can often be traced back to the survival instinct.

Take trypophobia (definition from Oxford dictionary, n. extreme or irrational aversion to or fear of clusters of small holes or bumps.) as an example. A study by Geoff G. Cole and Arnold J. Wilkins has shown that participants who reported trypophobic did not fear or disgust all the images that consisted of clusters of holes and bumps, participants who reported non-trypophobic could fear or disgust certain images in a way similar to trypophobic reaction. The more spectral features an image shared with venomous organisms, the larger chance that it would cause trypophobia. They argued that trypophobia was caused by the survival instinct to avoid venomous organisms[3]. "Venomous organisms" include animals, insects, plants, and non-living objects such as carcasses. They are not good or bad, just lethal to human beings. If we explain this phenomenon with Darwinian evolution theory: ancient human beings without the natural aversion to these venomous organisms were extinct, only those who had the aversion survived. Modern human beings, the descendants of those survivors, carry the gene that gives them the survival instinct.

Valerie Curtis and Adam Biran's study, published in 2001, interviewed a large number of participants in Africa, India, the United Kingdom,

the Netherlands, and in international airports. The interviewers asked the participants to form a list of things that they considered disgusting. Despite the drastically different cultural backgrounds and geographic regions where the participants came from, their lists had one item in common: bodily secretions, including feces and body parts like nails and sexual fluids[4]. The researchers analyzed the relationships between common diseases and the items on the list of disgust, and found a positive correlation. Human feces was reported to carry more than 20 bacterial, viral, and protozoan that could cause serious infection and might lead to death[5].

To briefly conclude this chapter, a living being cleansing its body is a naturally appearing survival technique. Cleansing takes different forms in different species under different circumstances, including removing waste and preventing contact with dirtiness.

# Chapter 2: Hygiene as a Set of rules

## 2.1 Out of Place, Disorder, Taboo

We know that all species have their means to avoid dirtiness. From the aspect of survival, the word “dirtiness” means any entity that could be a lethal threat to a living creature: venomous reptile, excrement, parasite. Its definition is very easy to understand. However, when we look at human beings, “dirtiness” and words related to it, such as “hygiene” and “cleanliness”, are much more complicated. Hygiene is not always black and white, irrefutable. Of course, fatal threats to human lives, such as high concentration pm2.5, Covid-19, and the ebola virus, are irrefutably not hygienic. I cannot and do not want to argue against that.

As human civilization developed, survival was no longer an individual’s major goal — the word “individual” here means people who had a stable supply of food and shelter; not everyone had this privilege; there were always people who had to fight every day to survive. Accordingly, the defense system has developed into sets of rules that tell people when and how they should clean their bodies, how much physical distance they should keep from each other, which smells on the human body are acceptable, how one should organize and decorate one’s dwelling space and etc. There came the standards of beauty: cosmetics, perfume, clothing. Personal hygiene, interrelated with beauty, had been associated with power. This new definition of hygiene could be seen as “the proverbial state

of health, wealth, and happiness"[6].

Hygiene or cleanliness is beauty, health, wealth, and happiness. Then the meaning of dirtiness can be deducted very easily: the antonym of these words. But what really is dirtiness? What is behind our reaction of disgust and fear?

I strongly agree with British anthropologist Mary Douglas' definition of dirtiness "Dirt is essentially disorder. There is no such thing as absolute dirt: it exists in the eye of the beholder."[7] and "If we can abstract pathogenicity and hygiene from our notion of dirt, we are left with the old definition of dirt as matter out of place."[8] Dirtiness is the thing that is out of its designated place. The simplest example would be coffee. Coffee is an aromatic and enjoyable liquid only when it is poured into a food-safe container, a ceramic mug, a glass, cappuccino cup. When coffee is poured onto your table, bed, books, or anything that is not meant to hold drinkable liquid, it is dirt called "coffee stain". Another simple example, oil paints are beautiful in the jars and on the canvas as a part of a painting, but when you accidentally get them on your nice woolen sweater, they are dirt.

The designated place of something is defined by the rules evolved from human beings' natural tendency to set an order and to exclude ambiguity. Taboo also originated from this set of rules to protect people from the items out of place, or to prevent people from creating the items out of place. Mary Douglas stated in the preface "Dirt is Dangerous"  that " Taboo protects the local consensus on how the world is organized. It shores up wavering certainty. It reduces intellectual and social disorder."[9]

Figure 3: Author. Paint Stain on My Sweater. 2021.

Again, to understand this idea in the simplest way, I use my own living habit as an example. I am not a tidy person. I never organize my clothes, plants, and food packages in the order of color or height (while one of my friends, who is also a SALA student, does this). However, I have noticed that my tolerance of untidiness has a threshold, which is: though items can scatter on the table or shelves, they have their own place to be: books and paper are always on the same table, food products and dished on another table, all my shoes are placed in the alcove behind the door. Besides this, I can't tolerate stains and hair on the floor. My mom always bashed me for being unorganized (of course, to her standard), but I do have my own order of home organization. In the realm of my own dwelling space, "order" is that I am able to find everything I need and see no stains and hair on the floor, "ambiguity" or "disorder" is that I can't find everything I need because they are not in the correct region (such as color pencil in the shoe area) and stains on the floor. "Taboo" is placing shoes on the books and papers table and not removing hair and stain from the floor.

## 2.2 “One Rule to Rule Them All?”

I need to clarify again that the hygiene discussed in this chapter is not a medical term. Medical “hygiene” deals with the fatal threats to our lives: parasites, vials, bacteria and etc. No one can argue that Covid-19 is “clean” for us.

If dirt is not absolutely dirty, it is essentially a matter out of place, something not following the order, and order is a set of rules made by people to organize the surrounding world and to exclude ambiguity, then, to different people who have set up different rules, dirt could take drastically different forms. Going back to the example of my home organization strategy mentioned in the previous section, dirt is only the stains and hair on my floor and objects in the wrong place (books on the food table, dishes on the book table, shoes outside of the alcove). However, to that friend who would organize his food packages according to their colors (he follows the rainbow) and put everything in a designated container parallel to the container’s edge, my entire home is dirt.

People are different, and cultures are different, and even the sacred religious hygienic taboo is not a universal rule. Muslims are forbidden from eating pork because consuming pork is not only unhygienic but also a sin. This food taboo is stated clearly in Qur’an multiple times[10]. One theory is that pig has similar genetic and physiological traits to human beings[11]. As result, parasites in pigs can infect human beings more easily than the parasites in other common livestock animals. To consume pork safely, people have to cook the meat completely, eliminate all the parasites and their eggs. Before the invention of earthen cookware that allows steaming and boiling, prehistoric people did not have the proper method to cook pork. Consumers got parasite infections. And later on, pork became a religious taboo. While China never had such a taboo. Isotope analysis of Cishan Culture in modern Hebei province has proven that ancient Chinese people in the Neolithic era kept pigs as livestock and consumed pork[12]. Traditional dishes all over the country involve pork. Pig bones are boiled and made into stock, minced pork is usually fried before adding in vegetables.

People also have a “spectrum of dirtiness” when looking at the same dirty object or activity. A dirty object under different circumstances might cause different intensities of disgust, fear, hatred, or no aversion at all. One example is excrement and the action of excreting. Dutch anthropologist Sjaak van der Geest argues that socially speaking, feces is a private and intimate bodily product; it should remain in the private realm. “By talking and writing about it, it becomes a matter out of place; it disturbs the order of proper behavior.”[13] Some people may claim that all shits are disgusting, and toilet bowls and pooping are also disgusting. However, if that person is asked to think about his or her own shit, pooping, and toilet, one generally will realize that one’s own bodily product is not that intolerable. Desiderius Erasmus even wrote that “Suus cinque crepitus bene olet” (one’s own shit has a sweet smell)[14]. Mothers usually have no aversion to their children’s feces[15]. And children’s feces is generally less disgusting than adults. Animals’ feces is also less disgusting than adults. Your close friends’ feces is less disgusting than other adults’ feces, going to the bathroom together with friends is a very common activity in many places, the author

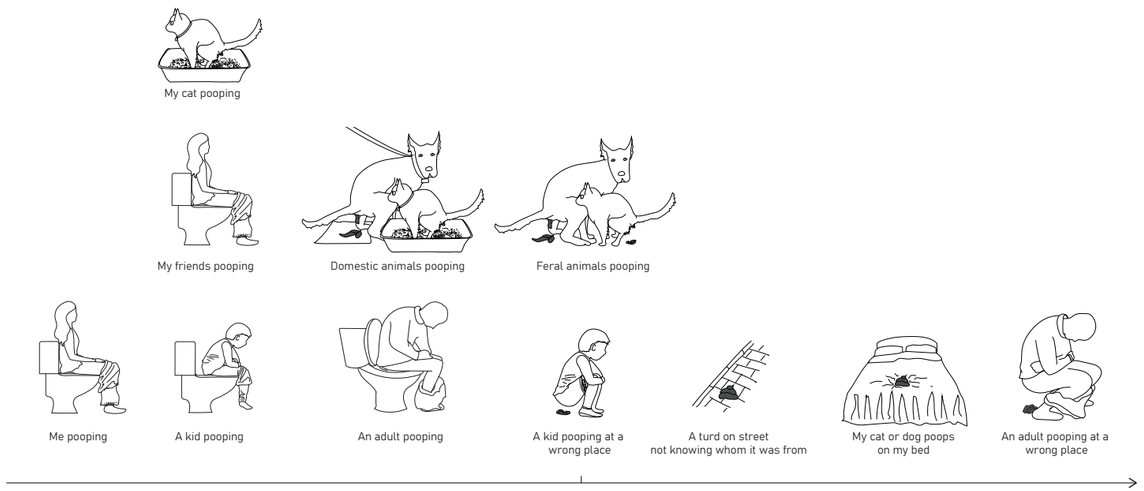


Figure 4: Author. Spectrum of Dirtiness: Pooping and Poop. 2021.

used Ghana and Netherland as examples[16]. My opinion is, your degree of dirtiness of feces has a positive correlation with the social distance between you and the creature who made the feces, and with how well should the creature know that it/he/she should or should not poop in a certain place. I gave poop and pooping a spatial order according to their degree of dirtiness to me (see Figure 4).

Let's briefly move away from human beings. Different animals have totally different hygienic rules. Some years ago, I had a cat and a dog. I have seen



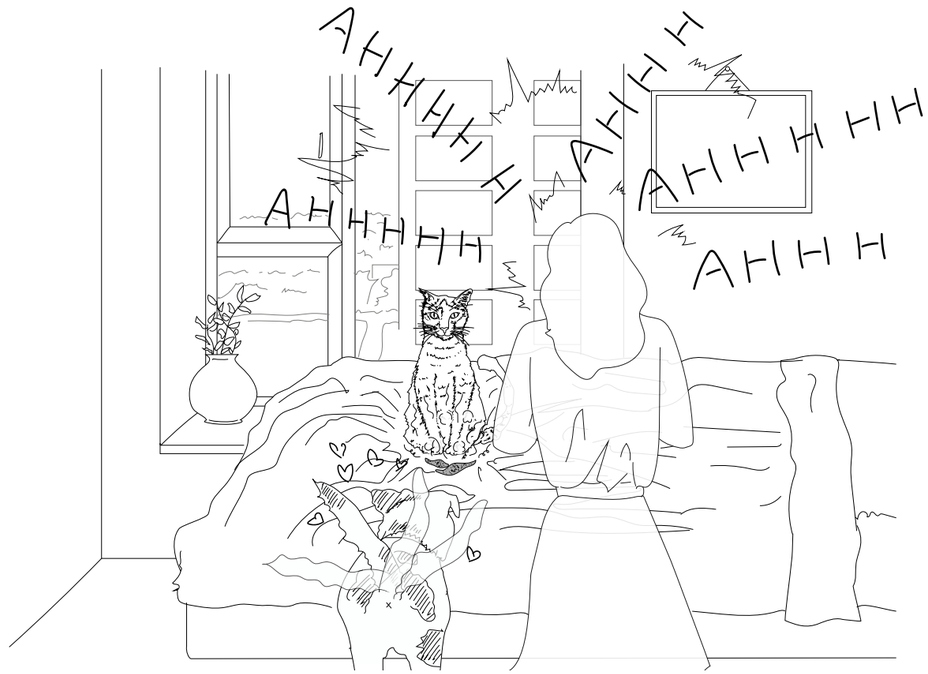


Figure 5: Author. A Cat's Revenge. 2021.

this difference so clearly that I can never forget. Once my parents and I left the house for a two-day trip, we took the dog with us, and left the cat at home because he never wanted to leave the house. When we returned home, I caught a horrible smell from my room. I dashed to the origin of the smell and saw the cat sitting on my bed. There was a freshly made, hot, and steaming cat's poop between us (cat owners would know how pungent the smell was). I started screaming, and had hundreds of thoughts about how should I deal with the bedsheet and mattress cover under it. Then the dog became so excited (the same excitement when he saw food) that he started

dragging me towards the bed. The cat knew that pooping on my bed was revenge; both he and I thought shit was dirty. But to the dog, it was clearly not dirty.

I suspected that my dog's behavior was due to some abnormalities, but the dog was perfectly healthy. He had no micronutrient deficiency. An article on VCA Canada website stated that "In fact, stools themselves are seldom unpleasant to dogs. It is one of the odors they are constantly attracted to when investigating their environment."[17]

Though there are certain items that are commonly considered dirty by people all over the world, we cannot say that all people share the same hygienic rules. If we broaden the sight and look at none human creatures, we can see that a universally dirty thing (to humans) might be delicious to another species. The answer to the title of this section is "no".

# Chapter 3: Hygienic Rules and Architecture

## 3.1 Two Strategies of Maintaining Cleanliness

I have discussed that seeking hygiene is a survival instinct, and non-survival-related hygiene is a set of rules that is always changing. Then, how are humans' hygienic rules related to architecture?

Human beings first inhabited caves to shelter themselves from rain, coldness and predator. When tools were invented, people moved out of caves, and started building huts with accessible local materials: wood, mud, stone, grass, and etc. The living space was encircled by walls and roofs, a clear interior and exterior distinction was developed. The Interior was safe, the exterior was dangerous. To maintain this safe haven, people need to actively exclude dirt from the interior. Before the invention of the modern flush toilets, or in dwelling spaces without flush toilets and sewers, people used bedpans or built "dry" latrines. Dirtiness will always be contained, separated from the healthy living space. Mongolian herdsmen have rules of where to empty chamber pots and where to release themselves around the tents. Even in Baroque France, whose hygienic standards were notorious low, Versailles had latrines for the servants, guards, and aristocrats. People used mastic-coated canvas to contain the smell of the latrines[18]. Only when the residents of Versailles found latrines closed or occupied and no chamber pots at an accessible distance would they relieve themselves at the corners of a corrido[19]. There was still a rule, just different from the

rules of other places.

Other than actively containing and excluding dirtiness by the occupiers, another strategy is prevention. The architecture or urban plan itself is doing the work. People built aqueducts and sewers, and harvested gravitational potential energy to discharge waste into the sewers. The modern building code usually has regulations on daylighting and ventilation. Hygienic rules shape the built environment. Guided by different rules, the built environment will evolve into different forms. This chapter will analyze a few examples.



## 3.2 Vitruvius's City

Marcus Vitruvius Pollio lived in the 1st century BC Roman Republic. The hygienic rules and the field of medicine of that era were very different from the modern ones. They believed that the world (including human bodies) was constructed by four elements (fire, air, water and earth) that were affected by four qualities (hot, cold, wet and dry). Vitruvius believed that a cold environment would benefit people. He wrote that " the summer heats produce languor and relaxation of body; and in winter, even the most pestilent situations become wholesome, inasmuch as the cold strengthens and restores the constitution of the inhabitants."[20] and "those who pass from a hot to a cold climate, far from being injured by the change, are thereby generally strengthened."[21] As a result, the city should be built to embrace coldness and avoid warmth. Because the human body contained a great proportion of water, to keep the balance, people should avoid damp winds and atmosphere[22]. From these rules, he gave the principles of city planning. He wrote that "A city on the seaside, exposed to the south or west, will be insalubrious: for in summer mornings, a city thus placed would be hot, at noon it would be scorched. A city, also, with a western aspect, would even at sunrise be warm, at noon hot, and in the evening of a burning temperature."[23] and "They should be planned as to exclude the winds: these, if cold, are unpleasant; if hot, are hurtful, if damp, destructive."[24] The drawing (Figure 6) illustrates his city planning strategy. His city planning strategy might sound absurd to a reader from the 21st century. We know that ventilation is crucial to a healthy environment, neither cold nor hot

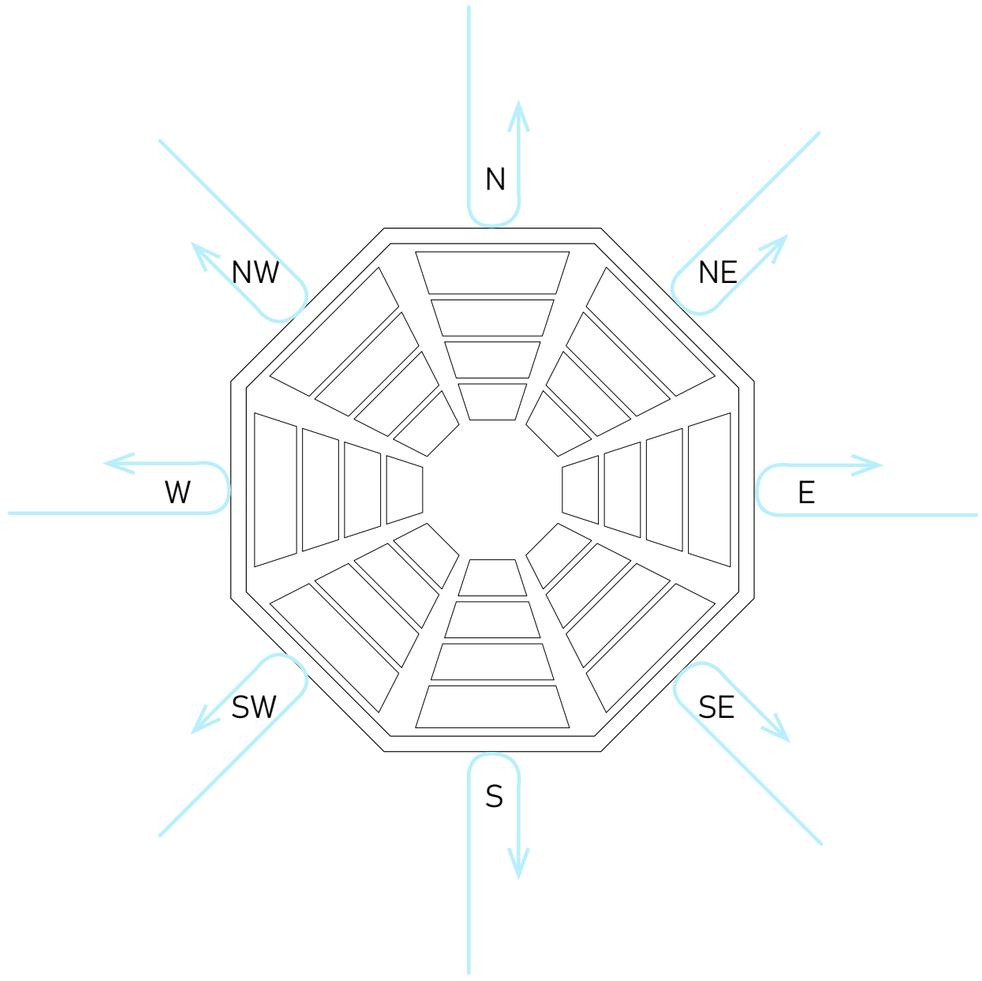


Figure 6: Author. Vitruvius' City. 2021.



is truly favorable, instead, a moderate temperature is the best. Passive houses' goal is to maintain a moderate interior temperature throughout the year without extra heating and cooling devices.

By Vitruvius' standard, Vancouver is a horrible city, because it has no city walls to exclude winds, and it is constructed in a terrible location. Vancouver, on the west coast of the North American continent, exposes to the sea on its west and north. It has a moderate climate, not too cold in the winter and not too hot in the summer. Vitruvius' claim on the terrible consequences of not following his rules does not apply to Vancouver (though as climate changes, heat waves and scorching noon start to appear in Vancouver,  they are not expected to be long lasting.)

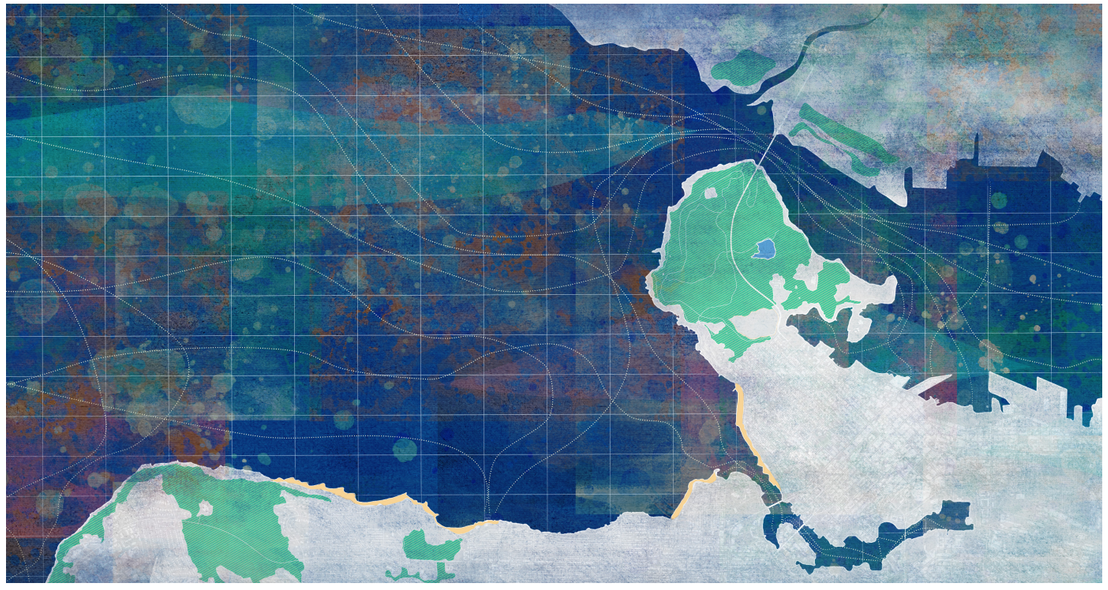

Figure 7: Author. Map of Vancouver. 2021.

## 3.3 The Model of Public Baths

After the release of the "Report on the Sanitary Condition of the Labouring Population of Great Britain" in 1842 by Edwin Chadwick, the Committee for Baths for the Labouring Classes was formed in 1844[25]. Edwin Chadwick's report concluded that the laboring class residents in the countryside had a longer life expectancy than residents in the cities because the countryside had better sanitary conditions. In response, the committee intended to build public bathhouses mainly for the working class all around British cities. The committee's goal was to build its first public baths as the model establishment of all future public baths. It ran an architectural competition in 1844. The winner, Price Prichard Baly, a civil engineer and architect, was commissioned to design both the architecture and the engineering system of the model establishment[26].

The site was in Whitechapel district in London, because Whitechapel was the "lowest, most populous, and dirtiest"[27] region in London, thus, it needed hygienic and moral reformation the most. Improving hygiene is improving the dignity of the laboring class.

Whitechapel Public Baths' architectural plan and management policies were creating finer segregation among the laboring class visitors. All the bathers would be given an individual bathtub, separated from other bathtubs by metal screens. Female bathers had their bathing area, male bathers had their designated area too. Each gender even had its own

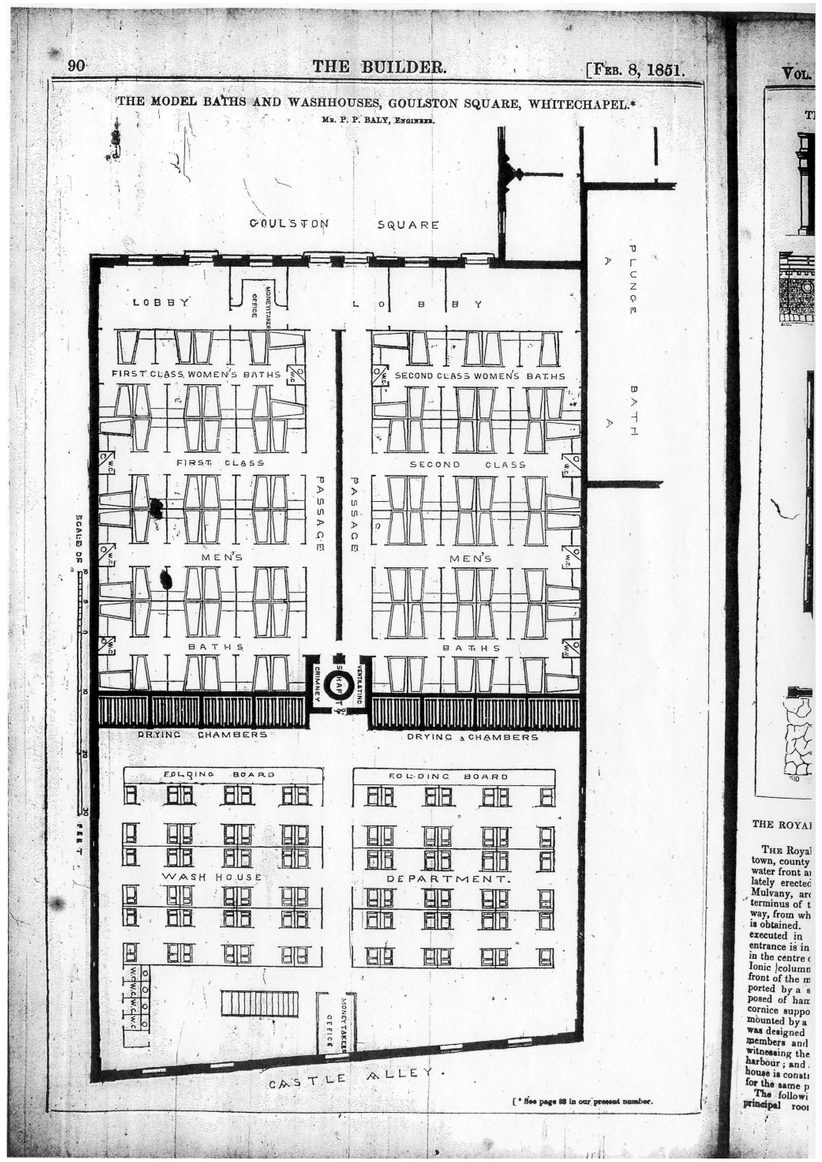


Figure 8: P. P. Baly Engineer, "As Built" Plan of Whitechapel Public Baths. The Builder, Feb 8. 1851, p.90. Source: https://archive.org/details/gri_33125006201822/, public domain, accessed Nov. 20th, 2021.

circulation. Female bathers were directed to the sides, male bathers would enter their area from the central aisle. On the other end of the building, the clothes-washing station, accessible from Castle Alley, kept the same spatial separation strategy. Each washing station was divided from the others by tall iron screens. They were discouraged from talking to other people because social interaction would cause conflict[28]. This public bathhouse was not designed to be an actual public space that stimulates social interaction, like the Turkish hammam.

One thing worth noticing is that Baly chose to install a central large drying chamber instead of individual smaller drying chambers next to the washing stations because the committee believed that poor people's linen required special treatment. The clothing and towels should be exposed to a high-temperature drying chamber, even though they were properly washed and then boiled[29]. Dirt, or hygiene, is always related to social classes. The amount of dirtiness, the place, and method to deal with dirtiness mark the distinction between social classes.



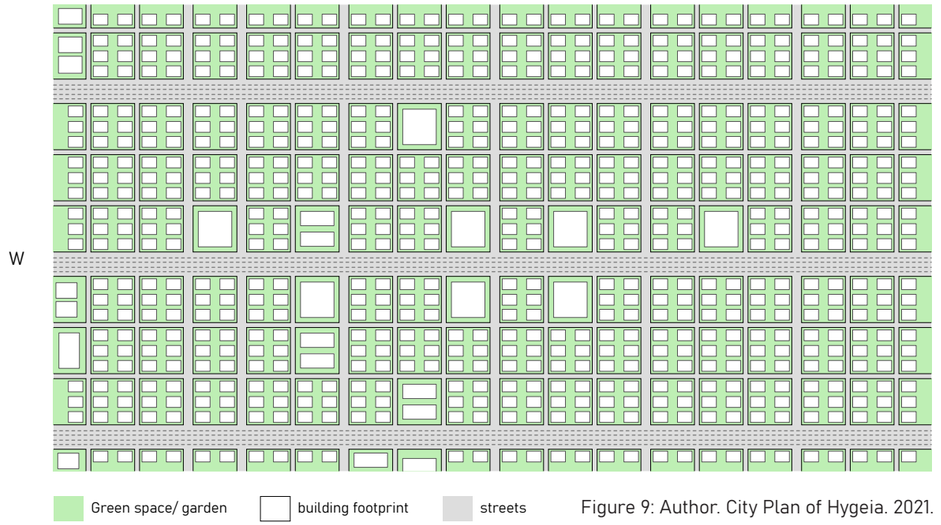


Figure 9: Author. City Plan of Hygeia. 2021.

## 3.4 Hygeia, Utopia of Health

It was not uncommon for British medical professionals in the Victorian era to design built spaces. They were generally disappointed by the real world houses and cities designed by architects, criticizing that the living spaces were so disease-prone and architects were doing their jobs so poorly. This group of medical professionals started to oppose the architects and design their own vision of healthy spaces[30]. Their works had a wide range of scales, from single-family houses to urban design projects. Among them, the award-winning physician, medical historian, and public hygienist Dr. Benjamin Ward Richardson's essay Hygeia (1875) was one of the most

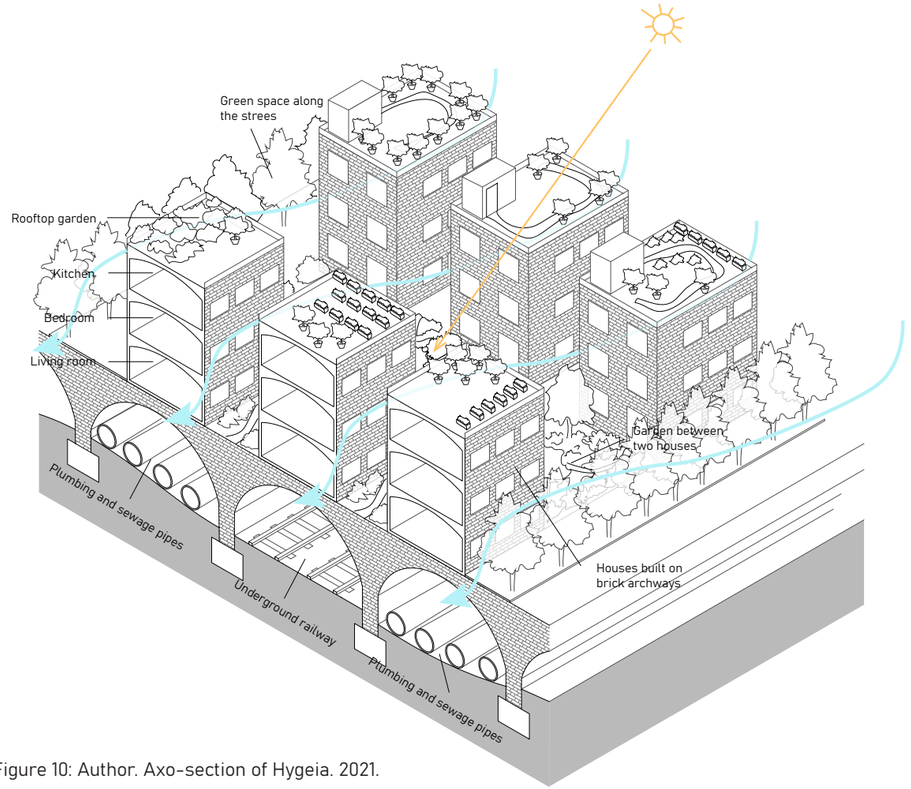


Figure 10: Author. Axo-section of Hygeia. 2021.

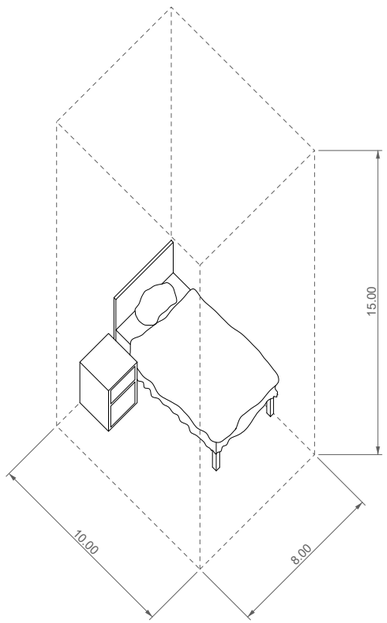


Figure 11: Author. 1200 Sqft Sleeping Space. 2021.

Figure 12: Annan, Thomas. Glasgow Slum. 1868. British Library, Public Domain



ambitious projects[31]. It was an entire utopian city of health. The written text described the infrastructure, including sewers and transportation system, the city plan, the living quarters, the workspaces, laundry facilities, and the administration system. He attacked the contemporary living spaces of the English laboring class from all aspects and suggested that spatial separation is the ultimate key to public hygiene.

Hygeia would be built on huge brick archways. It had three boulevards running East-West direction. Under the boulevards were the railways that handled all the heavy transportation. All the smaller streets were wide, planted with trees and flowers. Buildings should not exceed 4 stories so that they would not block sunlight and wind. Each house would have its own backyard garden and rooftop garden.

Firstly, the author separated the healthy and unhealthy infrastructures. Healthy infrastructures were residential buildings, work buildings, hospitals, and pedestrian streets. Unhealthy infrastructures were sewers and railways. Healthy ones are spatially placed on the top, unhealthy ones are under the brick archways.

Secondly, he separated the residential units so that each family had its own building: one entry led to one unit. No back-to-back house, which was very common in Victorian England, was allowed. He stated that “Tall houses overshadowing the streets, and creating the necessity for one entrance to several tenements, are nowhere permitted.” [32] While in real life, multiple families sharing one apartment or house was a common situation. Dr. Richardson did not mention the finer spatial separation within a single

family's dwelling unit, such as boys and girls should be given their own bedroom, as the Victorian moral reformist promoted[16]. He only mentioned that each resident would be given at least 1200 cubic feet of space to sleep, and none of the unnecessary furniture and fabrics were allowed in Hygeia, including carpets and clothes, because they trapped dirt and became disease-prone.

Thirdly, Hygeia separated residential space from workspace. Dr. Richardson wrote that "It has been found in our towns, generally, that men and women who are engaged in industrial callings, such as tailoring, shoemaking, dressmaking, lace-work and the like, work at their own homes amongst their children. That this is a common cause of disease is well understood." [33]To solve this problem, Hygeia had dedicated buildings to be used as rental workspaces. These spaces would be affordable, "on payment of a moderate sum per week"[34]. As a result, residences would strictly be the space for cooking, sleeping, gardening and family bonding, all clean and healthy activities.



## 3.5 White European Modernism

The 19th century welcomed important development in germ theory. Early in the 19th century, Italian entomologist Agostino Bassi proved that microorganisms caused diseases. French chemist Louis Pasteur conducted experiments and formally proved the pathology of several prevailing diseases. In 1882, German doctor Robert Koch isolated Tubercle Bacillus, the bacteria that cause Tuberculosis. In 1895, German physicist Wilhelm Röntgen discovered X-ray. The world of medicine and hygiene suddenly entered a new era. People looked at the living environment in a new way: the enemies were invisible microorganisms. As an active preventative force to maintain hygiene, architecture should change accordingly to deal with these tiny enemies. Architects of the 20th century criticized 19th-century architecture as disease-prone[35]. European Modernism, which emerged in this era, intended to design buildings to be a treatment for diseases. Le Corbusier claimed that an unhealthy city caused sickness, and the residents in the future should be able to clean the toxins and increase the physical energy of the residents[36].

Tuberculosis was an important disease to European Modernism. It was thought to be a wet disease[37], part of the cure was exposing the patients' bodies to sunlight that could dry the wetness. Sunbath therapy and cruise therapy were often prescribed ( of course, skin cancer hadn't been discovered yet during that period).

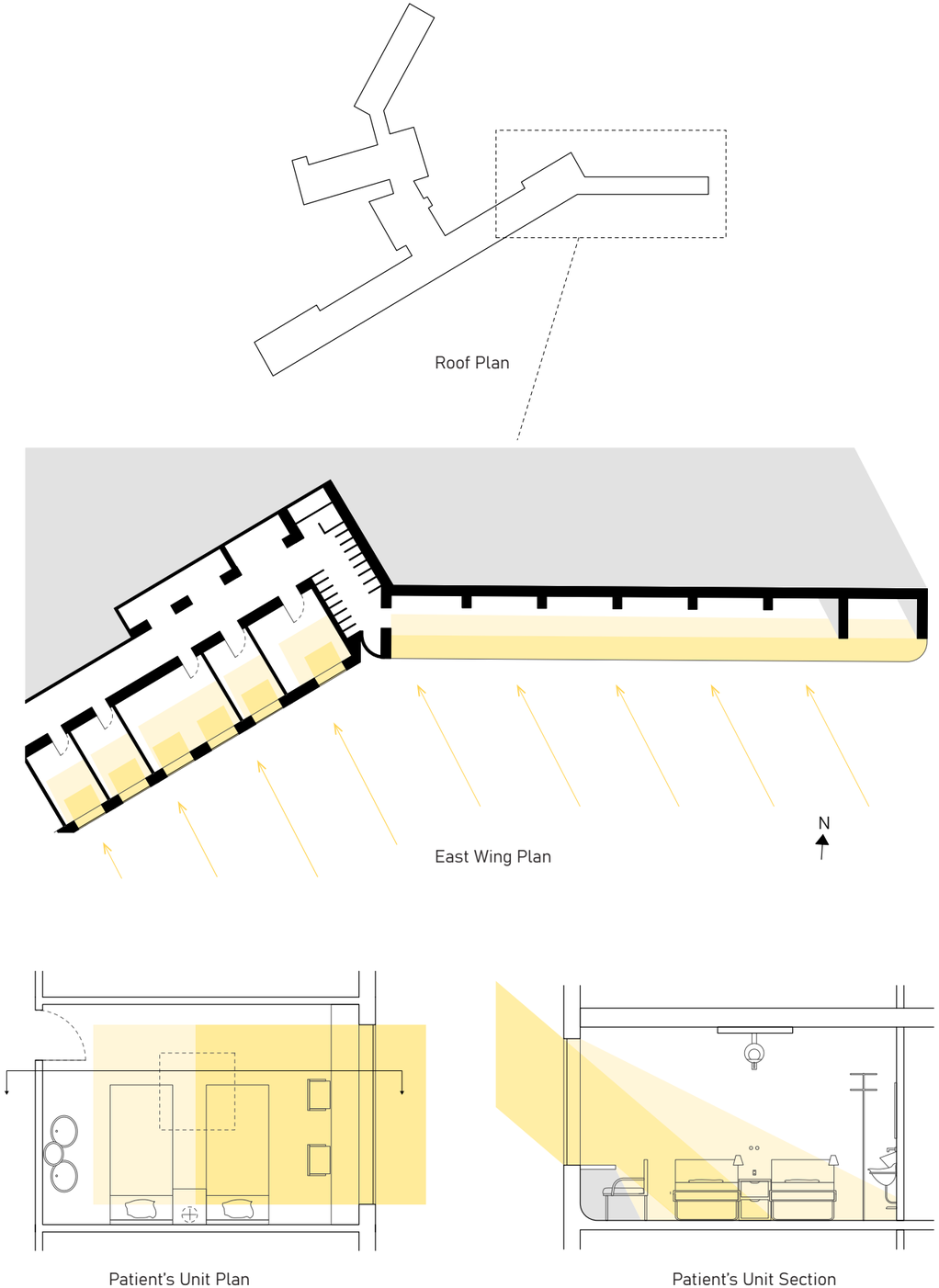


Figure 13: Author. Analysis of Paimio Sanatorium, Alvar and Aino Aalto, 1932, Paimio, Finland. 2021.

Alvar and Aino Aalto's design of Paimio Sanatorium is an example of architecture as the treatment of tuberculosis. Its patients' rooms are south-east facing, with large openable windows, so that patients can receive sun treatment in the room. To the east of the patients' units are large sun terraces. Nurses would pull patients' beds onto the terrace for sun exposure. The patient's room had rounded edges and smooth surface material for sanitation purposes. The washbasin was shaped in a way that reduced the noise. Lighting fixtures are placed closed to the pillow-side wall instead of at the center of the roof, thus, patients would not be stimulated by the light when they are in their beds.

Alvar Aalto explained that he should design for the people in their weakest position. Beatriz Colomina wrote in response to Aalto that "Sickness was no longer seen as the exception, but as the norm"[38] and "The sense of floating outside its normal urban habitat and angling itself to the sun to heal fragile bodies challenged the definition of architecture. It is as if architecture itself took the cure."[39]

## 3.6 Le Corbusier's 5 Points of Modern Architecture

Le Corbusier had given 5 points of modern architecture, a group of guiding principles that should be applied to both building scale and urban scale to make the built environment habitable. His famous 5 points are: **pilotis**, raising the occupiable floors above the ground by thin columns; **free plan**, eliminating load-bearing walls, freeing the interior division of space; **free facade**, separating the facade from the load-bearing structural system; **horizontal windows**, cutting the entire length of the facade; **roof garden**, abandoning the traditional pitched roof for flat roof, placing garden on it for occupants' use and structural protection.

These 5 principles were deeply rooted in health concerns. Pilotis' purpose was to move the living space away from unhealthy ground whose dampness caused diseases[40]. Roof gardens were places for people to perform physical exercise and expose themselves to sunlight[41]. Following his logic, it is not hard for us to deduct that long horizontal windows were for bringing ample sunlight into the space, and the free plan allowed the occupants to configure the interior space in a way to receive maximum sun exposure.

Villa Savoye (1929-1931) was his first project that fully realized these 5 points. The pilotis of Villa Savoye was given a second purpose: vehicular access. This house can be seen as an escape on wheels from dirty city to clean and healthy Paris countryside.


Figure 14: Gilchrist, Scott. Photo of Villa Savoye. Jun 2016. The Archivision Library, UBC access. Accessed on May 1st 2022.

## 3.7 Skyscrapers

Even if the program of the building is not medicine-related, modernist architecture carried the same set of elements: facade with high transparency, interior spatial division free from the structural system, ground-level for circulation. I analyzed 4 modernist skyscrapers: Lake Shore Drive Apartments, Toronto-Dominion Center, Seagram building designed by Mies van der Rohe, and Willis Tower (former Sears Tower) designed by SOM. In the plan, I only drew the permanent elements of each building: load-bearing columns, core with staircases and elevators, floor plate and facade. Interior division walls were not added because they were not permanent, they were meant to be reconfigured following occupants' needs.  We can see these buildings typologically the same: load-bearing columns supporting floor slabs, free plan on one continuous floor slab, circulation core placed inside the building, transparent facade attached to floor slabs and roofs.

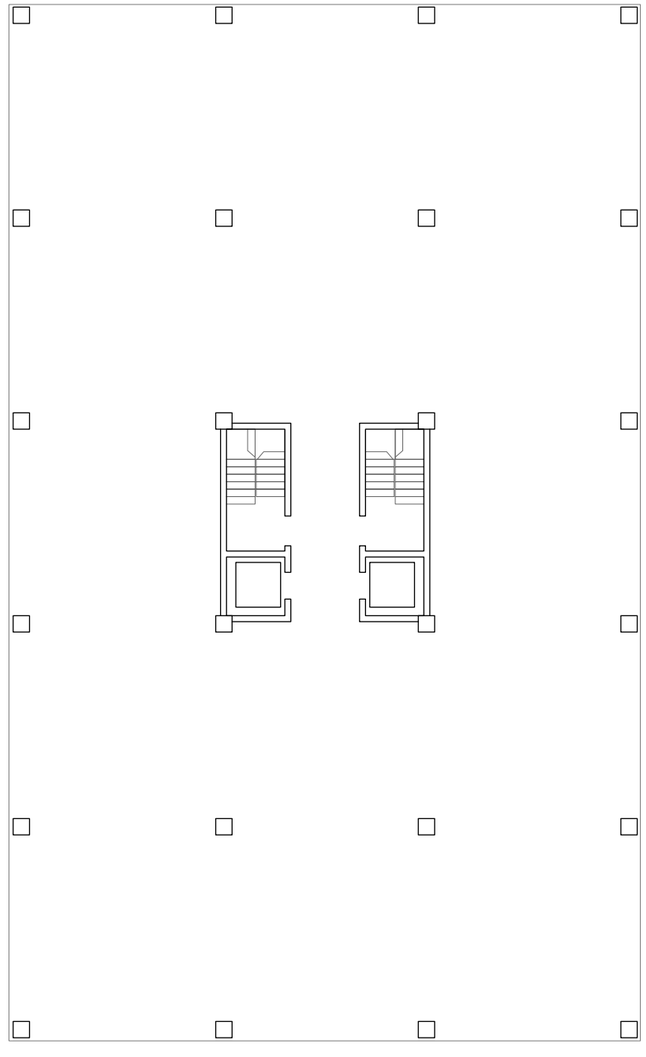

Figure 15: Author. 860-880 Lake Shore Drive Apartment Floor Plan. 2022.

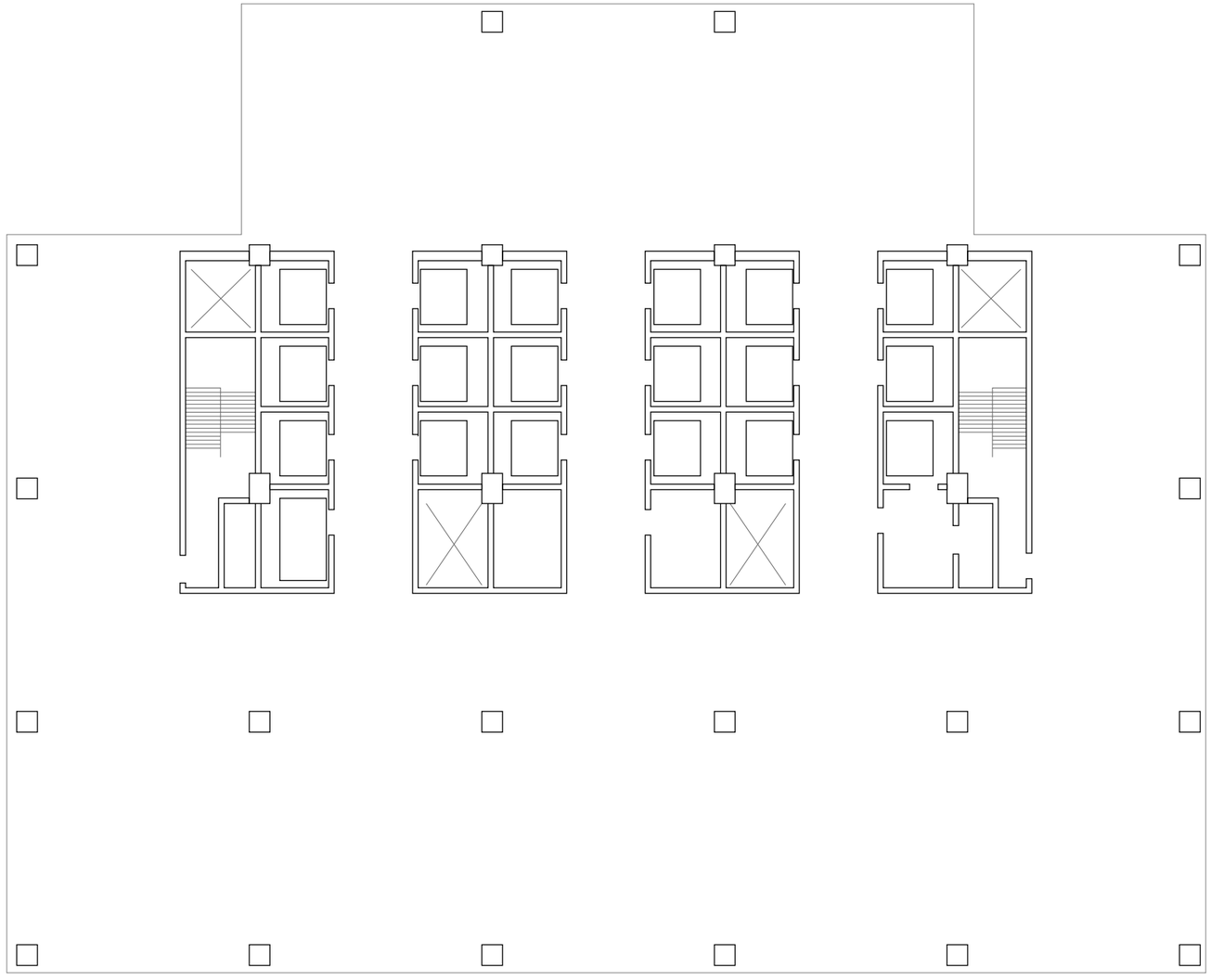

Figure 16: Author. Seagram Building Floor Plan. 2022.

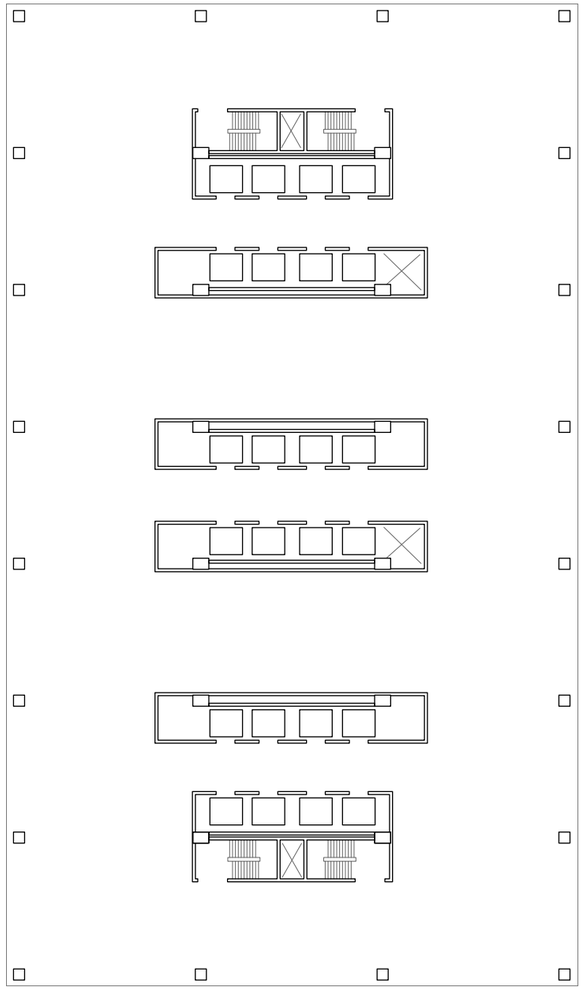

Figure 17: Author. Toronto Dominion Center Floor Plan. 2022.

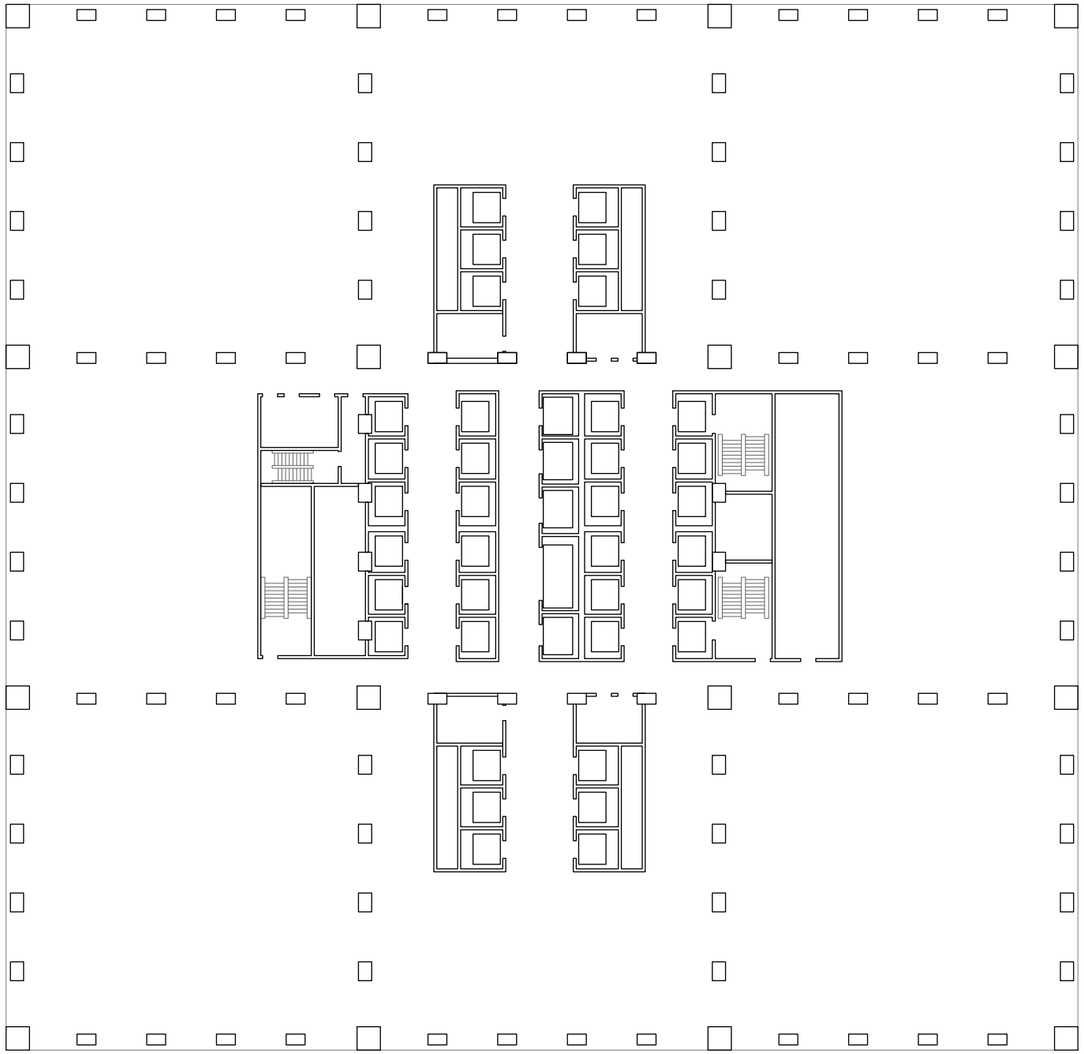

Figure 18: Author. Willis Tower Floor Plan. 2022.

# Chapter 4: 5 points of COVID Architecture, the Final Design

## 4.1 Creating My 5 points

With all the previously discussed background knowledge in mind, I started thinking, If COVID, a disease so different from tuberculosis, became the driving force, how should the guiding principles of architecture change accordingly? Can I extrapolate the principles, just like what Le Corbusier did, from this disease?

To do this, I need to analyze how COVID has changed our lives and perceptions.

In this Covid pandemic, staying alone is the cleanest activity. Staying with close family members or roommates is the next cleanest activity. We've already exchanged too many germs, so it is totally acceptable to exchange one more (and there is no escape anyway). When a social gathering is inevitable, wearing masks makes this event acceptable because we know that Covid-19 is an airborne disease. Large social gathering without masks is an absolute no. What is even worse? Someone shows any suspicious symptoms of the disease.

The pandemic has lasted for two years, long enough to change our habits and the social norm. When I try to recall the pre-pandemic era... Any type of social gathering was acceptable! Even when someone was coughing or sneezing right beside me! I did not find people problematic at all. Though restrictions on mask-wearing and social gatherings are gradually released as I am doing this project, I realize that my perception of people and social

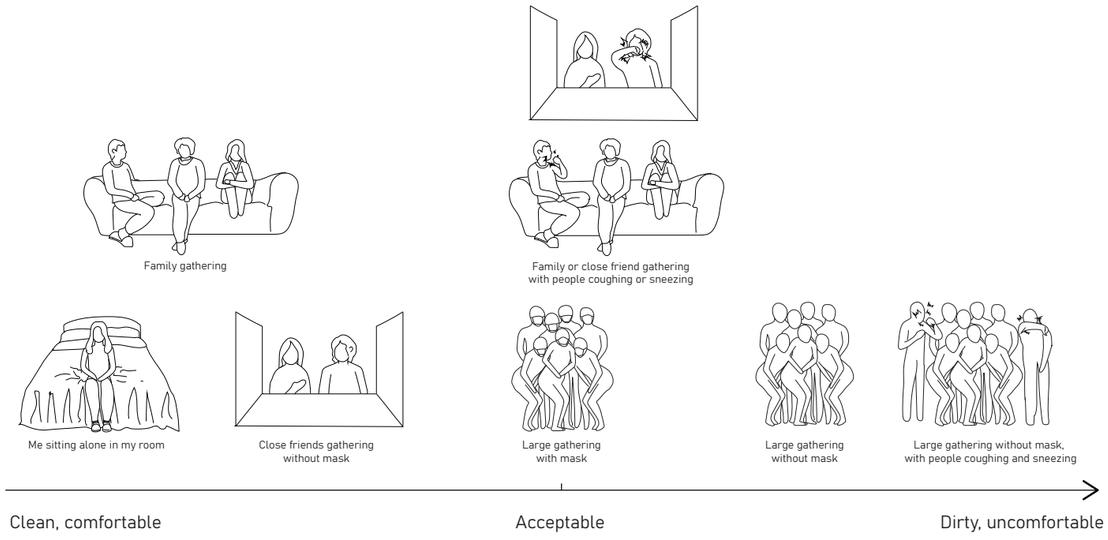


Figure 19: Author. Spectrum of Dirtiness: Social Gathering in Pandemic. 2021.

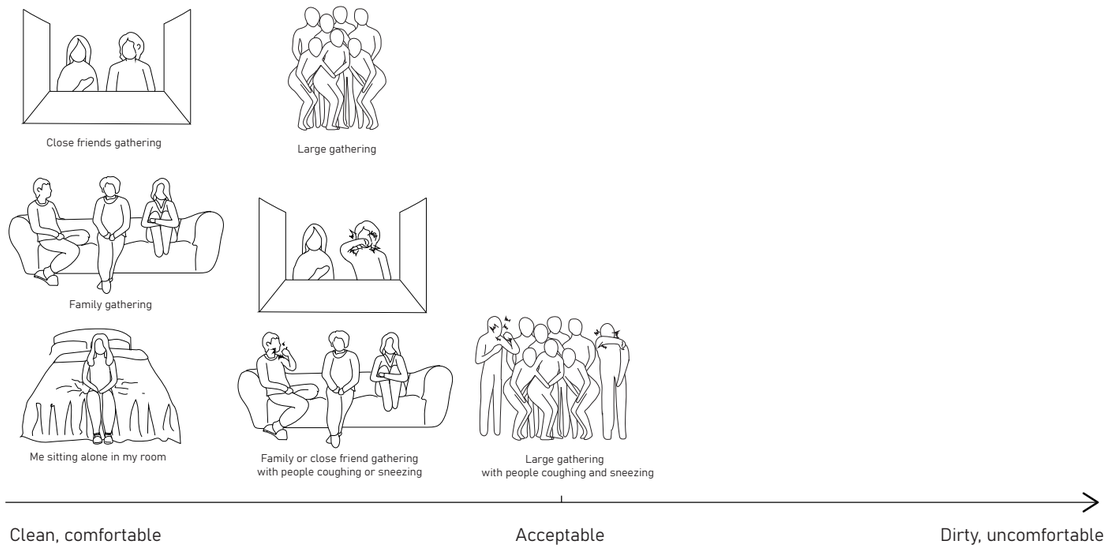


Figure 20: Author. Spectrum of Dirtiness: Social Gathering Pre-Pandemic. 2021.



gatherings has been changed. I don't know if I can say permanently, but at least for the next few years.

Privacy is always related to cleanliness. The intensity of dirtiness increases as the foreign item approaches the body.

This foreign item can be either physical or non-physical. "Physical" can be living creatures or non-living objects: a person, an animal, a piece of muddy rock, or a piece of someone else's belonging. "Non-physical" can be sight, sound, someone's appearance and approaching on the internet.

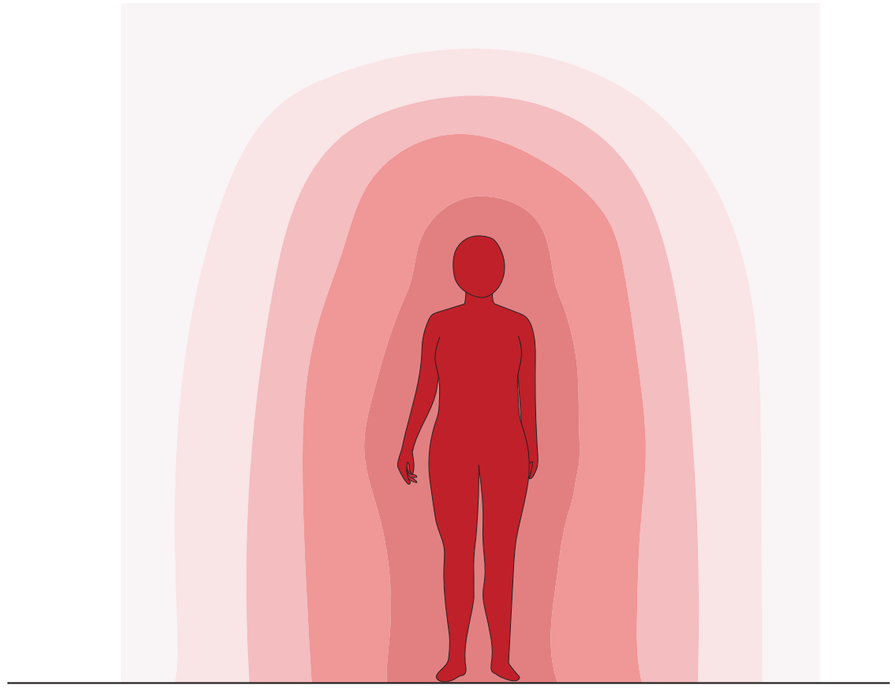

Figure 21: Author. Spectrum of Dirtiness: Body. 2021.

Privacy is clean. Spatial separation is clean. The closer a foreign item approaches the private realm, the dirtier it is.

In the COVID pandemic, the dirtiness of the physical approaching of a person or a person's belonging drastically increases. The disease forces people to physically separate from each other. However, human being is a social species. Companionship with other people is essential to one's mental health. When people cannot touch others physically, they will seek the next best option: visual and audio connection. The rules of privacy have changed in the COVID pandemic. Displaying one's daily life used to be a cringe or threat for city people living in hyper-privacy. The loneliness brought by the pandemic has driven them to change. Curtains are opened for visual communication with neighbors, to have a visual companion to get through isolated days; people go to their balconies or yards (if they have one), communicate and play games with their neighbors.

Pandemic stimulated or forced home offices. People are trapped in the same space all day long. Waking up, working, eating, entertaining and exercising all in the same space can be a serious mental threat. Our living spaces were designed in the pre-pandemic era when the home was only for sleeping, family gathering and relaxing. We need living different living spaces to accommodate the increasing needs.

Objects from outside of one's private living space are now considered dangerous. The virus can stay active on surfaces from hours to days. Cleaning the surfaces that have contacted the exterior world becomes a necessity: from the advice of washing hands that we got from the CDC to disinfect packages, outerwear and groceries. The ritual of cleaning and disinfecting happens in the space right next to the entrance, inside or outside.

Study[42] have shown that animals have a very low risk of passing COVID to humans. Though the risk of spreading COVID from humans to animals is medium, animals' COVID symptoms are not as severe as people's, seldom life-threatening. Animals can provide safe companionships for humans in the COVID pandemic. Nearly 3 out of 10 Canadians adopted pets during the COVID pandemic[43].

Ventilation is a key to staying healthy in the pandemic. Open windows are always preferable over closed windows or solid walls, even in the winter. Based on my observation, people are willing to sacrifice thermal comfort to not catch COVID (though the climate is an important factor here, my observation is based in Vancouver, whose winter is never life-threatening cold. It would be a different story in Montreal's -30°C winter).

And here comes my 5 points of COVID architecture. Unlike Le Corbusier's, my 5 points are driven by the occupants of the built environment, while his 5 points illustrate the permanent architectural elements.

Figure 22 Author. Point 1: Distancing. 2022.

**Distancing** is a practice that everyone has been very familiar with these 2 years. Social distancing, keeping a 2m distance between each group of people, reducing the maximum occupancy of each gathering space compared to the pre-COVID era. This point could give us more scattered plans that loosely distribute occupants when translated into architecture.



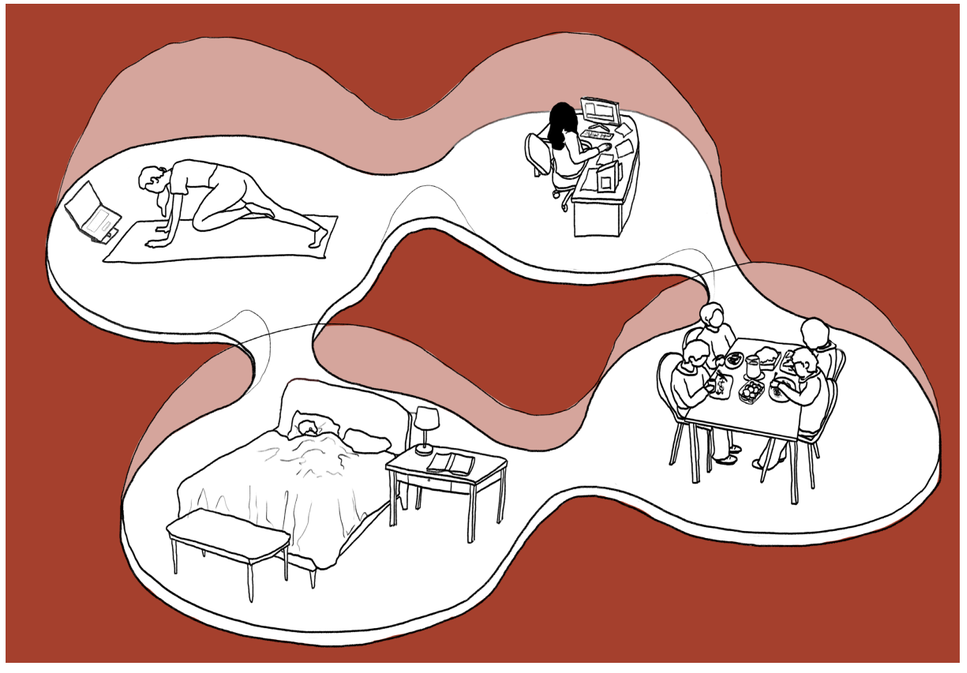

Figure 23 Author. Point 2: Bubble. 2022.

**Bubble.** The bubbles here are bubbles of activities that happen in an interior space. Like soap bubbles, these activity bubbles can connect and morph into each other. The bubble can give us  reconfigurable spaces.

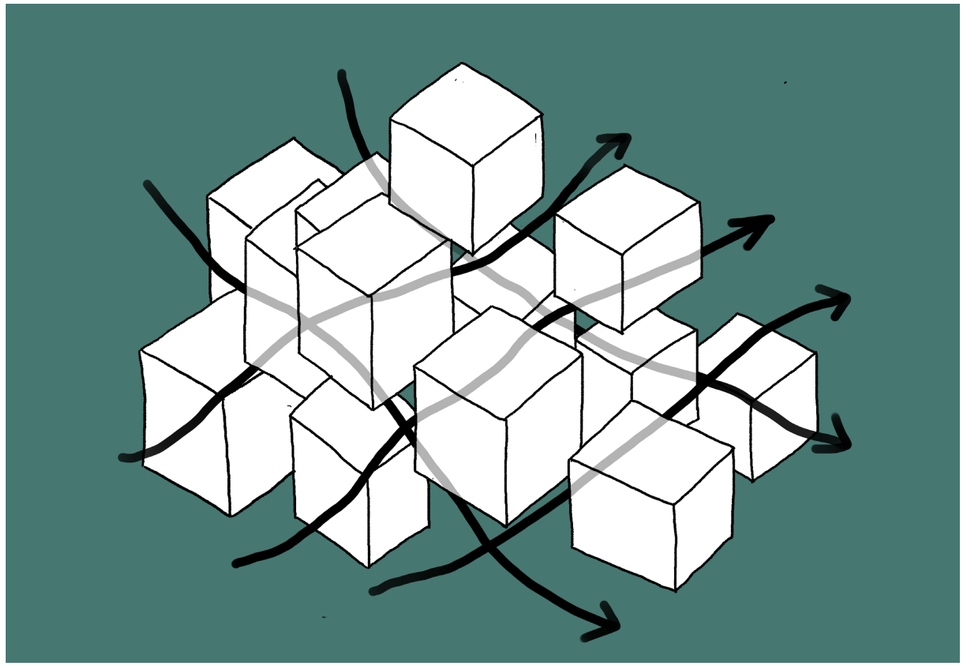

Figure 24: Author. Point 3: Porosity. 2022.

**Porosity.** Each built space of a certain group of occupants is treated as a floating object. It does not share walls or roofs with other spaces. The separation allows ample airflow between and within each space. Detaching spaces will increase transparency: what used to be solid division walls now have windows and doors. In an everlasting COVID pandemic, when physical interaction with people is dangerous, visual interaction becomes much more important, and the standard of privacy changes. This increased visual connection with the exterior world would be preferable.



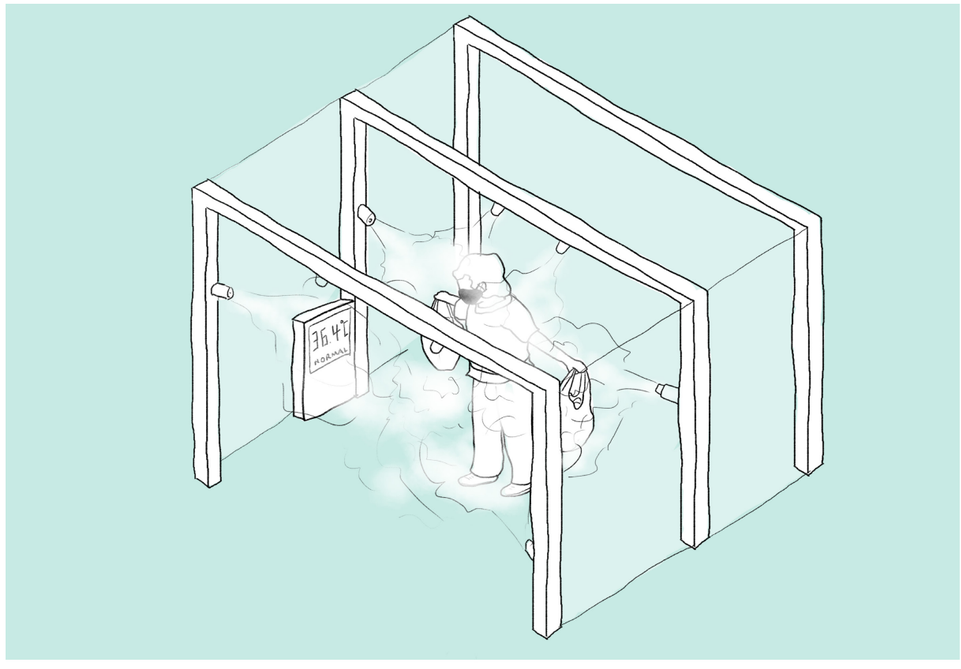


Figure 25: Author. Point 4: Anteroom. 2022.

**Anteroom** is a transitional space between an unhygienic, dangerous space and a clean and safe space. It is equipped with sanitization devices. For example, the illustration above shows atomizers and sprayers that generate a disinfectant cloud that kills the virus on your skin, hair, clothes and groceries bags.

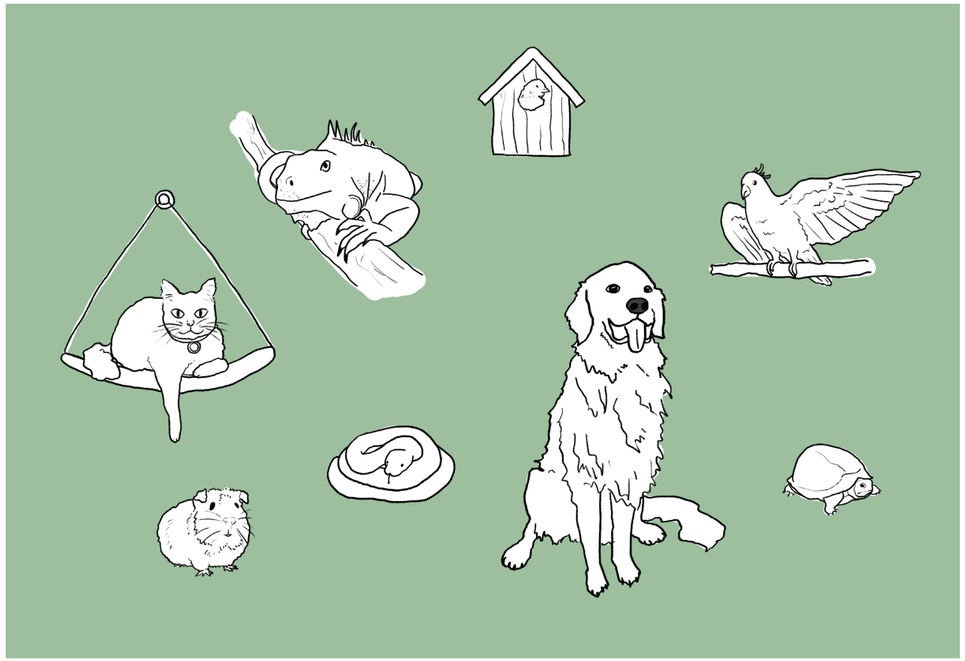

Figure 26: Author. Point 5: Cross-species Companionship. 2022.

**Cross-species companionship**. Animals are much safer companions than other human beings in the COVID pandemic. Human-centered architecture needs to change to serve these non-human dwellers: not only pet animals who share the living spaces between walls, floors and roofs with human beings, but also non-pet animals who share the urban spaces. Modern hygienic rules are excluding non-human creatures that used to share



the built environment with us. Magpies and swallows are regarded as auspicious birds in China. In the past, people would welcome these birds nesting in or around the houses. The birds usually lived under the roof overhang or on windowsills. In contrast, many modern city people have lost this tradition. They would hiss the birds away, worrying that the birds might scratch people, carry germs and parasites, and poop on the window. A similar change of attitude happened to the pigeons in western countries. Pigeons used to be the symbol of liberty. They were welcomed in cities and encouraged to nest and breed in buildings. However, nowadays, people will call these cities or buildings "pigeon-infested"[44].The COVID-pandemic is a great opportunity to bring back the tradition of cohabitation in urban spaces.

Green space is proven to be beneficial to mental health in the COVID pandemic by many studies around the world. National parks, woods and small hills around the city, public parks, or even a small garden in your neighbor's courtyard can improve mental health[45]. However, Le Corbusier's 5 points theory alreay included roof garden, so my points of COVID architecture do not have a point dedicated to green space.

## 4.2 Strategy of Making a COVID Building Typology

This drawing on the right (Figure 27) shows my strategy of creating a new typology of buildings according to these 5 points.

Top left drawing is the typical entry level condition of modernist architecture. Walls are pushed inward, leaving circulation space around the core. That's the **politis** of Le Corbusier's 5 points of modern architecture.

In COVID typology, the entry-level is a large anteroom, the top right drawing shows one way of creating such an anteroom. A cloud of disinfectant surrounds the core, it will make sure that everyone who intends to access the elevator and stairs will receive a thorough surface disinfection when approaching.

The single continuous floor slab is sliced, and each segment is detached from the others. For example, an apartment suite in a modernist residential skyscraper is now a detached house hanging on the structure system. Open-air pathways connect these houses from each other and to the circulation core. When the pathways widen, they form open-air social spaces(marked with light green in the drawing).

Occupiable blocks of different sizes are stacked. They create a dynamic visual language as well as accommodate the needs of different-sized occupants.  There is another type of open-air elevated pathway. They connect the building to adjacent buildings, and form an urban building cluster with layers of vertical public spaces.

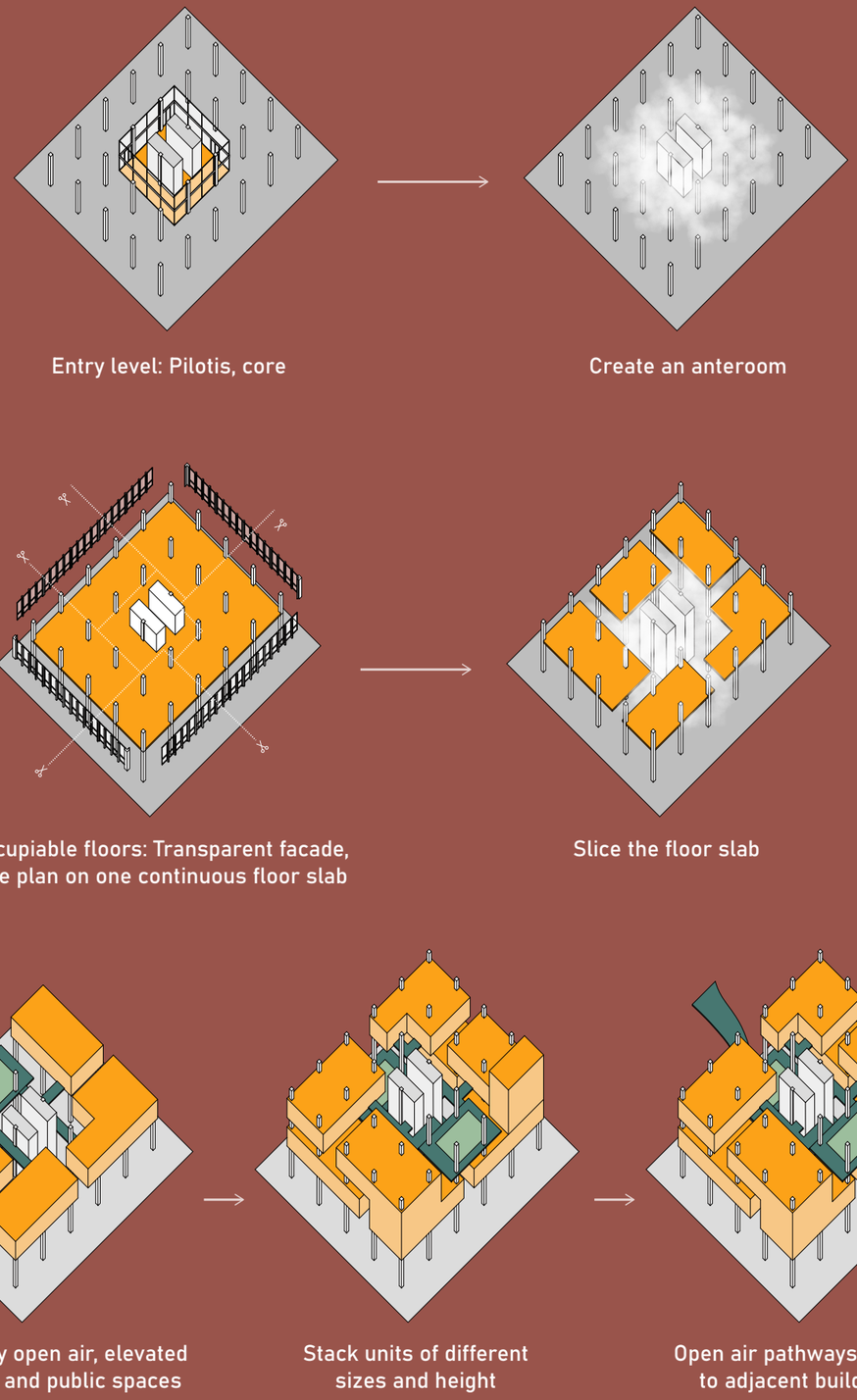


Figure 27: Author. Strategy Diagram. 2022.

## 4.3 The Apartment Unit Design

These two plan drawings depict the daytime(Figure 28) and nighttime(Figure 29) interior spatial arrangement of a typical 2 person dwelling unit. Right after entering the front door, there is an anteroom that will disinfect all your belongings that had contacted the outdoor air. The occupants will leave their outer coats and shoes inside the anteroom, change to indoor shoes after passing the second door.

These bookshelves and storage shelves are ceiling-high and movable, they function as reconfigurable division walls. In the daytime, desks can be pulled out from the storage units, two units are moved to separate the workspace of the two occupants. The apartment is now a 2 people's home office.

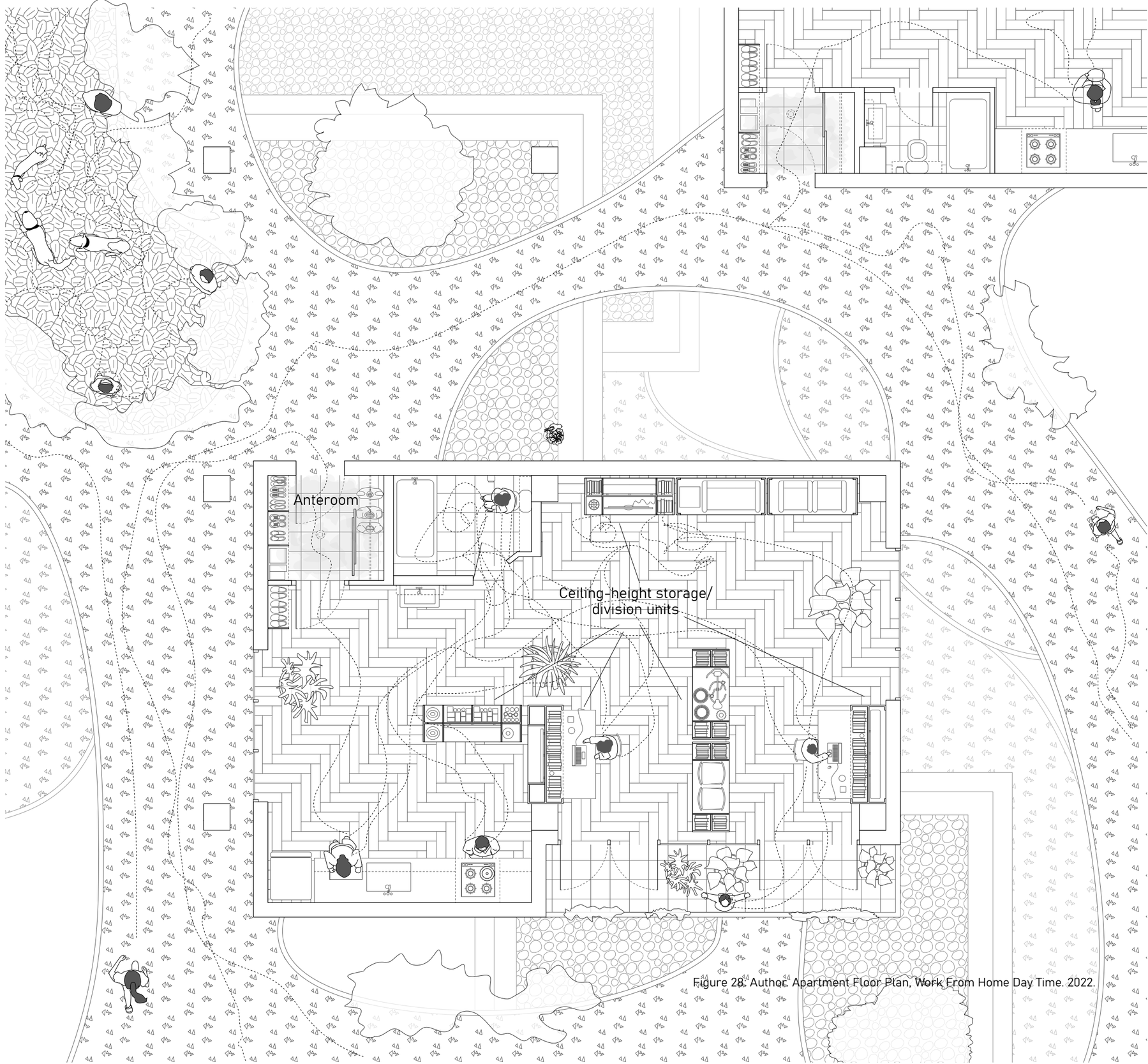


Figure 28. Author. Apartment Floor Plan, Work From Home Day Time. 2022.

At night time, desks retrieved into the shelves, bed, sofa, television, dining tables and fitness equipment are taken out. The interior layout is completely different from the daytime version. Reconfigurability ensures a work-life separation.

Spaces within the walls are occupied by human beings and their in-door pets, spaces surrounding these units are occupied by non-human creatures, birds, plants and etc. Figure 30 and 31, two design zooming-ins depicts some moments of animal life within the building. There are bird houses attached to the columns, meshes for birds and plants to climb on, in-building dog park for these pandemic pets to socialize when their human parents are at work.

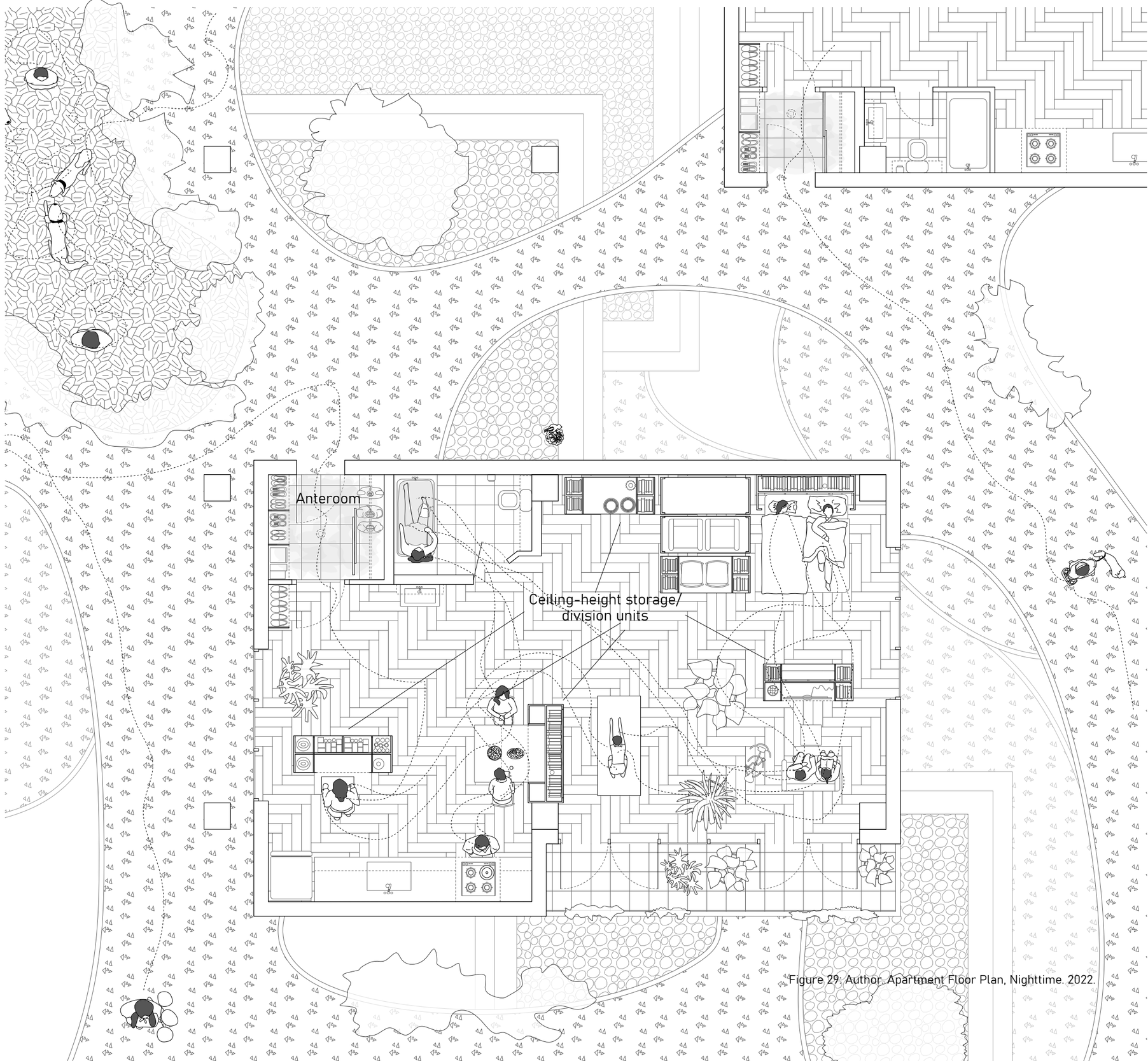


Figure 29: Author. Apartment Floor Plan, Nighttime. 2022.

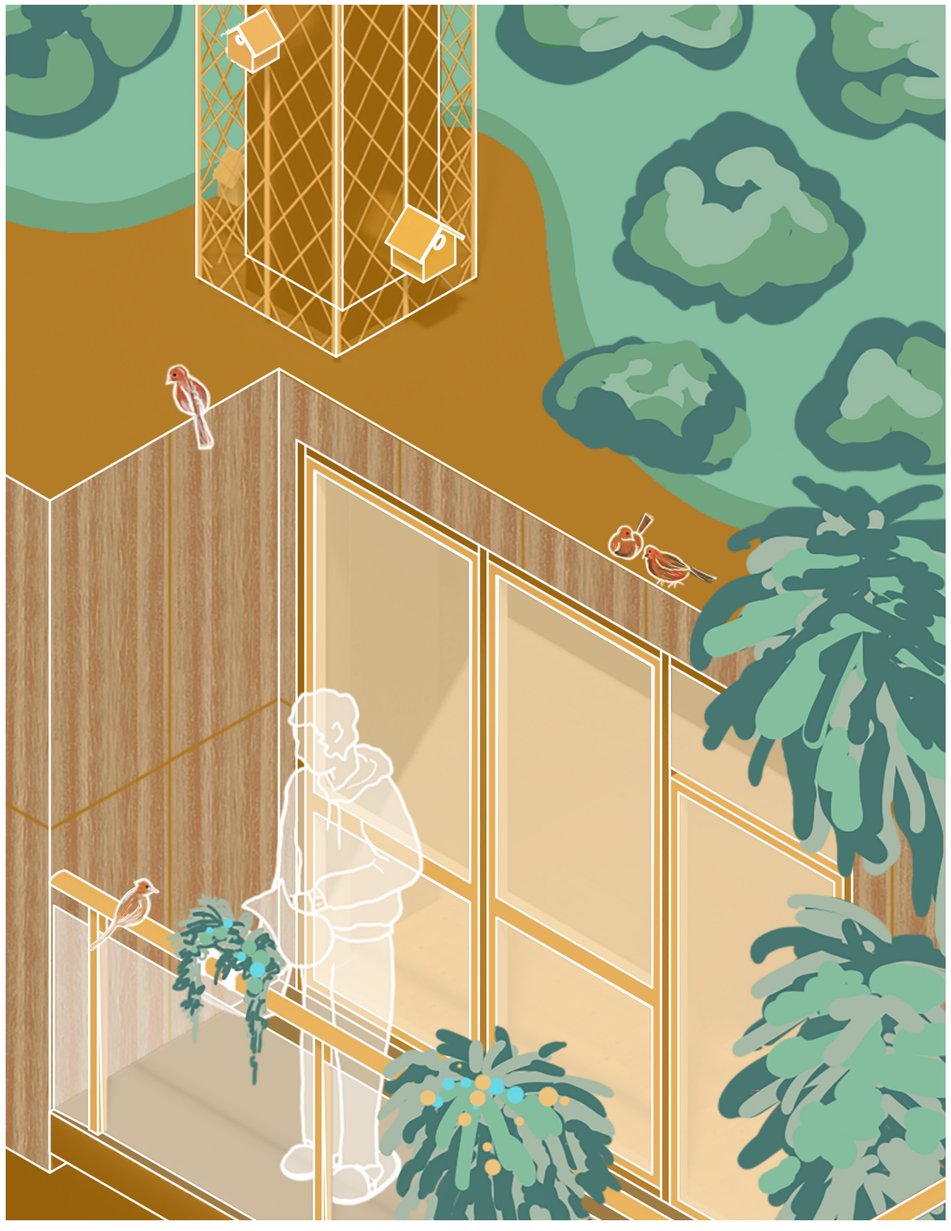

Figure 30: Author. Design Zooming-in 1: Birdhouses. 2022.

Figure 31: Author. Design Zooming-in 2: Dog Park. 2022.

## 4.4 Building Clusters

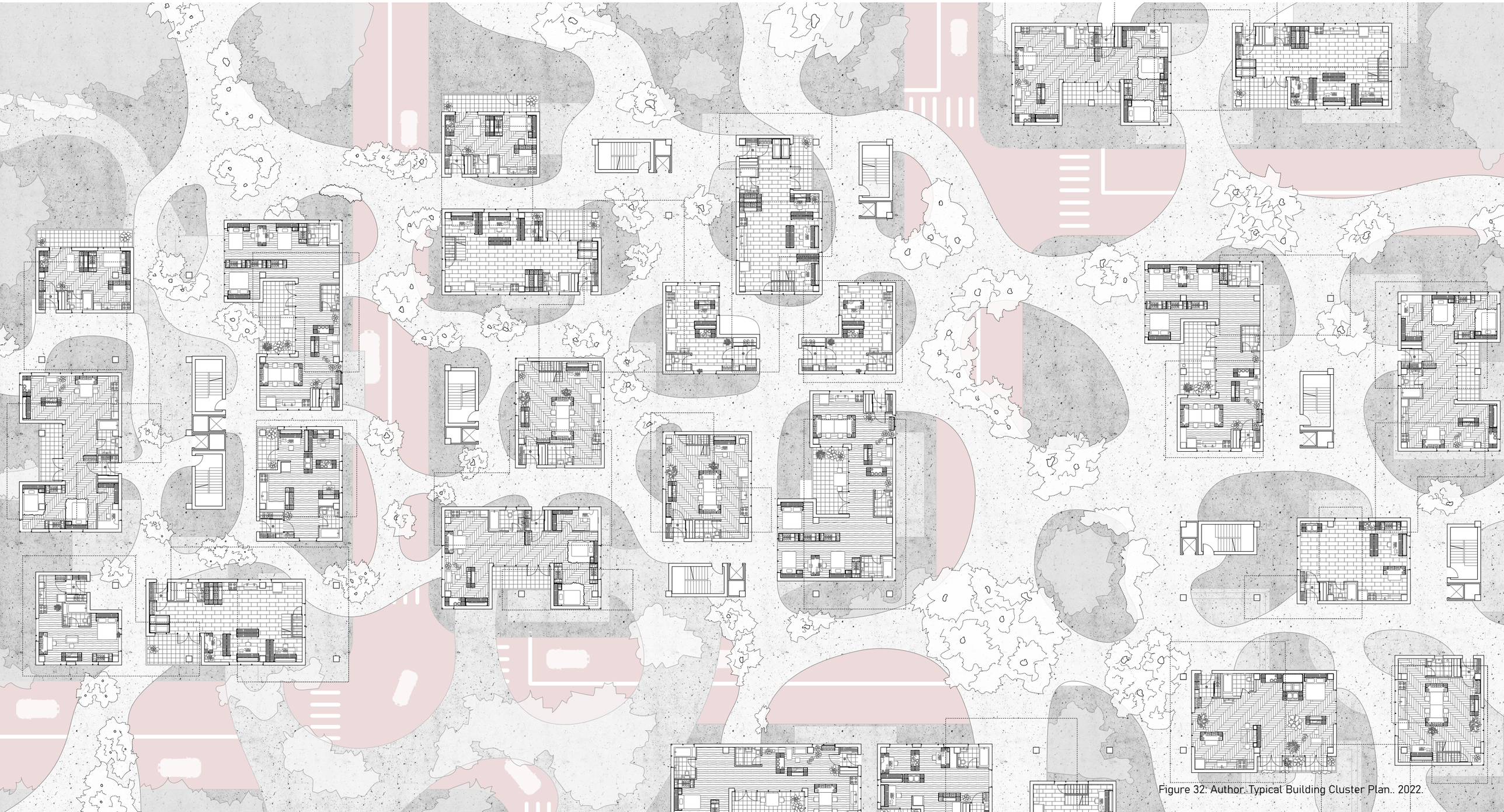

Figure 32: Author. Typical Building Cluster Plan.. 2022.

The plan drawing (Figure 32) cuts through a level where the elevated public pathway connects to adjacent buildings. The dwelling units are of various sizes and layouts, from the smallest 40 sqm one-person apartments to two-story units for a large family, to accommodate the needs of The distance between every two units is large enough for pedestrians to walk through while keeping the recommended social distance from other pedestrians or the unit occupants standing by an opened window or balcony. All the units have efficient cross ventilation.

The section drawing on the side (Figure 33) shows how the units and elevated pathways, public spaces are stacked vertically. All buildings are very porous, birds fly through them, and use the roofs, plants, and pathways as resting points. Outdoor, open-air activities can take place at the widened parts of the elevated pathways. At each point where the public space

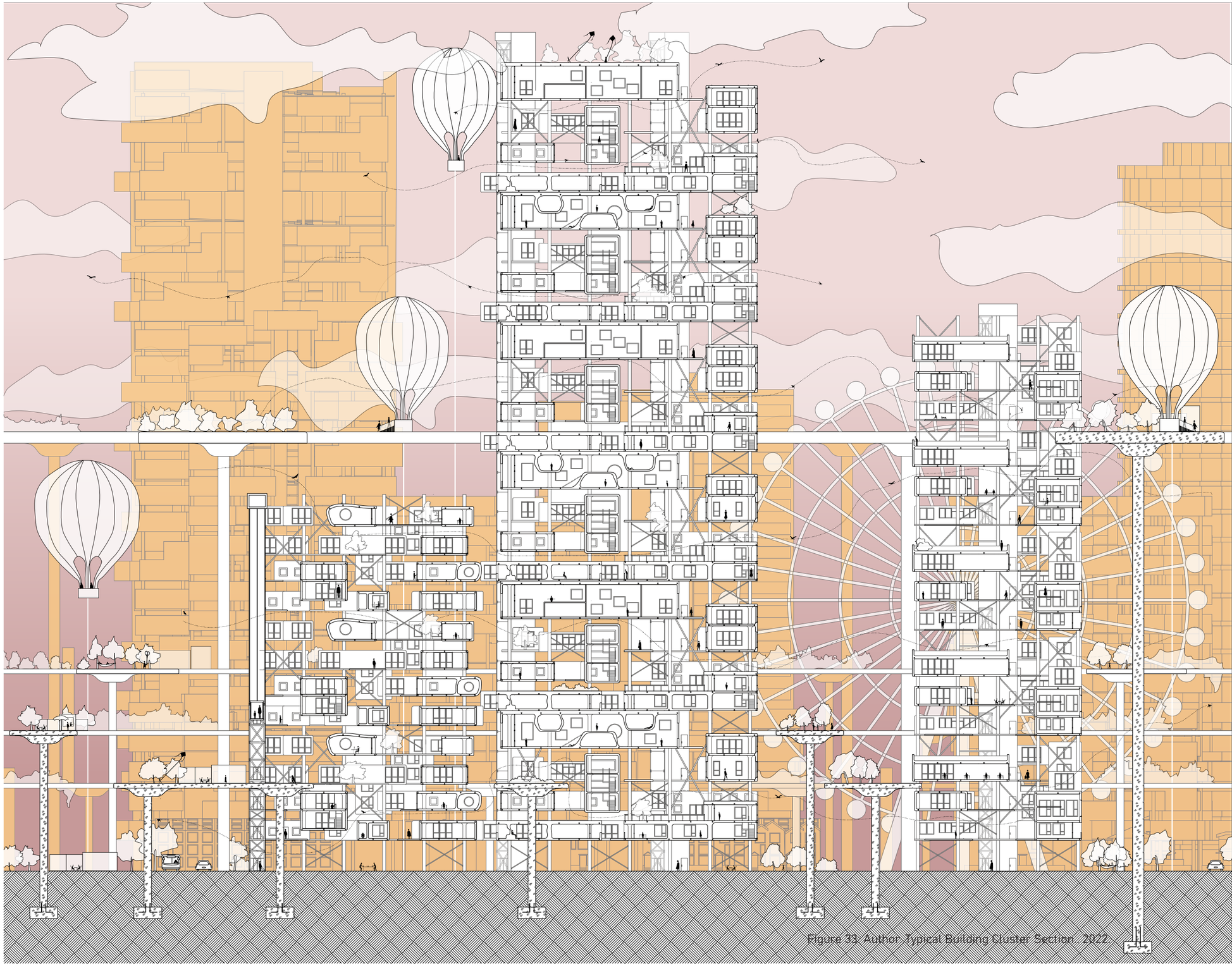

Figure 33. Author. Typical Building Cluster Section . 2022.

and dwelling units meet, there is an anteroom.

This city provides various forms of vertical public transportation for its residents. Pedestrians on the ground level can reach the elevated public spaces by elevator, stairs, or the hot balloons and ferris wheel. The third design zooming-in (Figure 34) depicts the drop-off point of a ferris wheel. The balloon in the fourth drawing (Figure 35) is dropping passengers at a sky train station.

Public spaces are crucial to a city, pandemic only makes them more valuable. The ground level of this city is still occupied, public spaces such as streets and parks are being used, but their capacity is drastically reduced if we compare it to the pre-pandemic number. There is no land to create more public spaces on the ground level. Then people have to move upward and distribute the users of public spaces vertically.

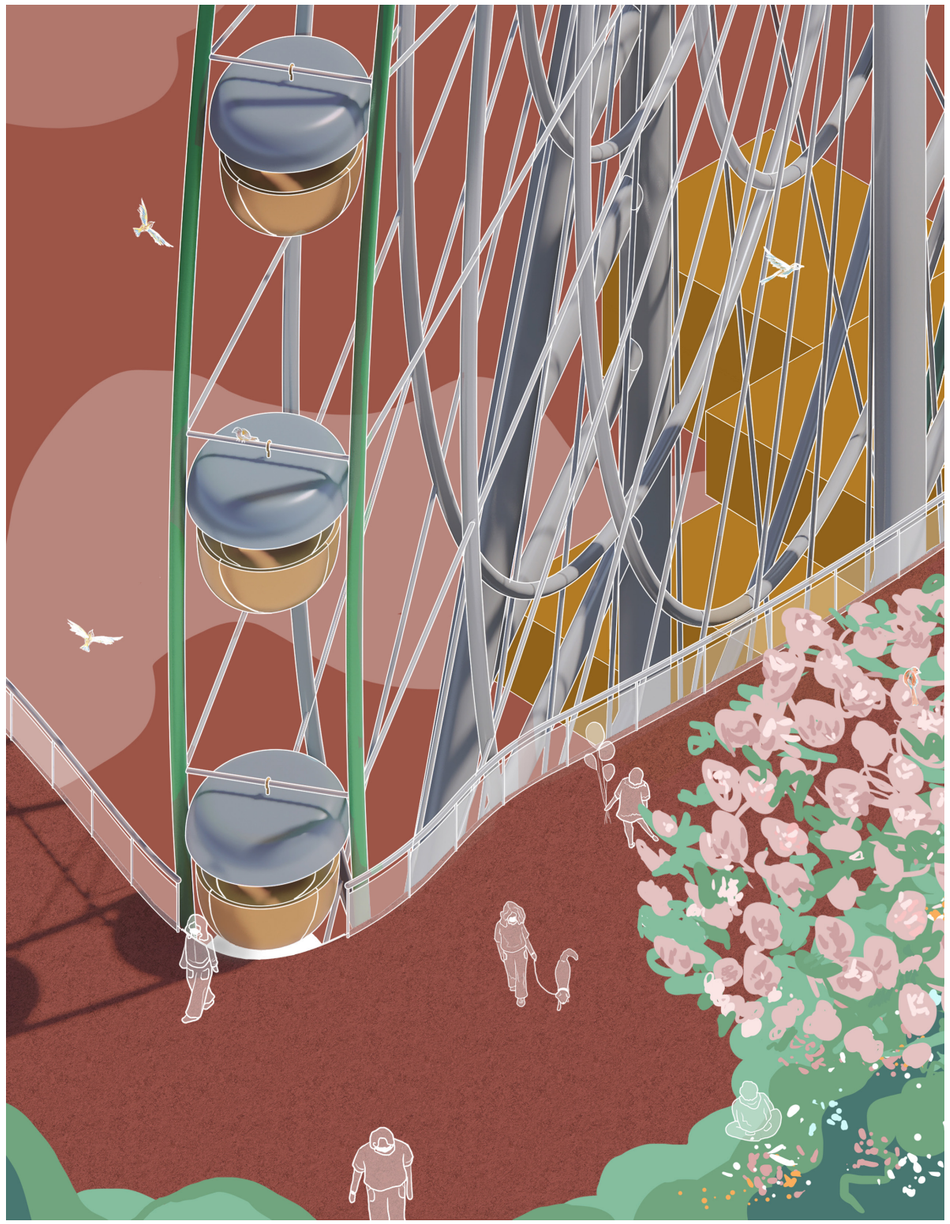

Figure 34: Author. Design Zooming-in 3: Ferris Wheel. 2022.

Figure 35: Author. Design Zooming-in 4: Hot Balloon. 2022.

Figure 36: Author. City Blocks Axon. 2022.

Figure 36 is a diagrammatic axon drawing of city blocks. Orange marks the buildings of the COVID typology, blue marks the buildings from the pre-covid era, dark red represents the elevated pathways, and pink marks the roads on the ground level. This drawing shows a scene from the transitional period, in which some buildings of the pre-covid era haven't yet been replaced, coexist with this new typology. Pre-covid single-family detached houses and townhouses can perform well in COVID pandemic, but these massive midrise and highrise buildings cannot. They are transformed into urban agricultural lands, hydroponic farming and roof top farming,  or open-air public spaces, where their envelopes are removed, structural elements treated to be exposed.

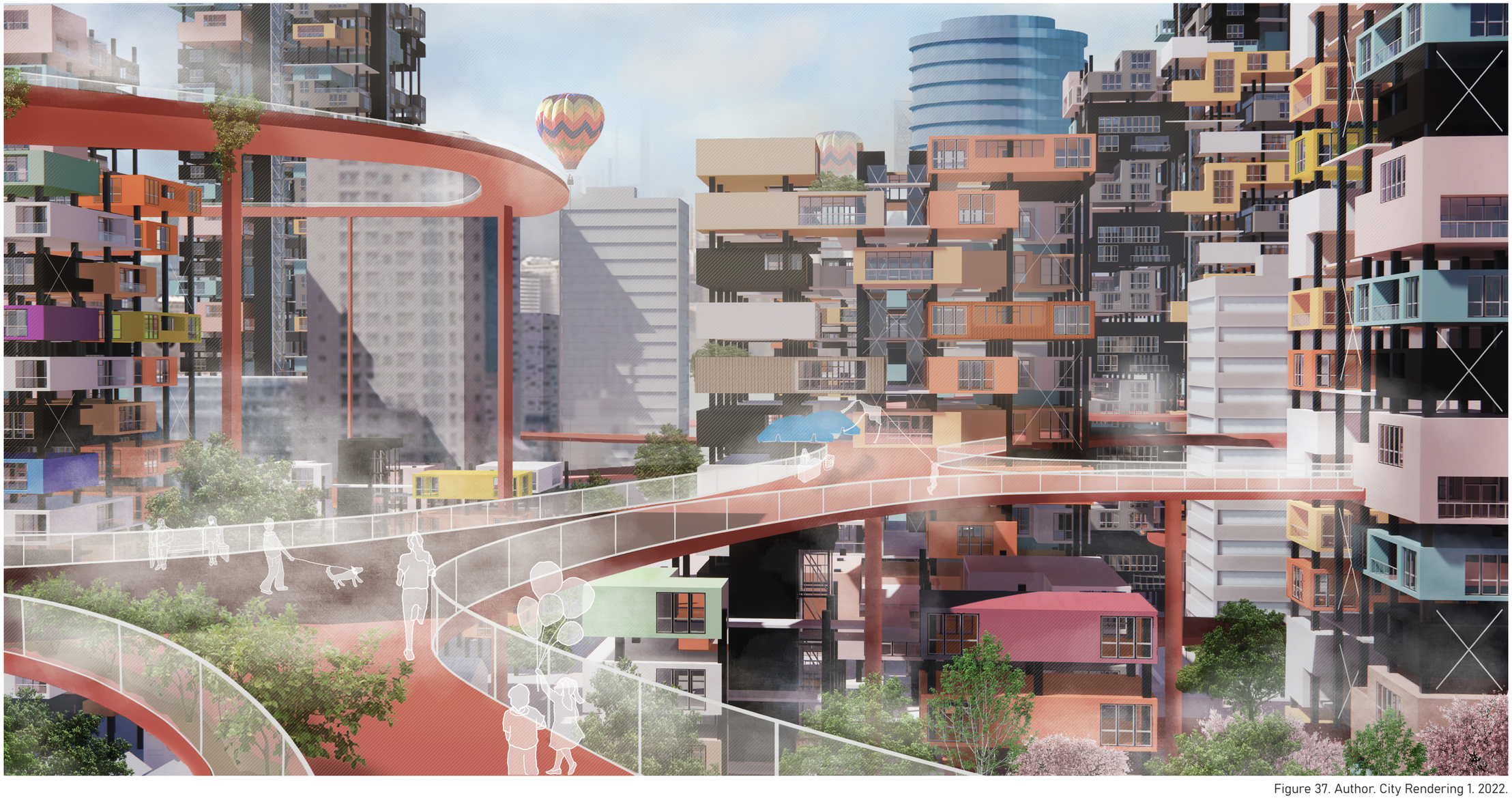

Figure 37. Author. City Rendering 1. 2022.

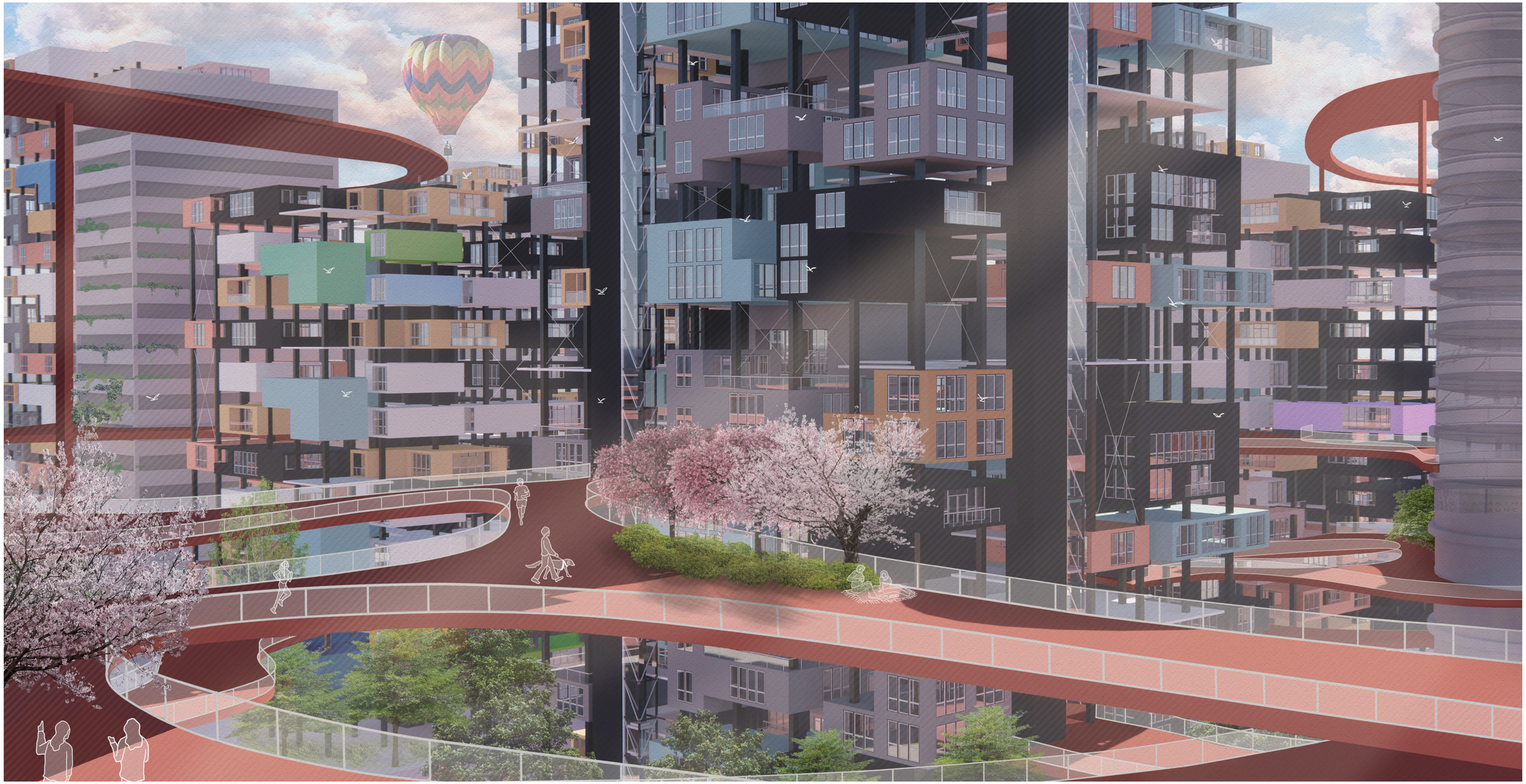

Figure 38. Author. City Rendering 2. 2022.

Figure 39. Author. City Rendering 3. 2022.

Pandemic is a depressing time.

Instead of depicting a dystopia of disease where everything goes wrong, everyone lives in panic, wearing full-body protection gear, I want the visions in this project to be fun, playful, and happy.

Love and peace to everyone.

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