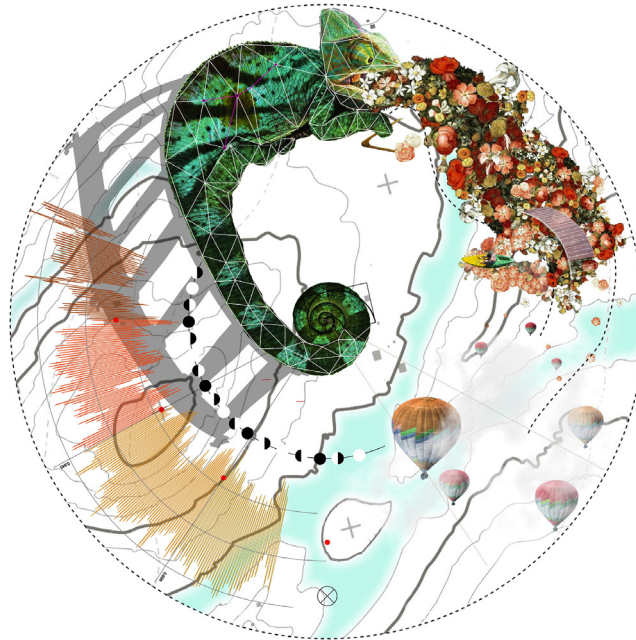


Ele[mental]



Connecting the User with the
Planet through Architecture

Leith A. Almashal



Elemental: Connecting the Users to the Planet through Architecture

Leith A. Almashal

Thesis submitted to the faculty of Virginia
Polytechnic Institute and State University in partial
fulfillment of the degree of

Masters of Architecture
in
Architecture

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Alexandria, Virginia

Elements, Spirit, Passive, Experience

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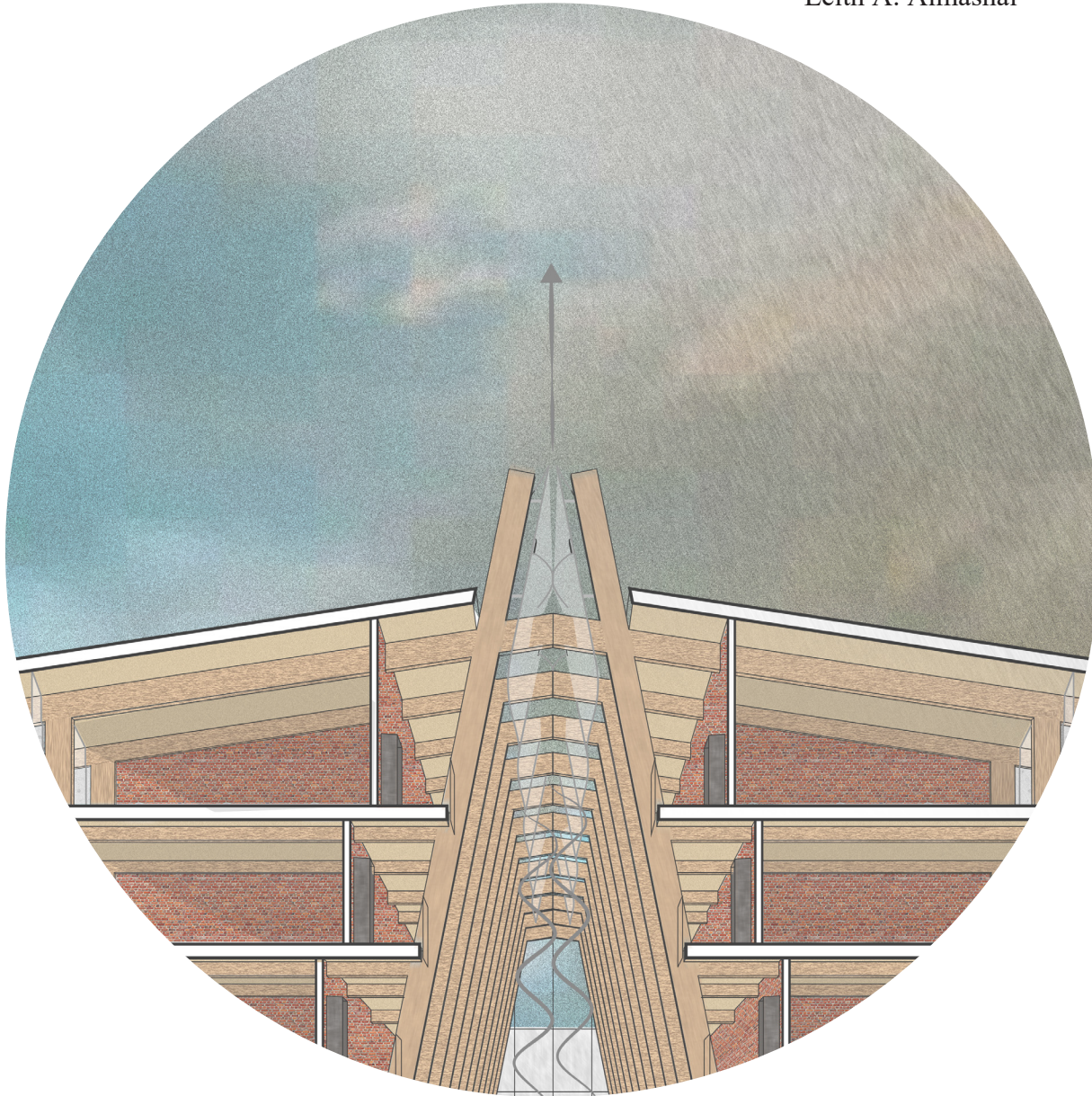
Abstract

The modern world has forgotten a crucial part of what historically has been a beautiful experience in our homes: its connection to the planet. This thesis proposes a mix-use building that acts as an instrument to connect the users with the planet while maintaining contemporary standards of living. I believe that human beings have an innate tendency to connect with nature. The building design will have a passive aspect that is experiential and the active aspect that is functional. The spaces come alive through design by translating the planet's four elements as a part of the daily lives of the users, activating the Fifth element, the Spirit. Connecting with nature on a fundamental level will enhance the inhabitants experience and create a connection with the planet through the spaces we inhabit.



Elemental: Connecting the Users to the Planet through Architecture

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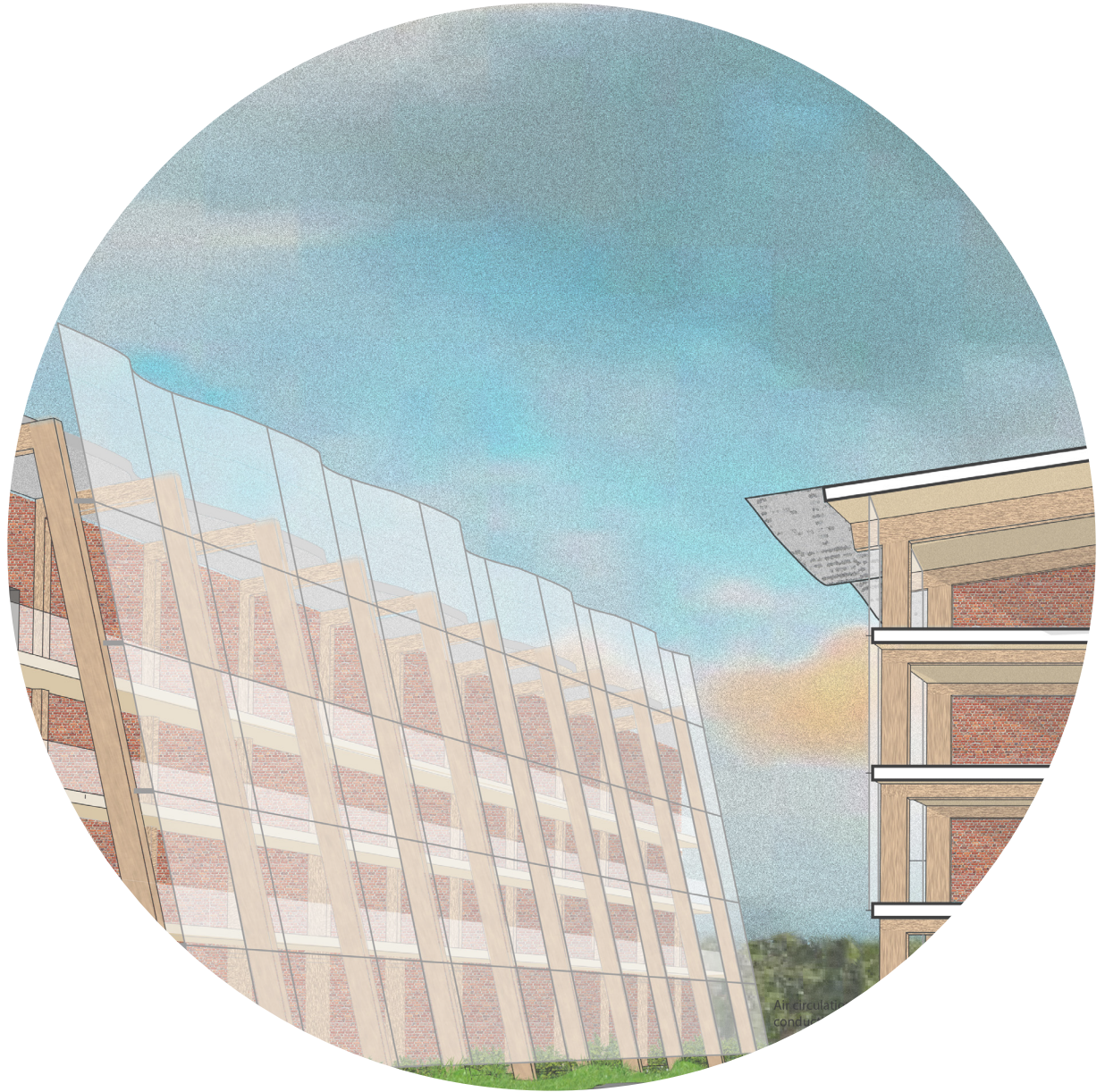


General Audience Abstract

Throughout history our homes reacted to the rains, winds, sun, and earth. Today, there is a disconnect between the dwelling and the planet. This thesis observes this disconnect and responds to it through a mix-use building design that acts as an instrument to connect the users with the planet while maintaining current standards of living. Connecting with the planet will enhance the inhabitants experience by creating a connection through the spaces we inhabit.

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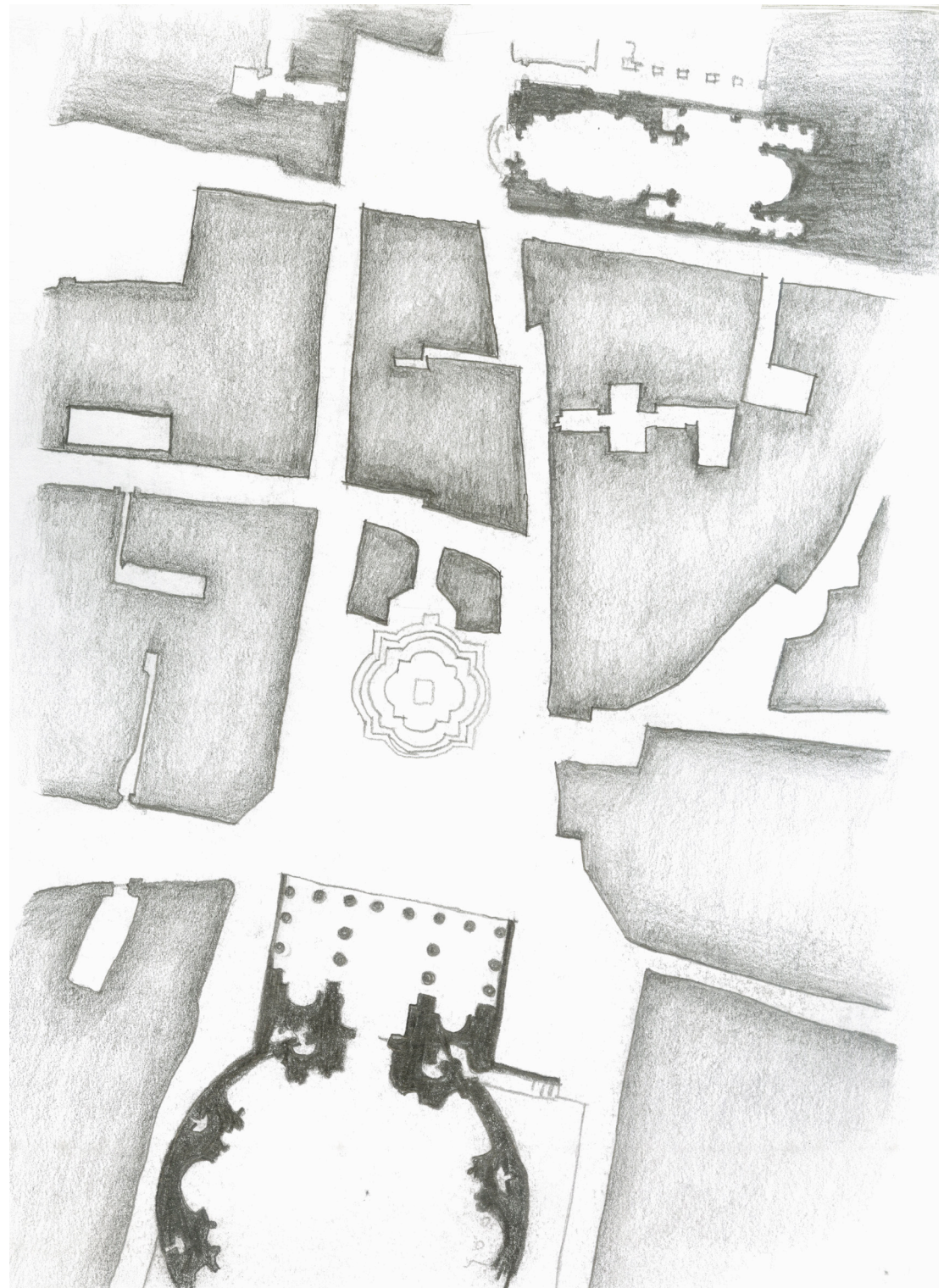


Introduction

My realization of the power of the elements in architecture started when I was young in our apartment home in Amman, Jordan. During a hot summer night, instead of using our window hung AC my father would open windows at two ends of the apartment, one facing the direction of the prevailing winds and the other on the opposite end. The result was a cool breeze running through our apartment that can never be replaced by any mechanical invention. At the time I thought nothing more than what I was experiencing, but as I got older and more curious I started to realize that this experience can be created for anyone through design.

Years later, during my undergraduate studies, I visited the Pantheon in Rome. As I enter the space its history can be reminisced. To my luck it began to rain outside. I saw the rain coming down the oculus and then received by the drains in the center of the space. This experience was the first time I felt the connectedness with the planet that was produced through design since my father's natural ventilation trick.

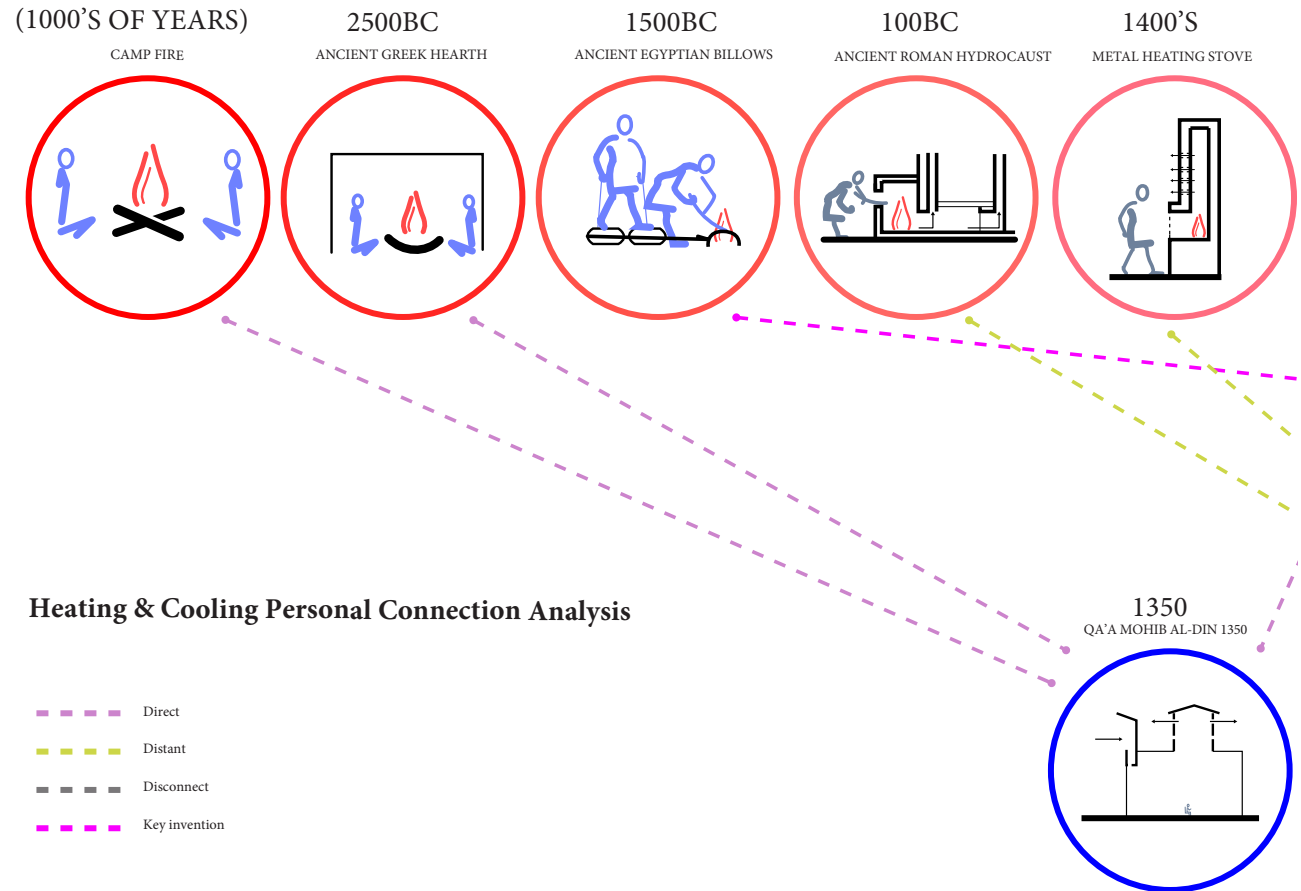
How have we gone from these works of architecture that were working in unison with the planet to what is created in many cities today, architecture that does not integrate our senses with nature. In order to start my research on how to connect the users to the planet, I needed to first understand how and why our societies became so disconnected in terms of architecture. Everywhere we look around, a new glass box is erected with no long term consideration to the forces of the planet and how they can enhance our life. My journey commenced by studying the history of heating and cooling, starting with the humble camp fire.



Heat & Cool

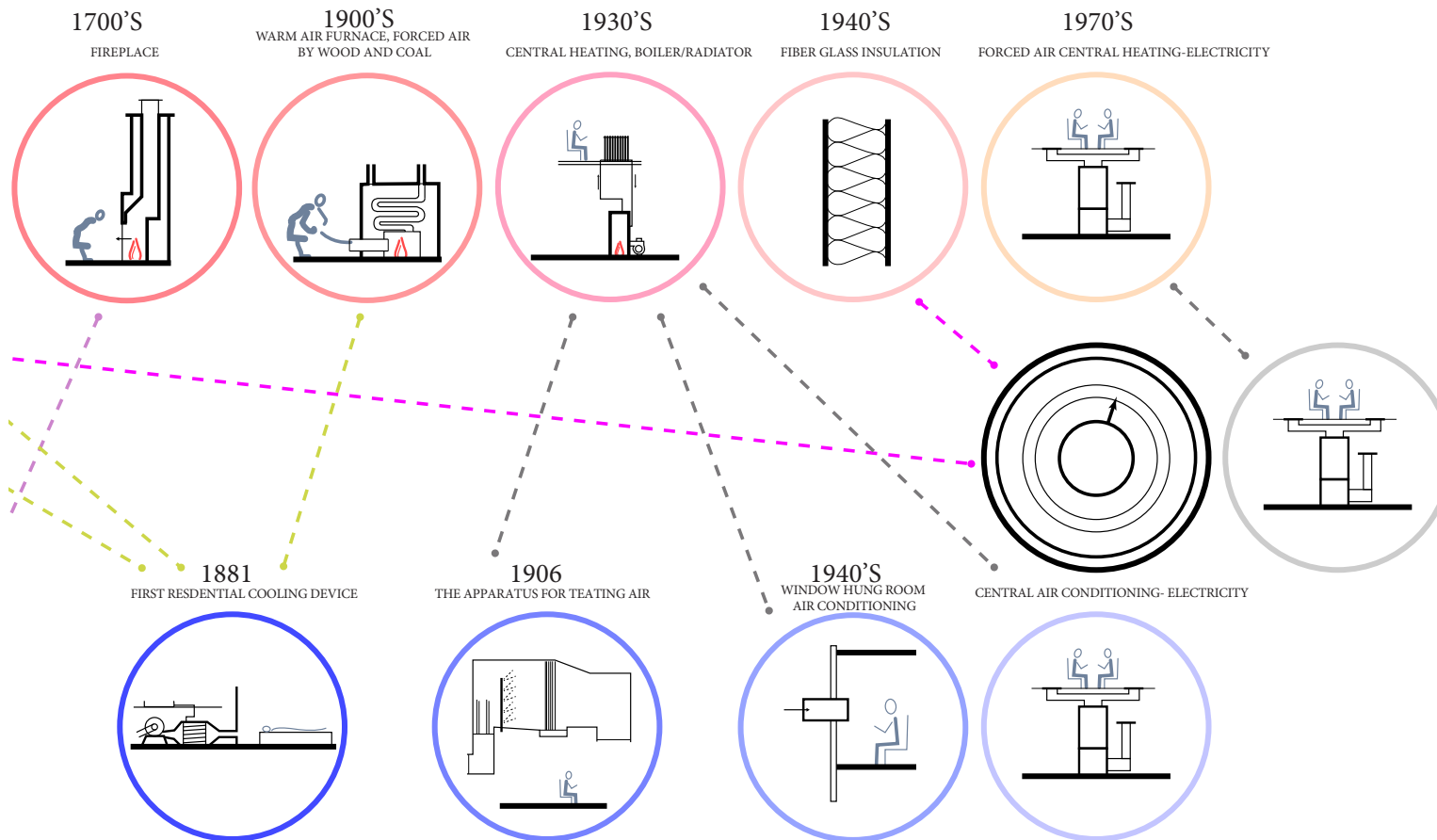
The “camp fire”, an open flame controlled by a few stones surrounding the fire, is the earliest known means of heating caused by the combustion of wood. The heat is directly transferred from the flame to the person. Direct interaction happens when the heating or cooling does not go through any means of transfer. The bonfire, the hearth, systems involved in cooling Qa’a Muhib Al Deen and the fireplace have had a direct interaction with the users.

In 100 B.C. the hypocaust heating system invented by the Roman empire, was integrated in the walls and floors of their buildings. The word hypocaust comes from the greek words “hypo” which means “under” and “caust” which means “burnt”. The fire was stoked below the ground level. The heat rose through gaps in the wall and floors to heat the spaces. The hypocaust was an innovation that distanced the user from the direct flame by receiving its heat transfer through the walls. Similarly, the metal heating stove, the first residential cooling device and the warmed air furnace disconnected the user from the direct source.



From the 1940s onward, our innovations became more and more efficient yet at the price of creating a complete disconnect between the users and the source of heating and cooling.

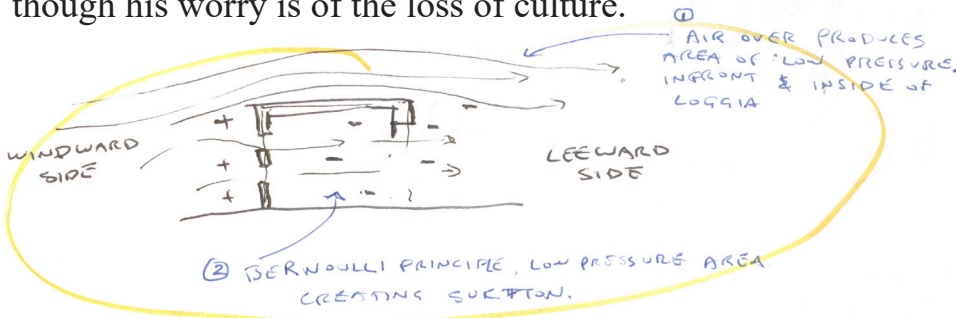
The result of this study concluded that we lost our interaction with the planet because of our focus on efficiency, which took precedence over the experiential benefits of heating and cooling. It is not only the heat that we gain from the fire, or hydration from the water, or coolness from the wind, or shelter from the earth, it is much more than pure function. There are a few architects in our modern world that have aligning views, the next stage in my research is studying these architects and learning from their work.



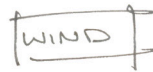
Hassan Fathy

Hassan was well known for his passively designed mud brick structures and his attempts to create harmony with architecture and the winds. He was inspired by the durability, structure, and spatial possibilities of mudbrick and its poetics, “both come from the earth and must eventually return to it, dust to dust”, a quote from his book Architecture Monographs. His research focused on the national architectural identity of Egypt and to solve Egypt’s housing problem.

In his book Architecture Monographs, Fathy wrote “*Nowadays, we never think about what we are losing by not reacting to nature,; but if you take the solutions to climatology in the past, such as the wind catcher, which considers wind movement and aerodynamics, and the marble salsabils with carvings of waves on them for the water to trickle over on its way to the fountain, you find they create culture. With today’s air conditioner we have removed culture completely.*” Hassan strongly believes that there is much more involved when reacting to nature, although his worry is of the loss of culture.



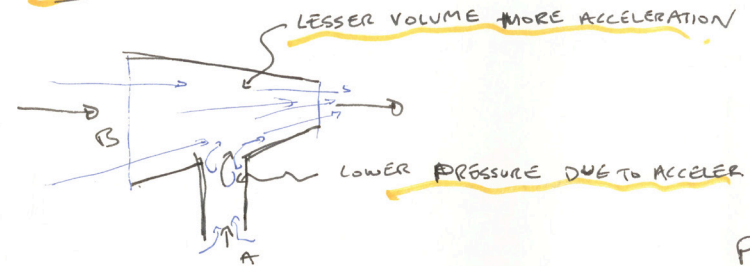
“*Experience has shown that air movement is faster and steadier when the area of the openings on the leeward side of a structure is larger than the inlets on the windward side.*”; “*narrow inlets allow for air to cool before reaching main space*” -Fathy, Natural energy and vernacular architecture.



ARCHITECTURE CAN ENJOY NATURAL AIR MOVEMENT THROUGH 2 PRINCIPLES:

- 1 - DIFFERENCE IN WIND VELOCITY PRODUCE PRESSURE DIFFERENTIAL WHICH RESULTS IN AIR FLOWING FROM THE HIGHER TO THE LOWER AIR PRESSURE REGION.
- 2 - AIR WARMED CAUSING CONVECTION

BERNOULLI EFFECT



P. 53

$$V_A = V_B^2$$

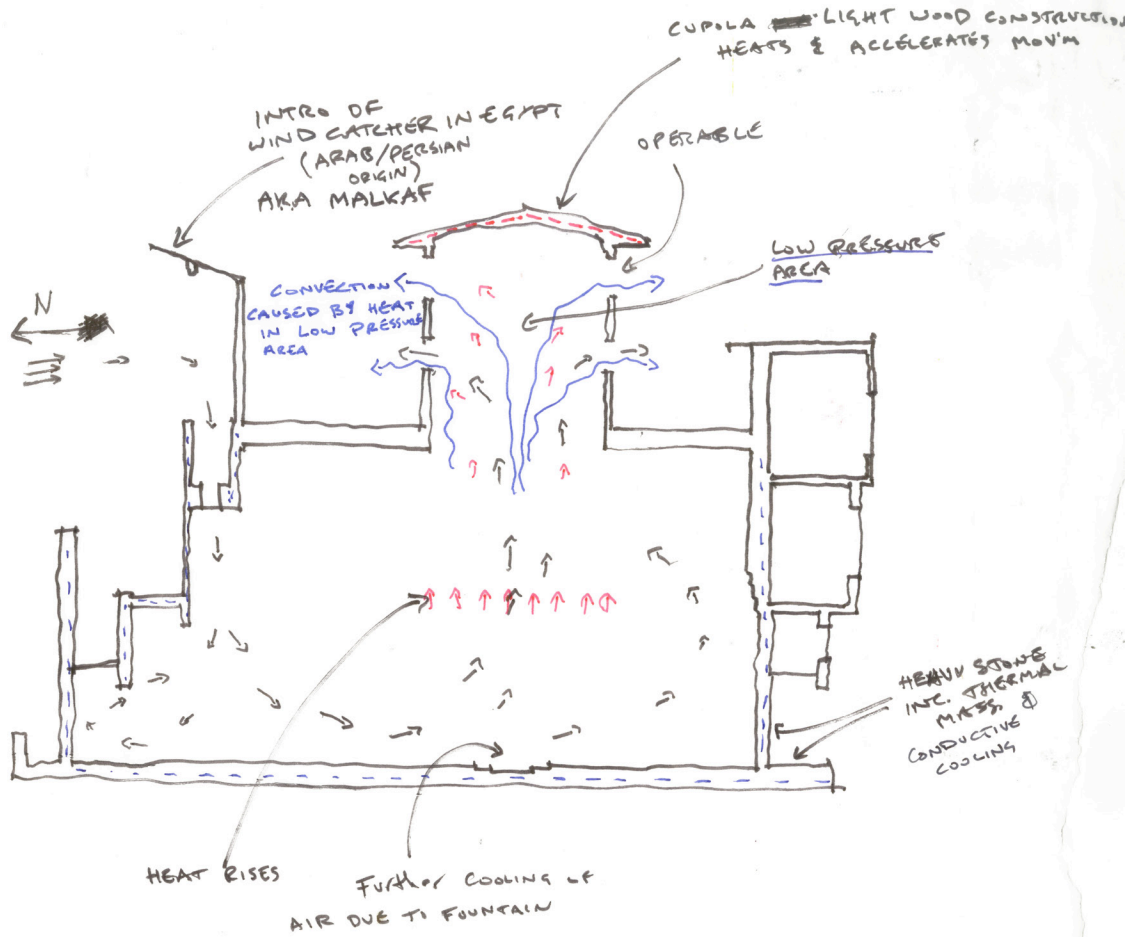
The study of Hassan’s projects and precedents along with several practical experiments to prove my understanding of wind movement in architecture (video link), I started to appreciate the integration of wind in architecture for function as well as experience.



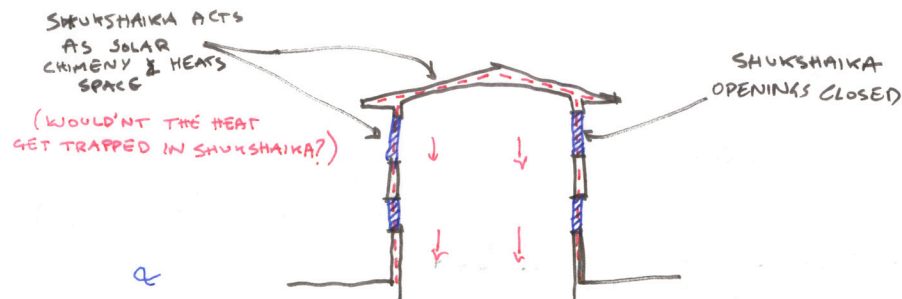
<https://leitha6.wixsite.com/experiment>

What most interested me was one of Hassan's precedent studies, The Bayt Muhib al Din Muwaggi (Bayt Kathoda). Bayt Kathoda is known for introducing the wind catcher (Malkaf). In his book NEVA Fathy wrote of the environmental control achieved. The wind catcher was oriented towards the prevailing winds which allowed regulation through several degrees of openings inside. Air directed through center of hall cooled further by introducing the fountain into the floor of the Durqa'a. As air heated, it rose to the tower above (Shuksheika), escaping through the openings. Shuksheika thus turned into a low-pressure area and per the principle of convection began to draw air into it. The cupola was made of light wood construction causing it to heat up and accelerate movement in the interior even when the air outside was perfectly still. In the winter, tower openings closed turning it into a solar chimney that would heat up the interior on the green house principle. Walls and floors built of heavy stones increased thermal mass and as a result slowing heat penetration from outside, preserving cool air inside and aiding conductive cooling of people inside the room.

In his book Natural Energy and Vernacular Architecture, Fathy wrote "Architecture can ensure natural air movement through 2 principles: 1- difference in wind velocity, produce pressure differentials which result in the air flowing from the higher to the lower air pressure region. 2-air warmed causing convection"



SUMMER PASSIVE AIR CONDITIONING
OF HOUSE OF MURIBB AL-DIN
MUWAGGI



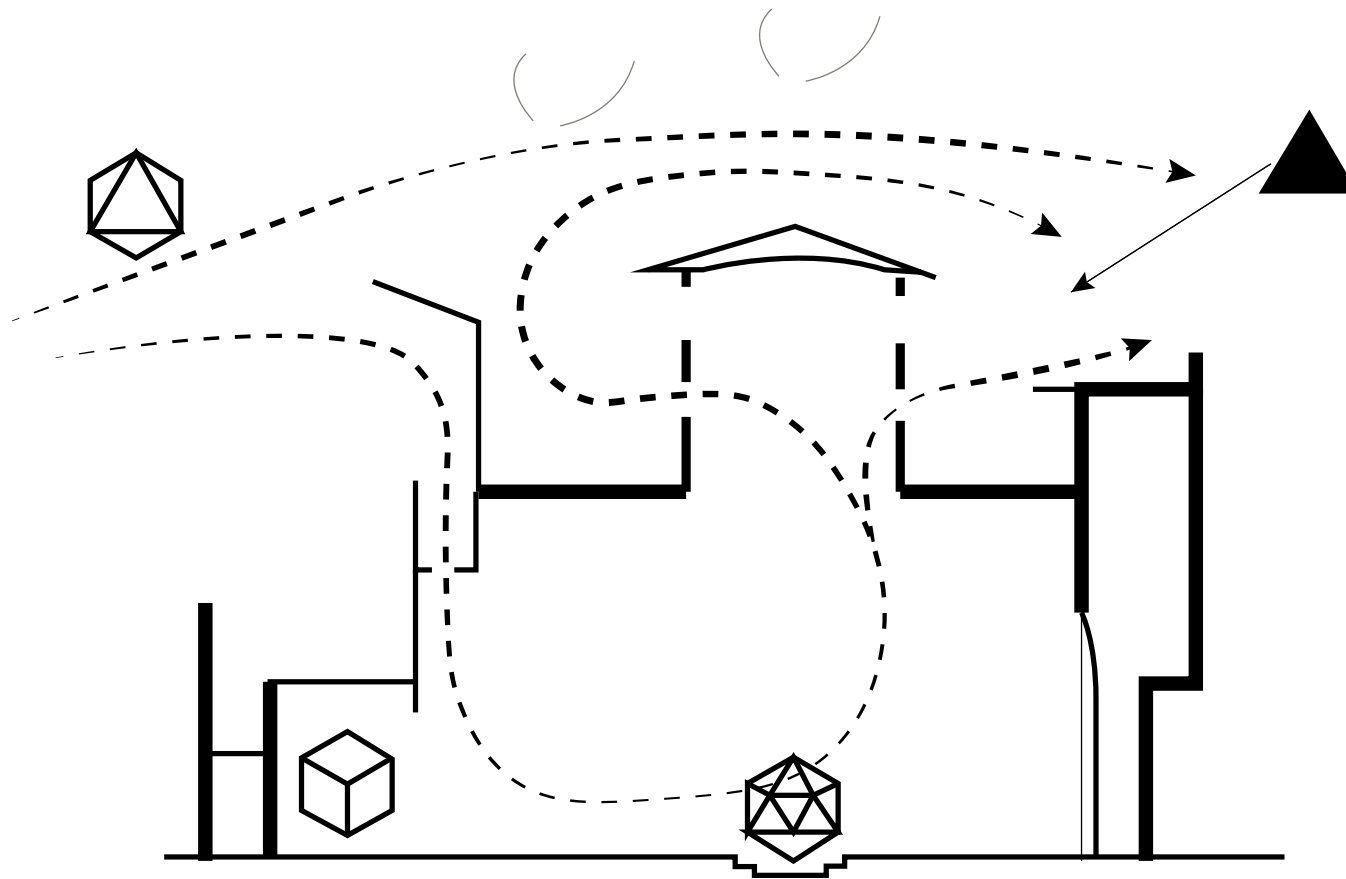
Bayt Kathoda Diagram

This following diagram illustrates the connection of architecture with the elements. This study helped me realize that architecture must work as a whole, as one design which brings the elements to unison for the building to come alive.

The elements' symbols are adopted from the "Platonic Solids" due to Plato's similar view on the elements as an experience. In his book *Timaeus*, Plato wrote "Let us now assign the geometrical forms to their respective elements. The cube is the most stable of them because resting on a quadrangular plane surface, and composed of isosceles triangles. To the earth then, which is the most stable of bodies and the most easily modelled of them, may be assigned the form of a cube; and the remaining forms to the other elements,—to fire the pyramid, to air the octahedron, and to water the icosahedron,—according to their degrees of lightness or heaviness or power, or want of power, of penetration." The single particles of any of the elements are not seen by reason of their smallness; they only become visible when collected." Plato relates each element not only through science, but also with feeling and associates it with a shape that corresponds with the feeling. The sting of fire is related to the sharpness of the tetrahedra and the smoothness of the air is given the octahedra, the smoothness of water to icosahedra, and the stackable cubes are given to Earth. Although my view of the 5th element corresponds more to an Aristotelian view.

The spirit is born as a result of the four elements. Similar to the Aristotelian point of view "pneuma is the fifth - element - in - its - connection - with - the - changeable - sublunary - elements, and differs in vital force and vital quality... Pneuma does not exist separately , by itself, but exclusively mixed up with the sublunary elements.";(421) "3.And overall he [Aristotle] agrees with Plato on most matters, with the exception of the doctrine of the soul. 4. For according to Plato the soul is immortal, but according to Aristotle it survives and also disappears then by merging into the 5th element, which he assumes to exist alongside the other four - Fire and Earth an Water and Air- <but> more subtle, like pneuma." Wrote Bos in his "Pneuma as Quintessence of Aristotle's Philosophy" (424). Following this research, my belief is; if architecture was designed to receive the 4 elements and translated for the users to experience, then the spirit is living "alongside" the translation of the 4 elements.

Upon studying Hassan Fathy's precedent *Qa'a* of Muhib Al-Din Ash-Shafi, I have created this diagram to illustrate how the 4 elements create the harmonic architecture.



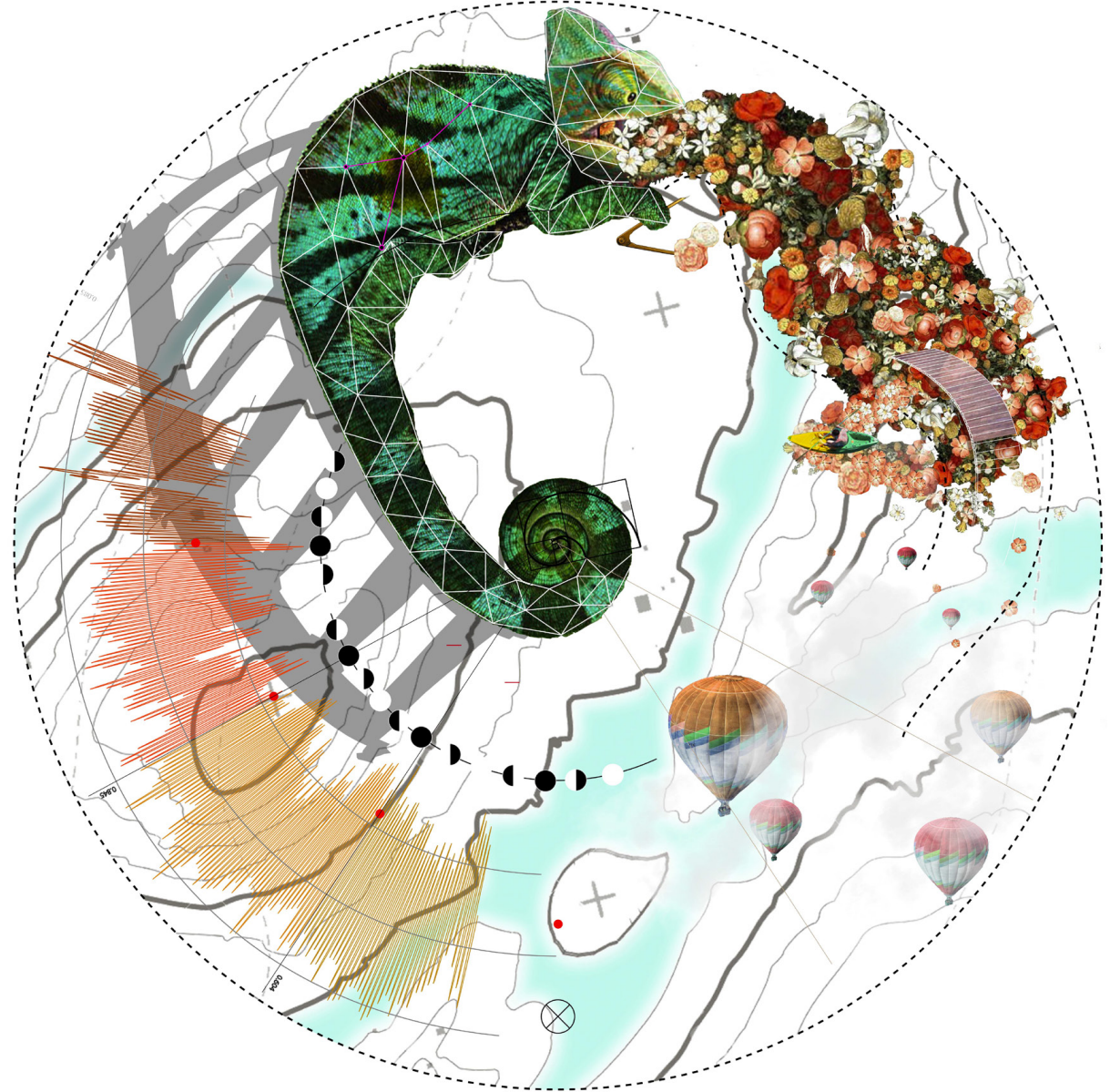
Qā'a of Muhib Ad-Din Ash-Shāf'i, 1350
Location: Cairo
Climate: Desert

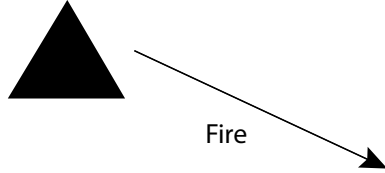
Glenn Murcutt

Glenn Murcutt naturally came as my second case study after Hassan Fathy due to his similar philosophies in harmony in design implemented in a contemporary manner.

In his book, 'Master Studios and Lectures', Murcutt explains the design process as a process of discovery rather than a process of creation. *“design is a response to where you are”*; *“Our role as architects is that of the discoverer”*; *“The violin, the cello, any of the brass instruments. They haven't been designed to be beautiful things in themselves.”* These statements are what inspired drawing of “The Discoverer” illustrating the architect's role as a discoverer.

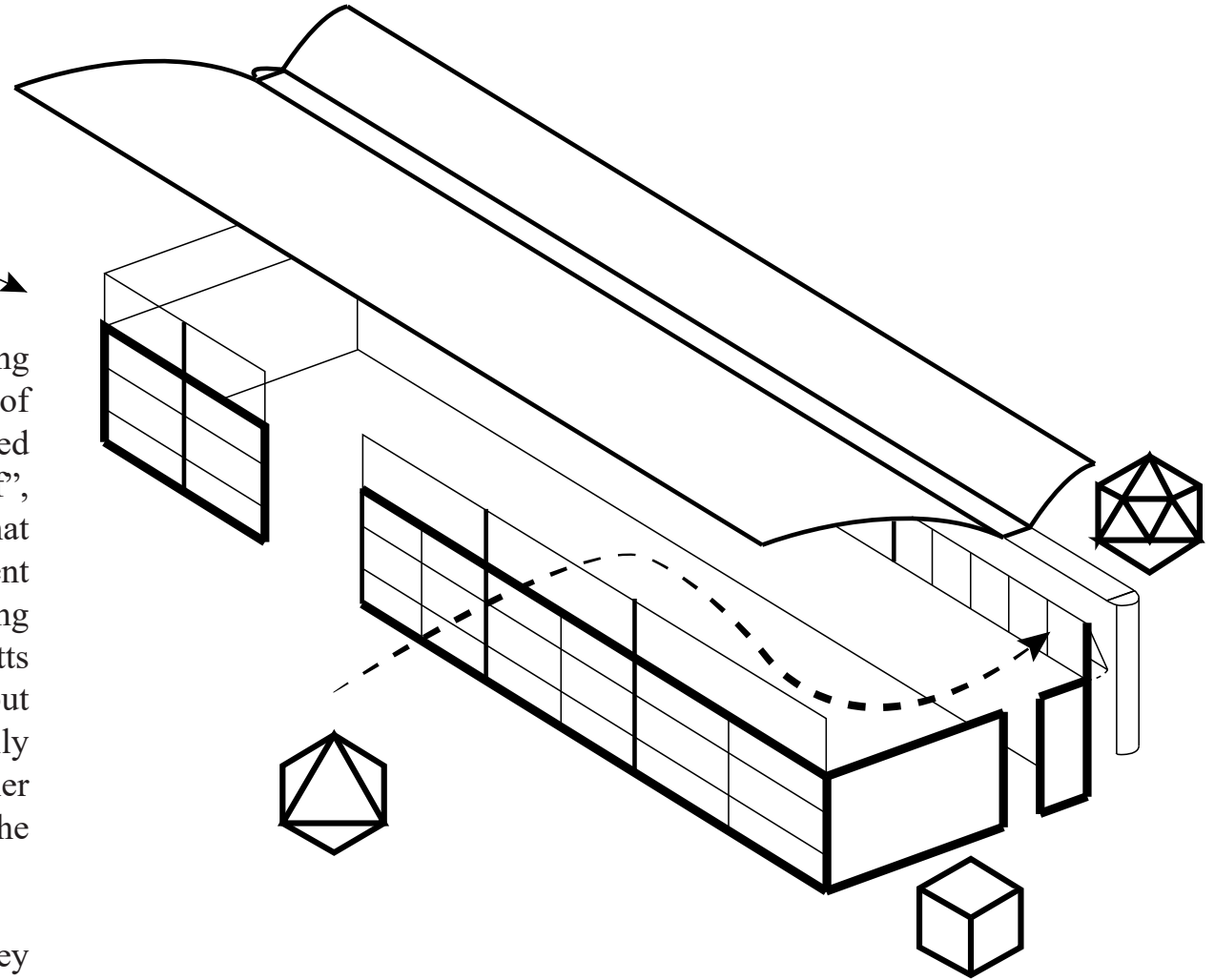
His buildings are alive with the weather, hydrology, history, of the specific location. In his book Master studios and lecture, Murcutt wrote *“The building becomes the instrument to all things around us that are being picked up and being translated for you to experience.”*; *“Aboriginal people don't own land. they have never owned land. The land is their mother. you don't possess you mother. the land is your mother which is a gift of life. you respect it as you respect your mother. you respect it as a gift of life.”*





In a deeper research, in the book “Thinking Drawing”, Gusheh wrote about the proposal of the broken hill mining museum that incorporated big rammed earth walls topped with a “Malkaf”, the use of the word Malkaf revealed that Glenn Murcutt has also studied the ancient middle eastern innovations of cooling using architecture. Gusheh also explains Murcutts concept of “modern architecture without glass”, done by using these systems primarily for their operability (as a wind catcher) rather than transparency. “The window becomes the Malkaf”.

This is a diagram of Glenn Murcutt’s Magney House, illustrating the use of the 4 elements in creating harmony in his residential design. The house is oriented north to face the sun. The roof and the glass act as a wind catcher to capture the cool ocean breeze. Masonry rainscreen embracing the home on the South as a thermal mass to maintain cool temperature inside. Forming an asymmetrical U-shape, the roof of the Magney House collects rainwater, which is recycled for drinking and heating.



Eastern woodland tribes

Studying Glenn Murcutt lead me to understand that it is crucial to inherit the knowledge from the indigenous people of the land as they have a deeper understanding of the value of interacting with the natural world. The following study is of the structure and materiality of the tribes of the Eastern Woodlands which inhabited the lands of present day North Eastern United States. This study had impacted the expression of the structure and materiality in the final design.

● Chippewa, Michigan

● Minnesota - Algoquian conical Wigwam, east of present day St. Paul

● Secota, Virginia. 3 days walk down the Pamlico River

● Powhatan, Virginia.

● Virginia. "Town of pomeiooc" Between present day Wyesocking Bay and Lake Landing

● Assawompset Pond in SE Massachusetts

● Chatham Massachusetts

Saplings

hickory, basswood or elm trees

Use: Framing

Bulrushes , Cattails

pulpy stalks sewed together 4' wide by 10' long

Use: Bedding, Wall mats and Floors mats

Reed

a tall, slender-leaved plant of the grass family that grows in water or on marshy ground.

Use: Siding

Bark sheets

Elm, Birch, Oak

Use: Siding

Thatch

A roof covering of straw, reeds, palm leaves, or a similar material.

Use: roofing

Animal hides

a hide or skin is an animal skin treated for human use

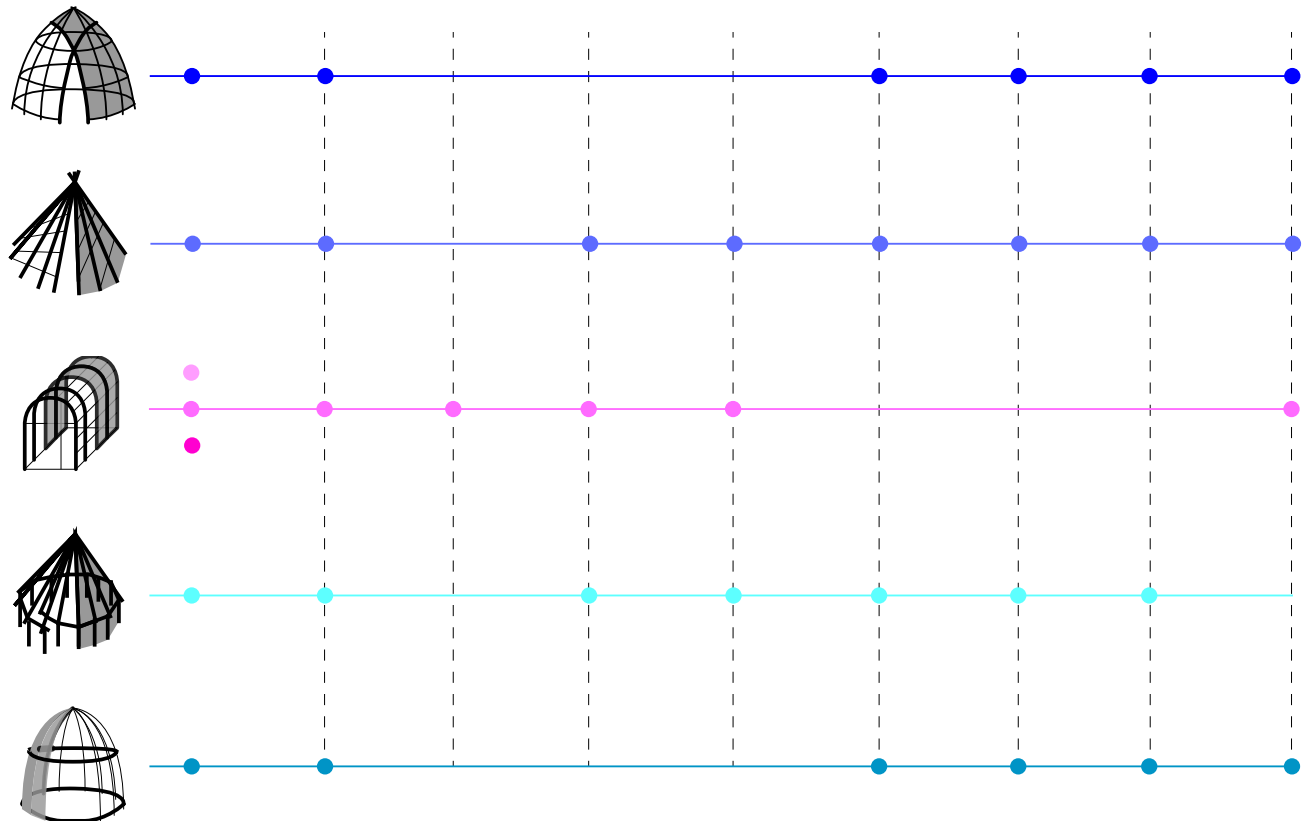
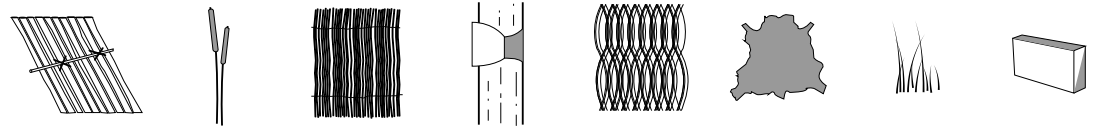
Use: sleeping, doors

Grass

Use: Insulation

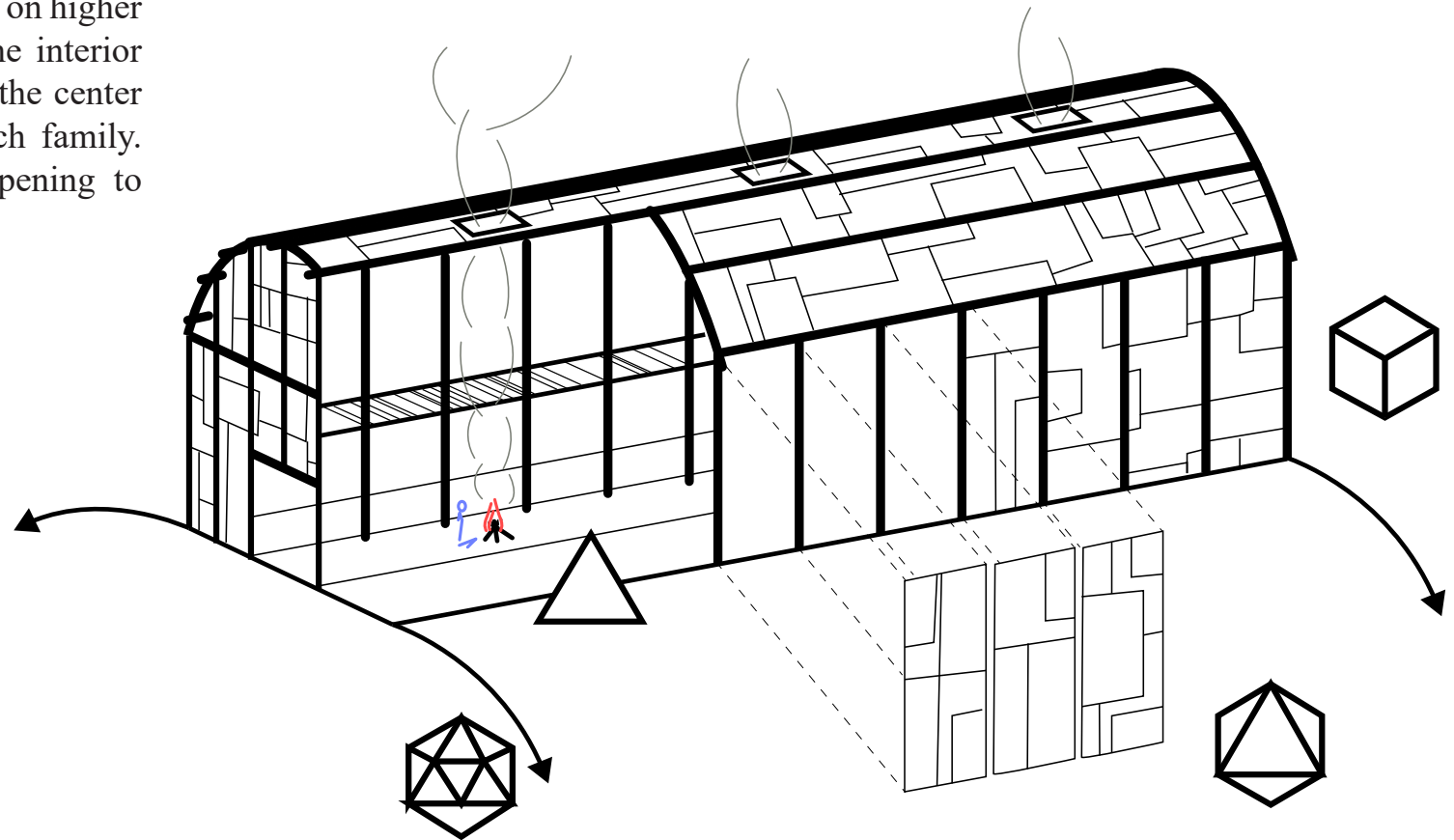
Mud

Use: Smole Hole



The Eastern Woodland long house

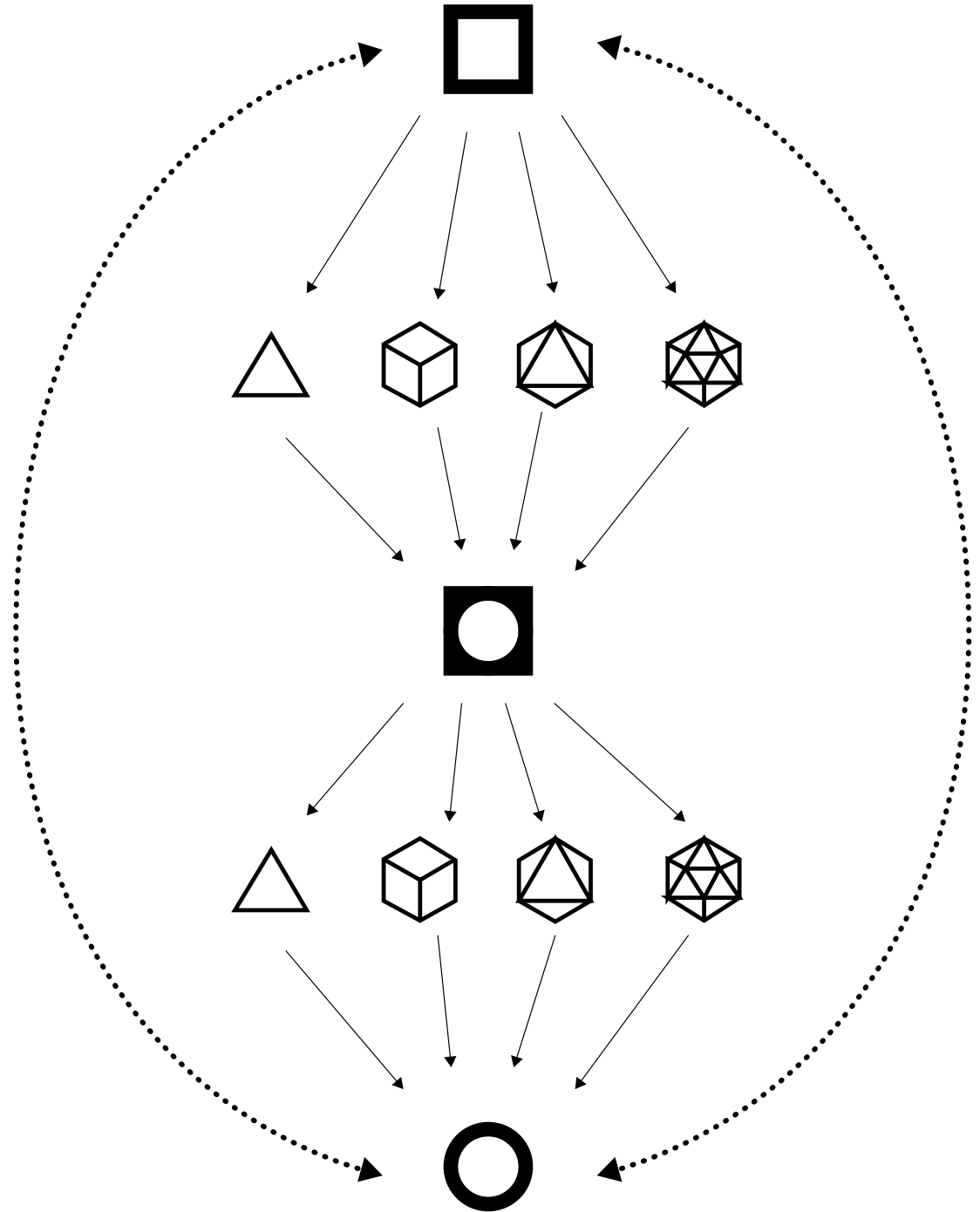
The Longhouse was constructed with a timber structure covered with bark and stuffed with grass as insulation. Bark on the center of the bars are removable or rollable for air circulation in the summertime. They are located on higher ground so the rain drains. The interior is divided into segments and the center is lined with bonfires for each family. Above each bonfire is an opening to vent out the smoke.



Long house - Eastern Woodland Tribes
Location: North Eastern United States
Climate: Subtropical

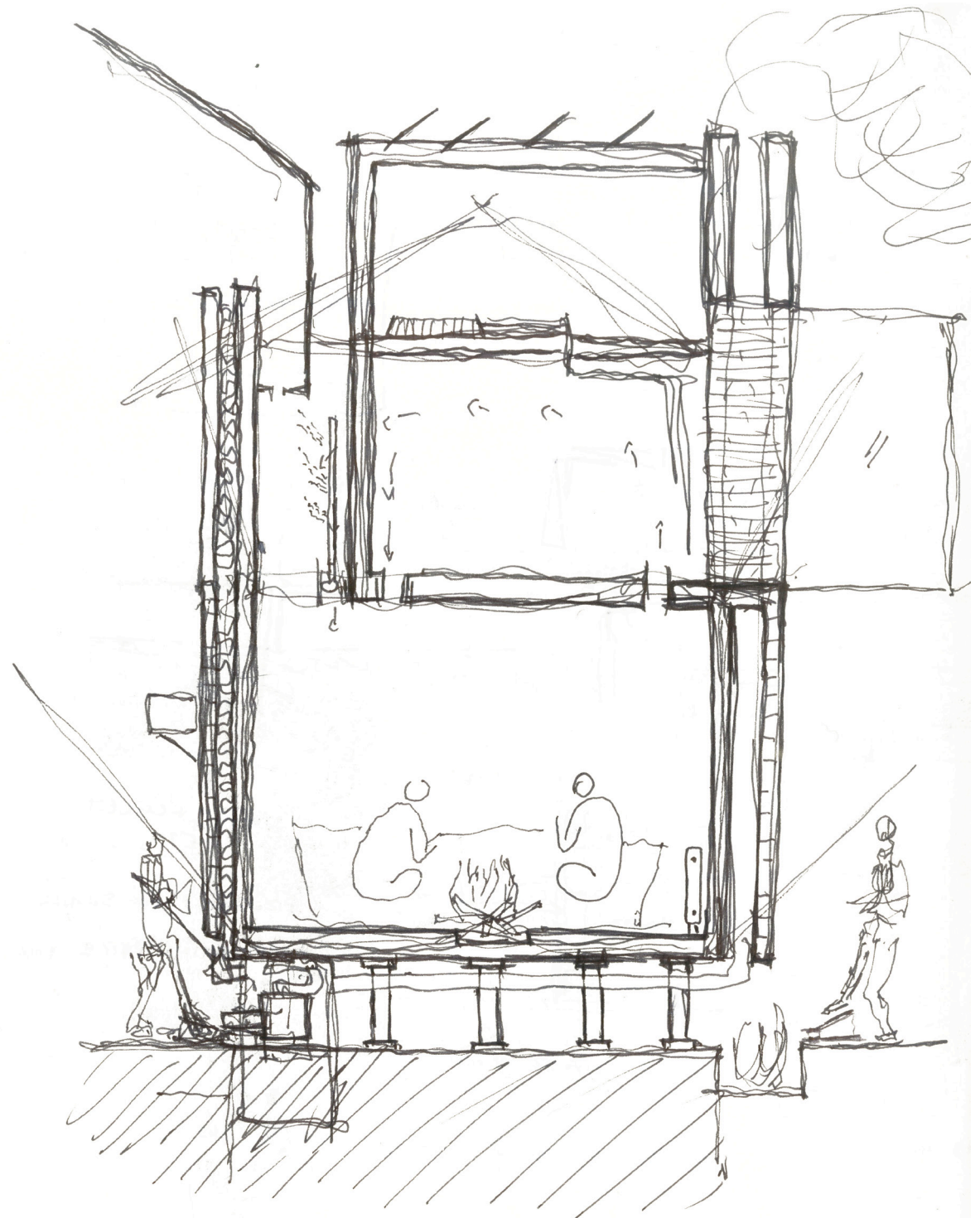
Connecting the dots

This diagram expresses this thesis in a nutshell. The Square is the planet, the planet presents us with its 4 elements, the Sun(fire), Wind(air), Rain(water), and Earth. The Circle inscribed in the Square is architecture. The Architecture receives the Planet's 4 elements and translates them for the user to experience. The result is the activation of the 5th element, the Spirit.



Research to Architecture

It dawned on me while drawing this silly sketch, I was attempting to fit as many types of heating and cooling entities into one building, merely for entertainment purposes, when I realized that passive design solutions can be used for the experience of the elements rather than strictly functional aspects and active means of heating and cooling will be used strictly for their function. Thus creating a design that re-connects the occupants with nature through architecture as well as maintaining current standards of living.

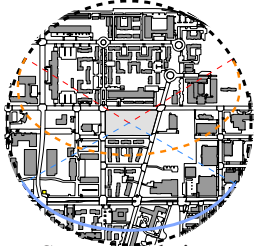


The site is located on 200 I St. SW Washington D.C. in a residential neighbourhood. On the North is a 11 story apartment building, on the South, 2 story town homes and it is uniquely situated between a church and a library on its' East and West. The site is currently occupied by 2 story townhomes bound to be redeveloped in this rapidly developing neighborhood.

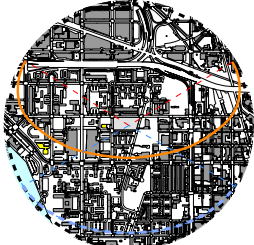
Pre-Design



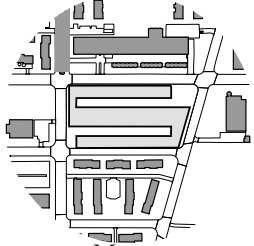
Major axis



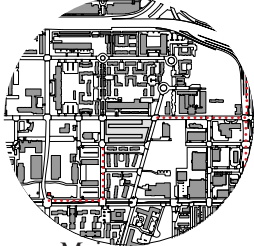
Summer solstice



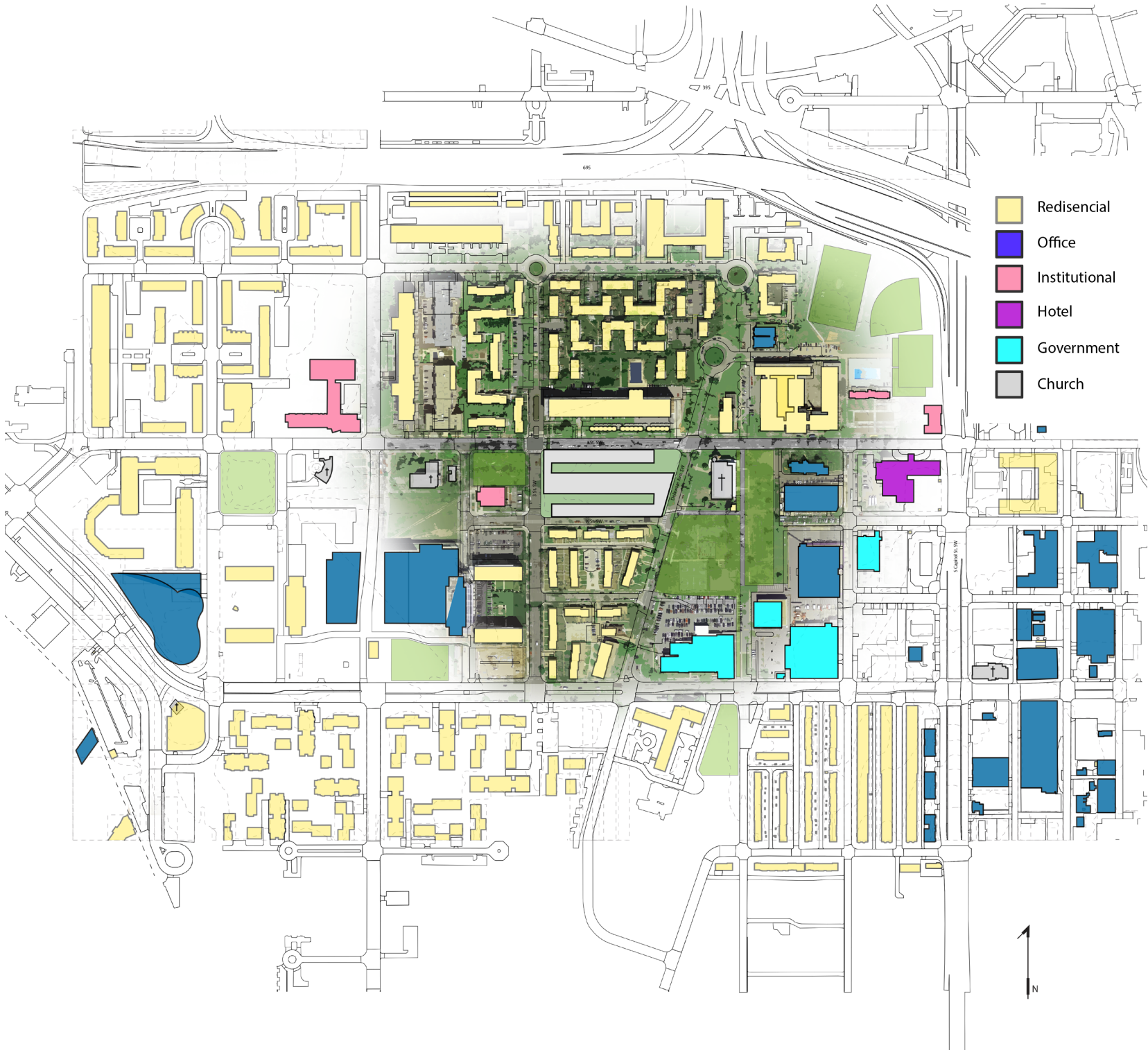
Winter solstice



Mass



Main access

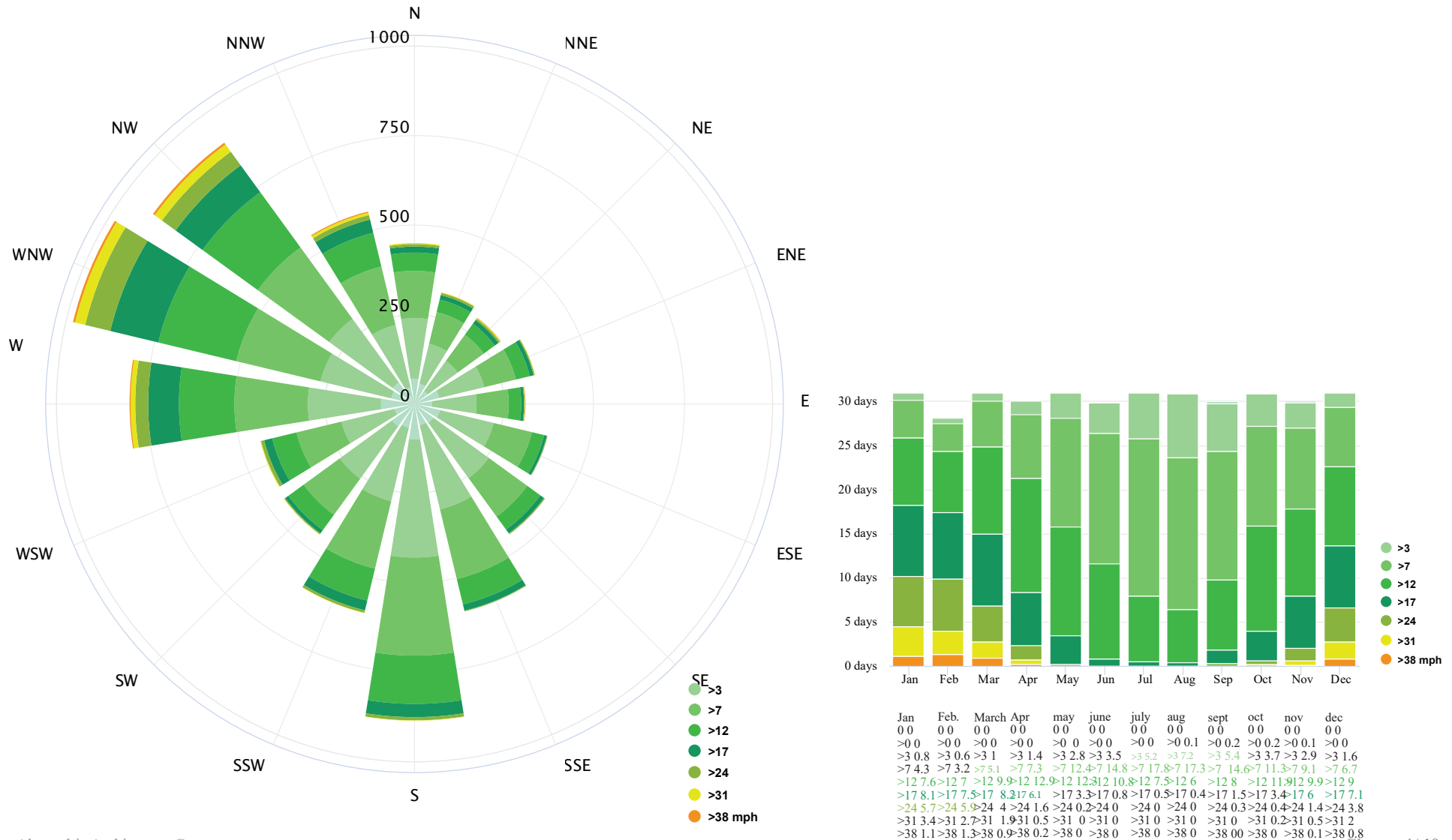


- Residencial
- Office
- Institutional
- Hotel
- Government
- Church

Wind rose - Wind speed

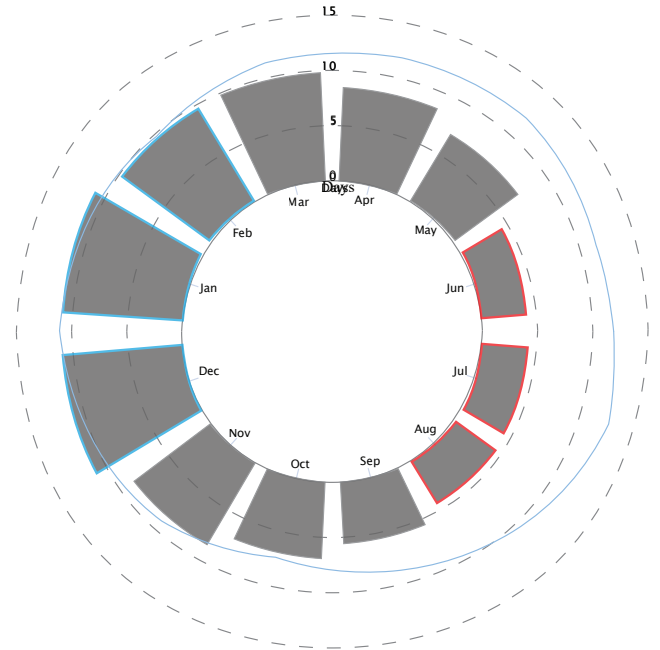
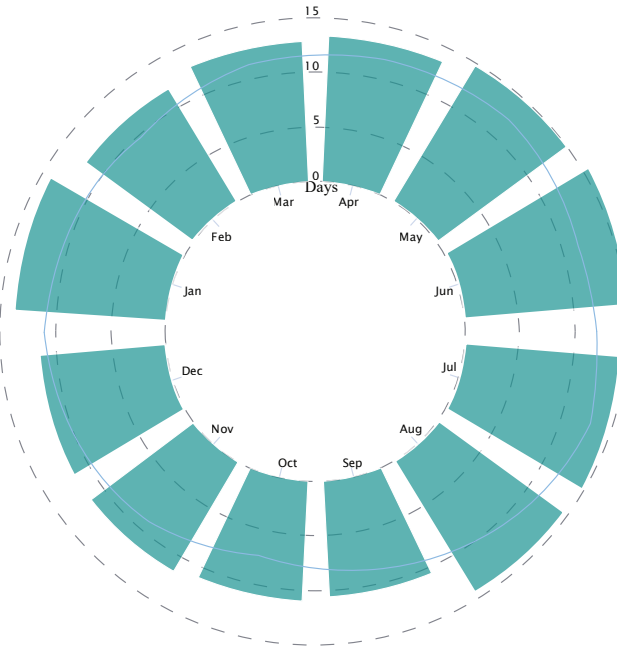
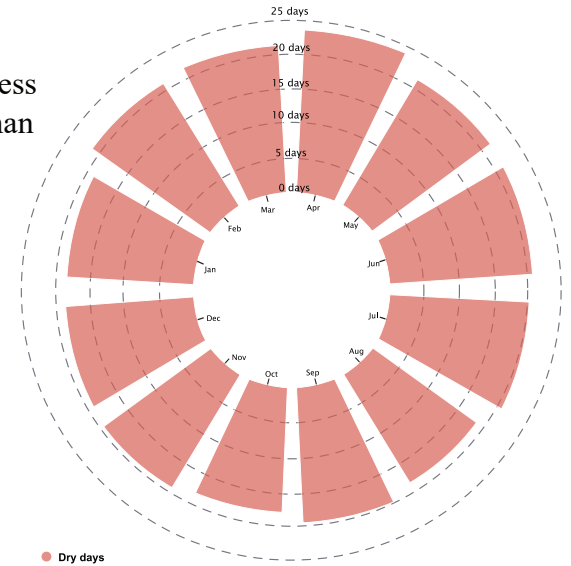
The wind speed diagram shows how many days within one month can be expected to reach certain wind speeds. Wind speeds are taken about 33' above the ground. Although the strongest winds appear to be from the NW, the time of year this occurs is during the winter, so the Southern winds will be targeted for the summer.

The Climate studies of the site are a collection of typical and extreme data to start the discovery process for the design on this site.



Cloudy, sunny, and precipitation days

The graphs show the monthly number of sunny, partly cloudy, overcast and precipitation days. Days with less than 20% cloud cover are considered as sunny, with 20-80% cloud cover as partly cloudy and with more than 80% as overcast.



● Sunny — Precipitation days

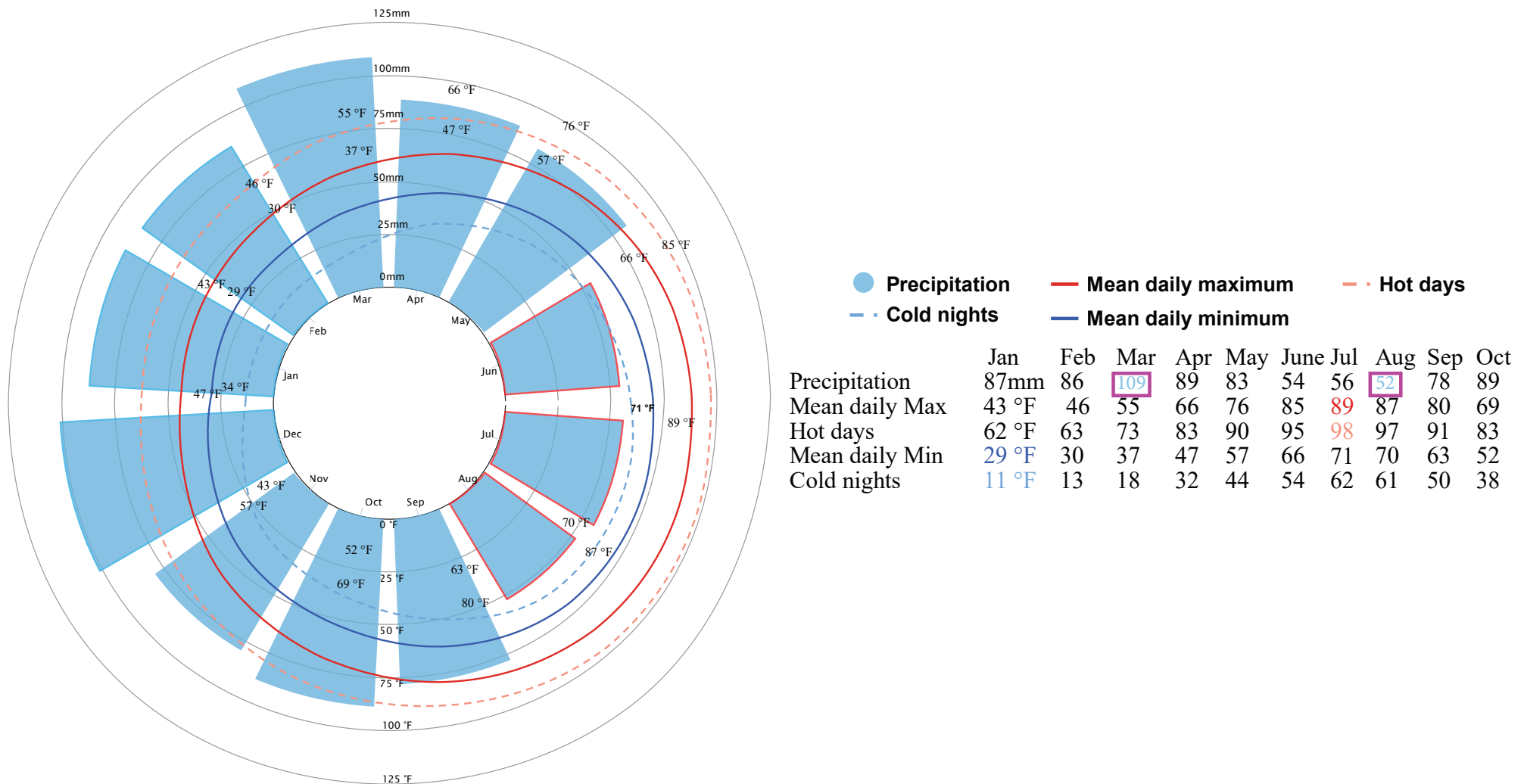
● Partly cloudy

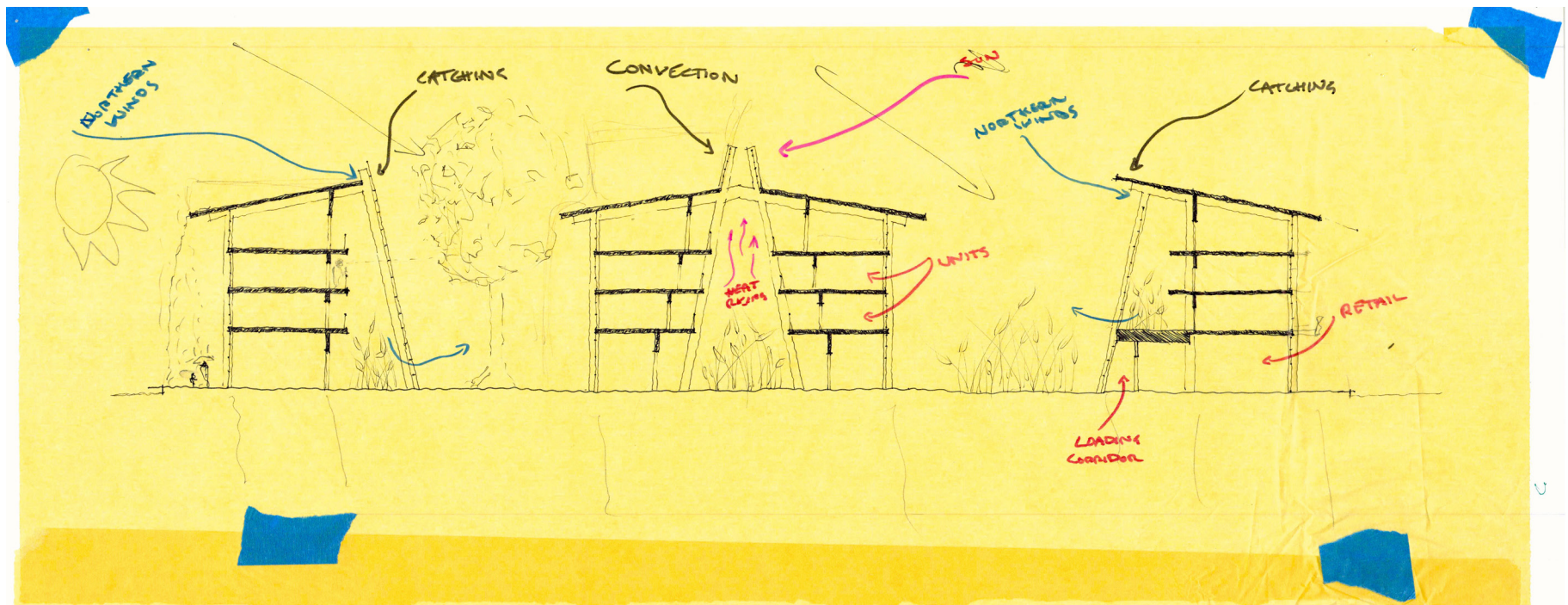
● Overcast

Jan	Feb	March	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
sunny 6.2 days	sunny 6.7	sunny 8.4	sunny 8.3	sunny 9.8	sunny 11	sunny 12.6	sunny 12.8	sunny 13.8	sunny 13.1	sunny 10	sunny 8.5
partly cloudy 13.9 days	partly cloudy 11.9	partly cloudy 12.8	partly cloudy 13.3	partly cloudy 14.3	partly cloudy 15	partly cloudy 14.2	partly cloudy 13.9	partly cloudy 10.6	partly cloudy 11	partly cloudy 11.5	partly cloudy 11.6
overcast 10.9	overcast 9.6	overcast 9.8	overcast 8.5	overcast 6.9	overcast 4	overcast 4.1	overcast 4.3	overcast 5.6	overcast 6.9	overcast 8.5	overcast 10.9
precipitation days 10.7	precipitation days 9.7	precipitation days 11.3	precipitation days 11.8	precipitation days 12	precipitation days 11.3	precipitation days 12.5	precipitation days 10.3	precipitation days 8.6	precipitation days 7.3	precipitation days 9	precipitation days 10.2

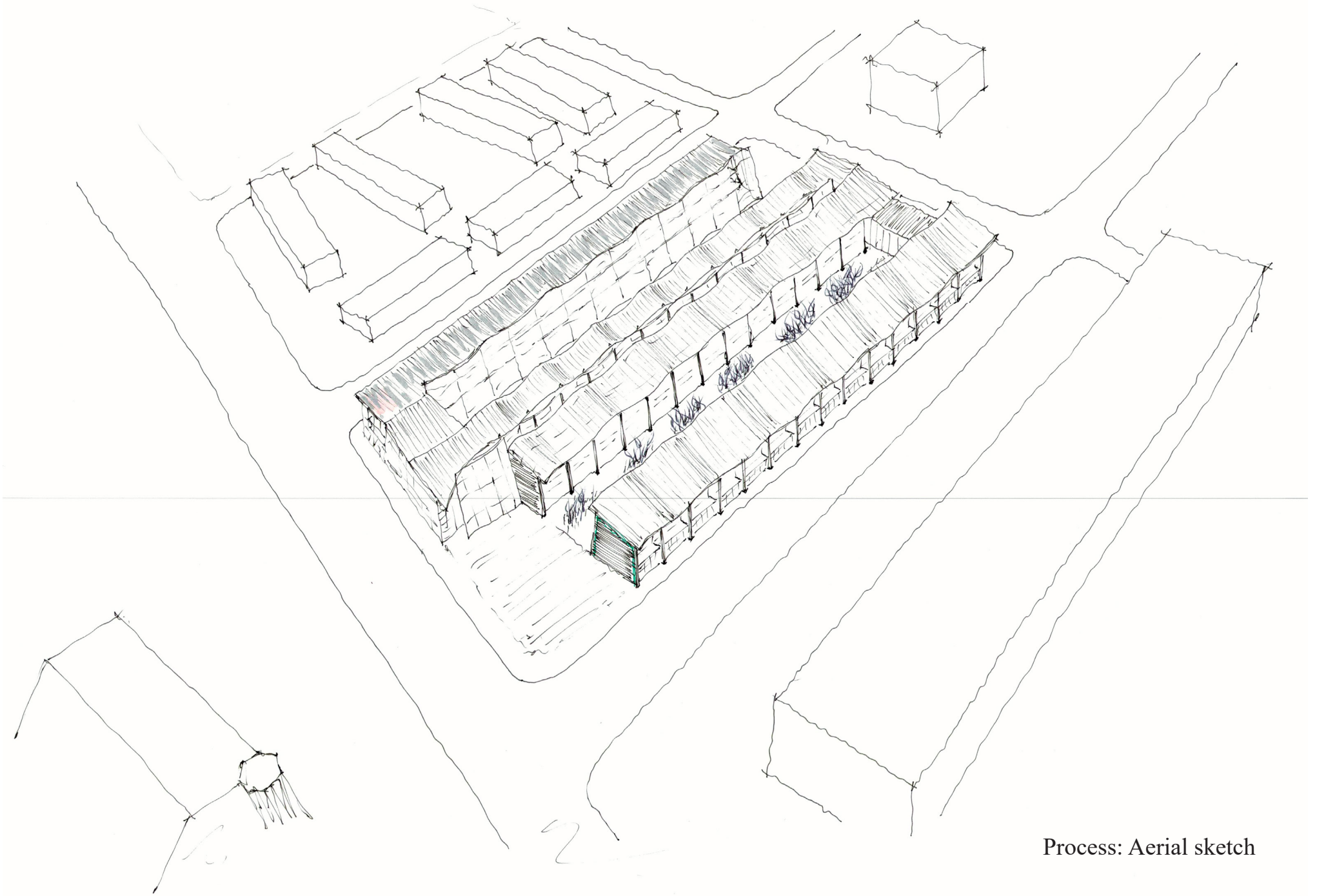
Average temperatures and precipitation

I have combined the "mean daily maximum" (solid red line) shows the maximum temperature of an average day for every month, "mean daily minimum" (solid blue line) shows the average minimum temperature. Hot days and cold nights (dashed red and blue lines) show the average of the hottest day and coldest night of each month of the last 30 years.

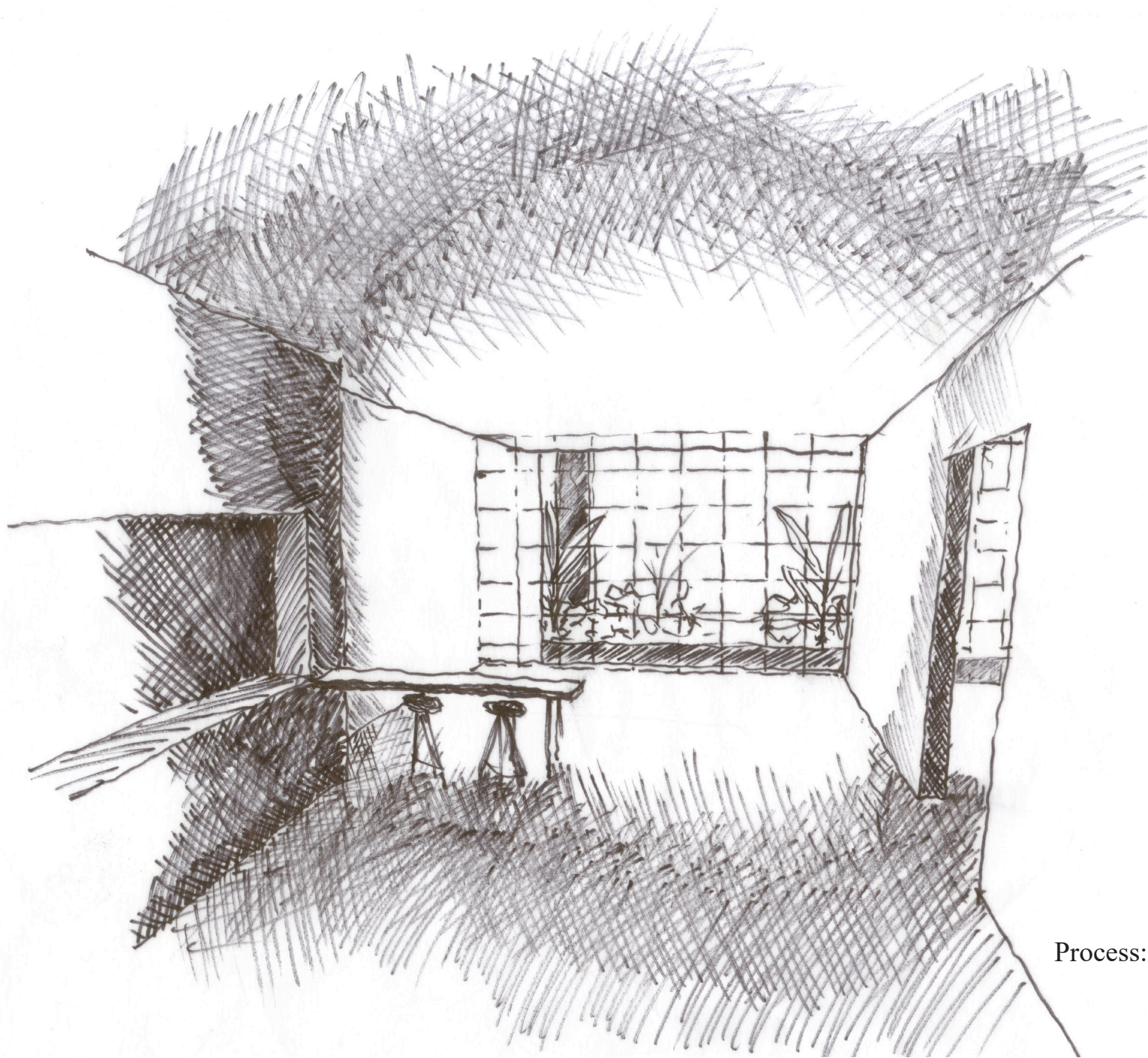




Process: First sketch



Process: Aerial sketch



Process: Unit sketch

The Mix-use building (Residential/Commercial) is divided into 3 bars and 2 connectors creating the 2 community courtyards in the middle. The entries are through 2 main lobbies and 2 Jump lobbies located on the NE and SW ends of the site. Parking garage is located on the Lower Level with the Mechanical

rooms and the stormwater management rooms.

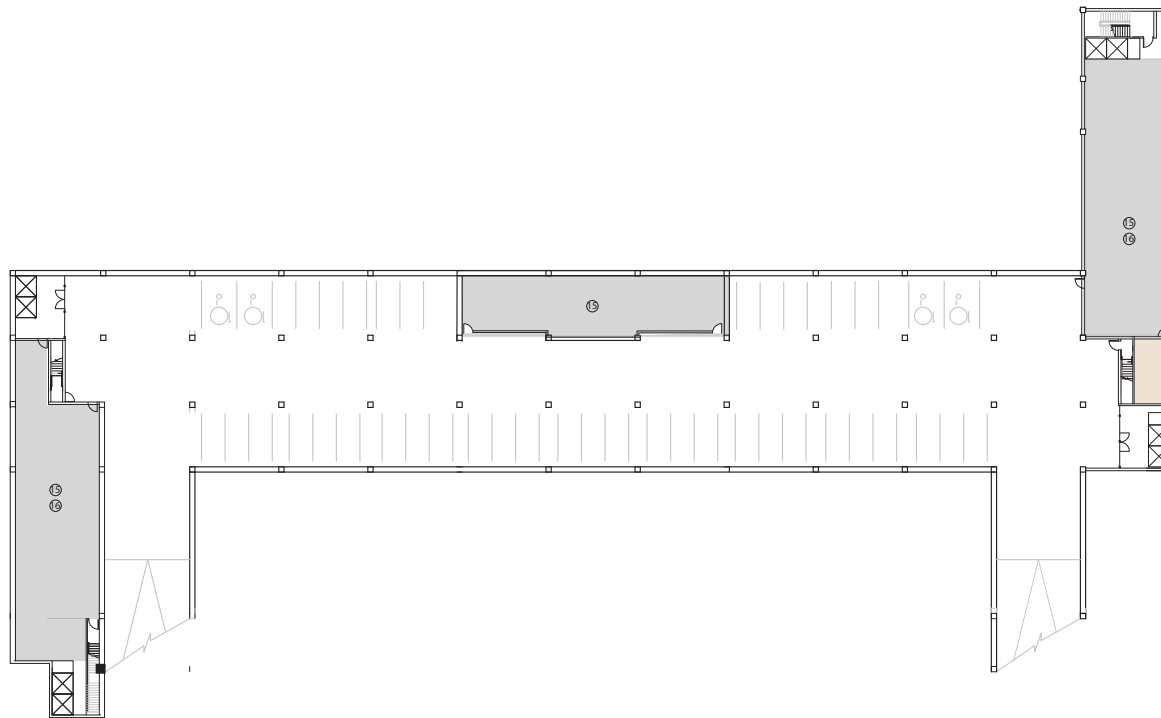
All the passages leading to the units (on the 3 bars) are enclosed yet open air and passively ventilated spaces. Each bar is designed in a different way in order to allow for the units to-

use the passive ventilation as needed (more detail on P.).

The residents living quarters design was realized by active heating and cooling as function and passive heating and cooling as experience. The “connectors” where all the interior community spaces are, are solely active.



Basement Level

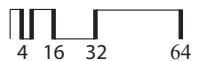


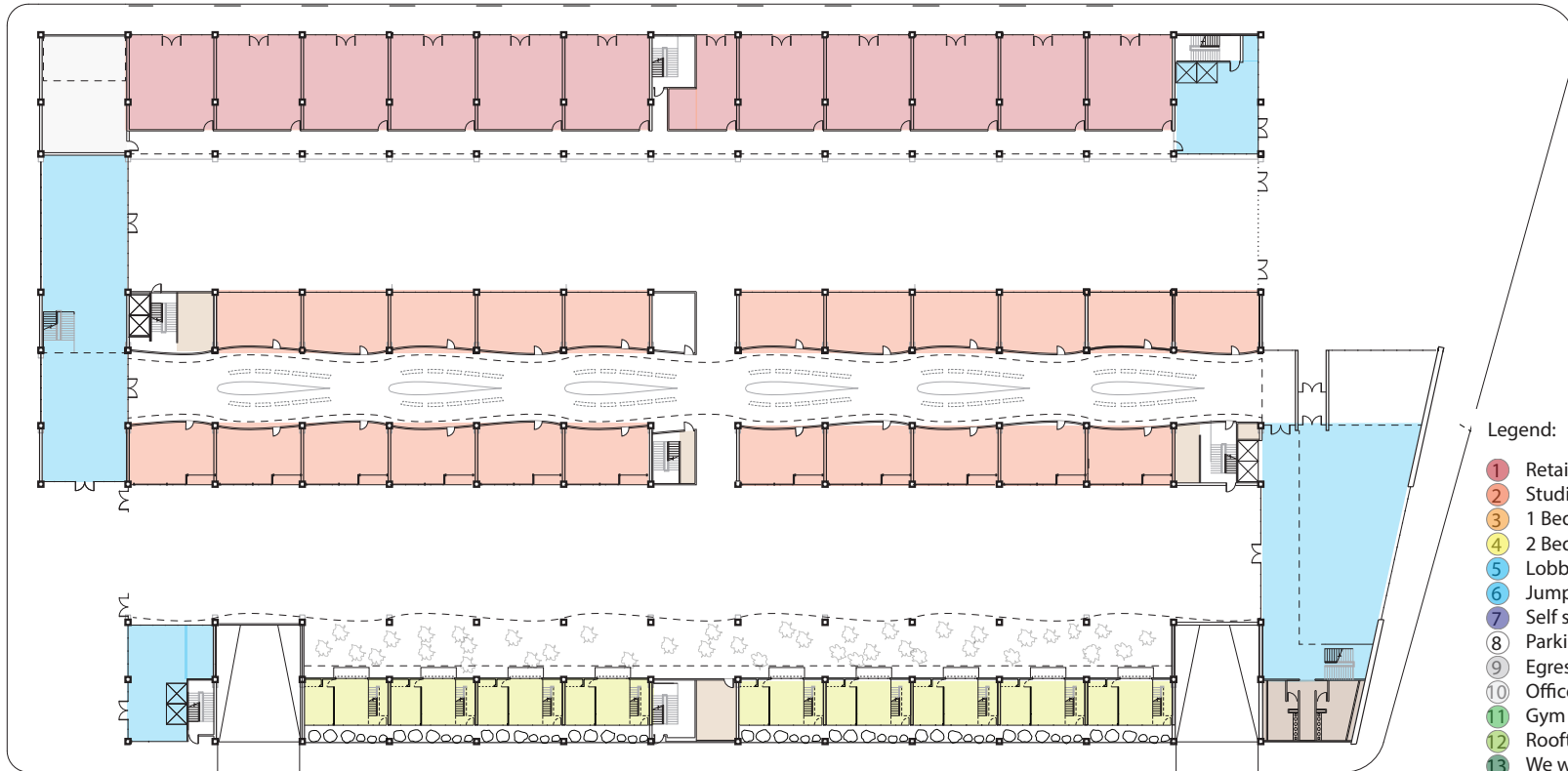
Legend:

- 1 Retail
- 2 Studio
- 3 1 Bedroom
- 4 2 Bedroom
- 5 Lobby
- 6 Jump Lobby
- 7 Self serve cafe
- 8 Parking
- 9 Egress Stair
- 10 Office
- 11 Gym
- 12 Rooftop Recreation
- 13 We work
- 14 Storage
- 15 Mechanical room
- 16 Storm water management
- 17 Loading Dock
- 18 Community
- 19 Lobby bathroom
- 20 Lounge
- 21 2-Bedroom loft
- 22 Circulation

The 3 “bars” house the apartment units. The Ground and 2nd levels of the South bar house 2 bedroom lofts. The 3rd and 4th floors house 1 bedroom units. The middle bar houses all the Studio units. The North bar houses 2 bedroom units from 2nd to 4th levels. Unless otherwise indicated in plans.

This results in 88 Studio units, 9 Loft units, 39 2-bedroom units, 25 1-bedroom units.

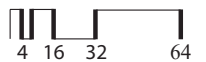


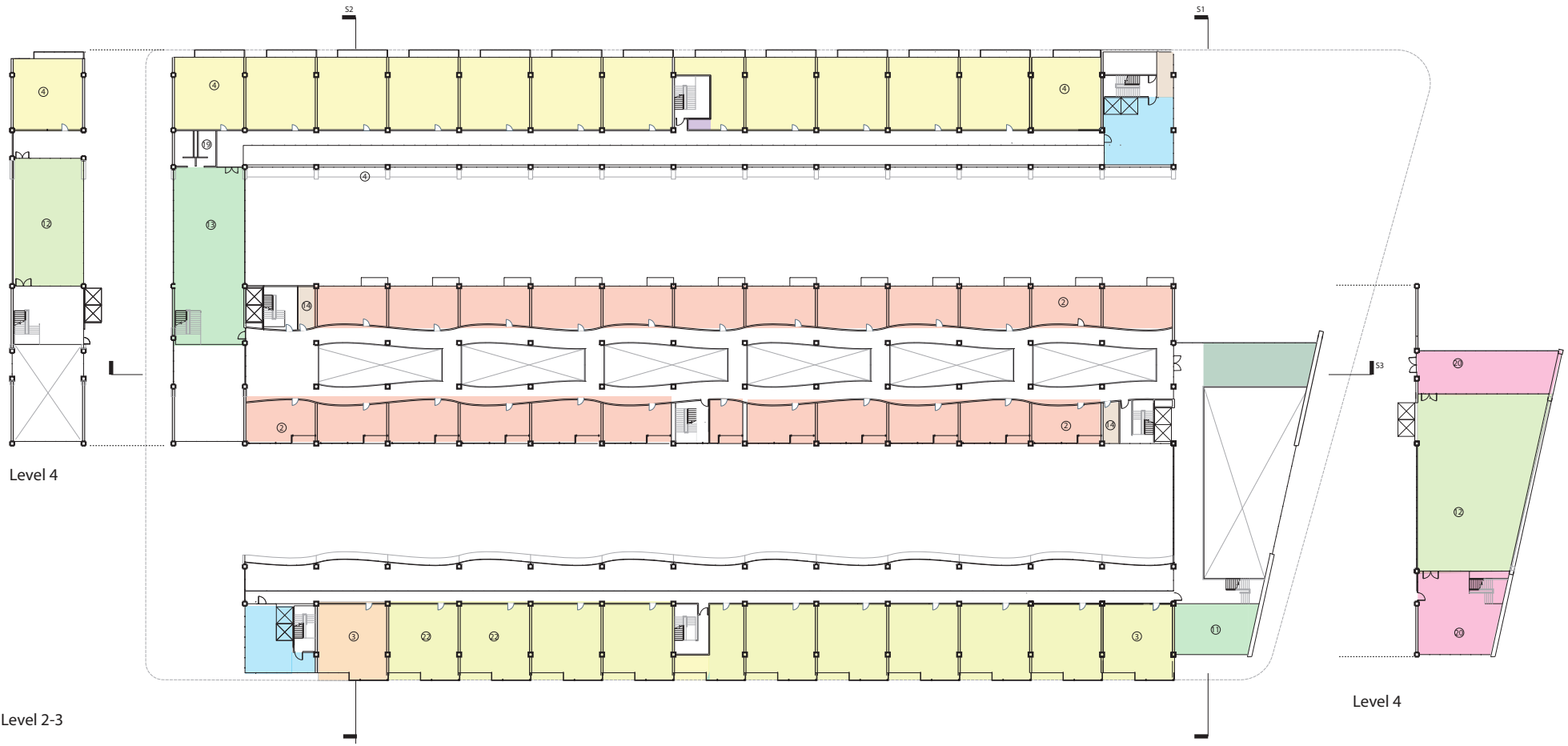


Ground Floor

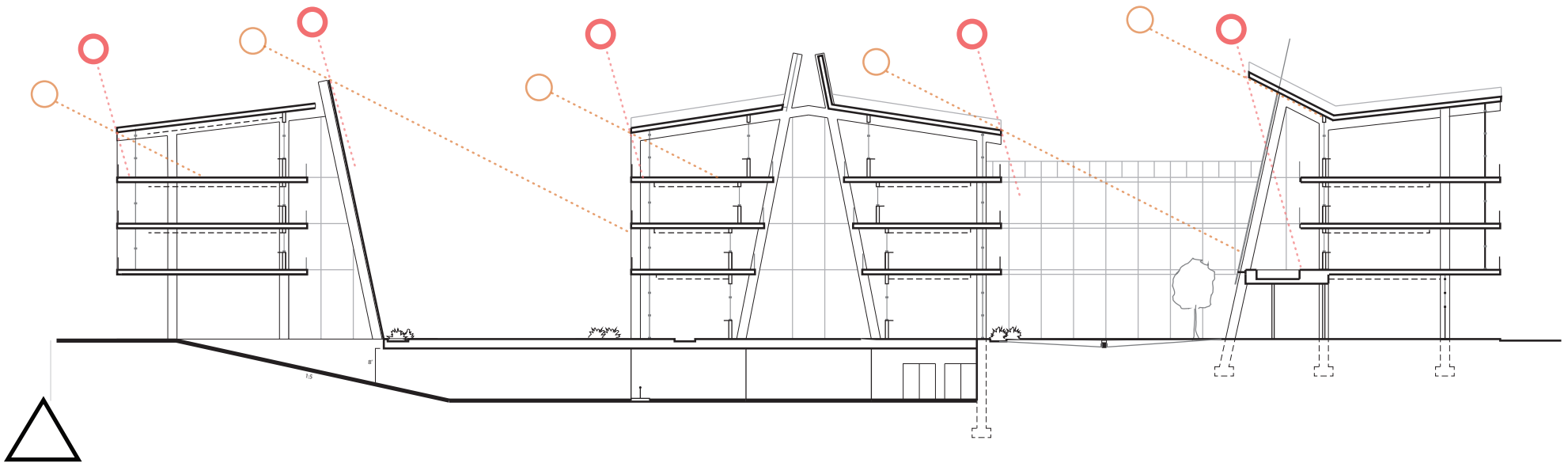
Legend:

- 1 Retail
- 2 Studio
- 3 1 Bedroom
- 4 2 Bedroom
- 5 Lobby
- 6 Jump Lobby
- 7 Self serve cafe
- 8 Parking
- 9 Egress Stair
- 10 Office
- 11 Gym
- 12 Rooftop Recreation
- 13 We work
- 14 Storage
- 15 Mechanical room
- 16 Storm water management
- 17 Loading Dock
- 18 Community
- 19 Lobby bathroom
- 20 Lounge
- 21 2-Bedroom loft
- 22 Circulation

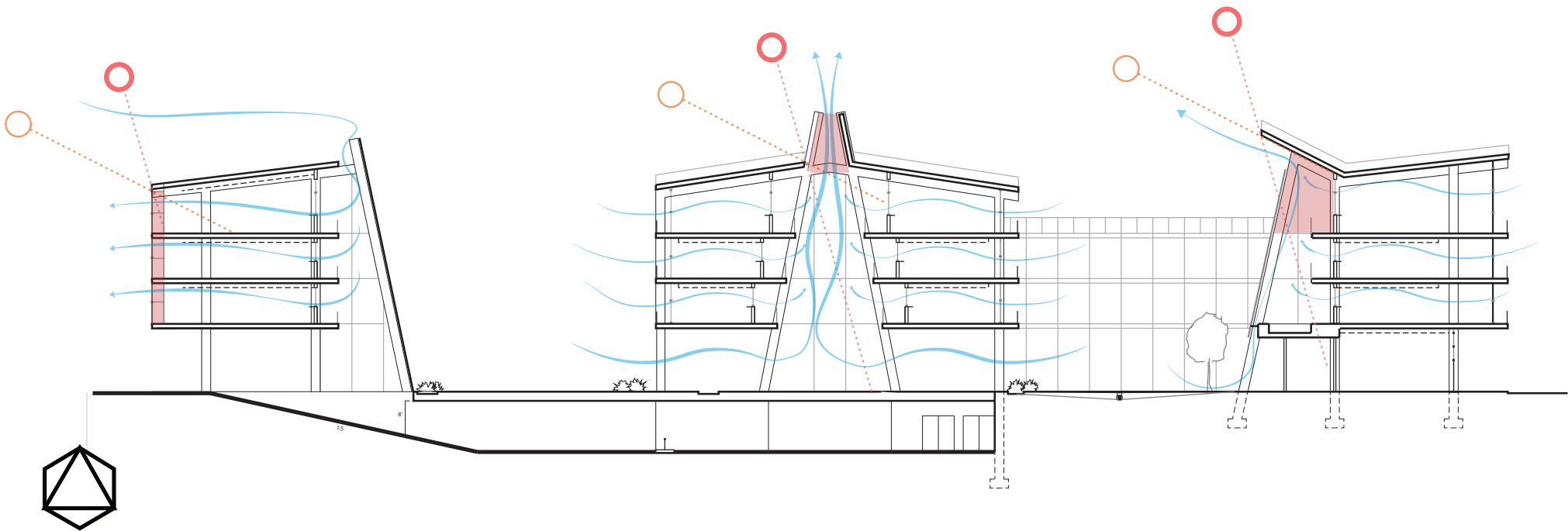




The following diagrams show the 4 elements delivered from the planet as Rain(water), Wind(air), Earth and Sun(fire) and how the architecture receives them in order to be translated for the users to experience.

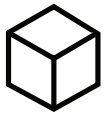
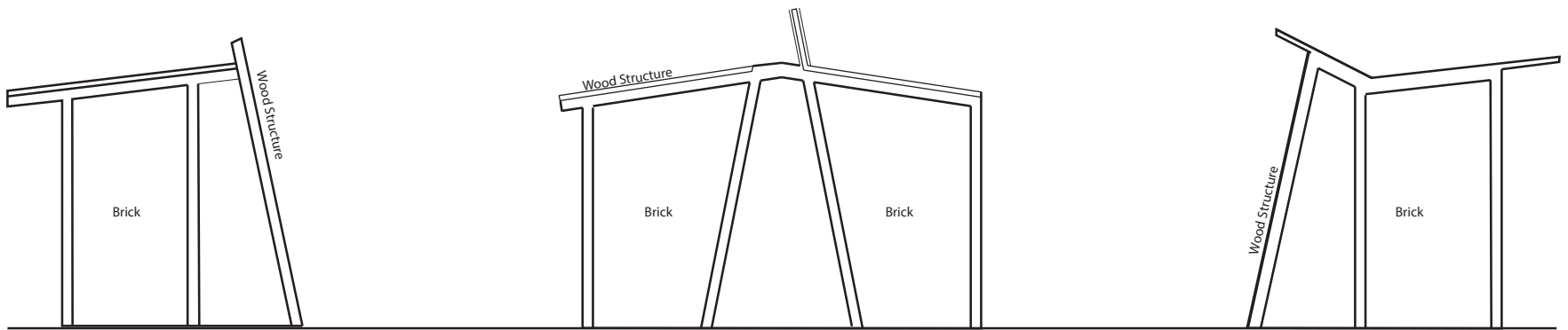


In the Southern bar, Fire is received as the sun and translated to the users experience through the asymmetrical design. The North facade is designed to receive more indirect sunlight with the extruding balconies and the southern Facade is designed with sunrooms that work in conjunction with the wind catcher. The heat buildup in the sun rooms created the opportunity for convection to occur when windows on the north and south ends of the apartment are opened. The difference in wind velocity, produce pressure differentials which result in the air flowing from the higher to the lower air pressure region. When the windows in the apartments are closed, the atrium space is still ventilating through the large opening on the bottom of the north glazing.

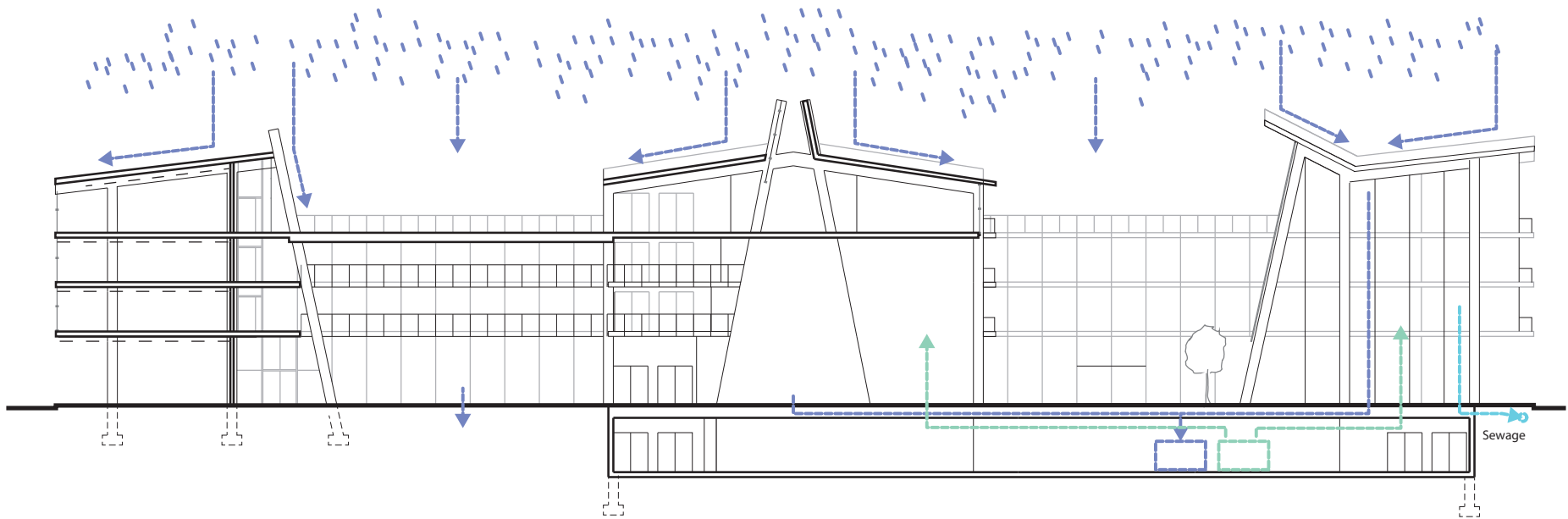


The Central bar activates convection through a solar chimney which is walled on the north end and colored black and glass on the south in order to trap and pressure the heat. When the windows in the apartments are opened, the air will flow into the apartment and out the solar turned into a low pressure area and by the principle of convection began to draw air into it. The south facade is designed to receive more direct sunlight in the winter while blocking the sun in the summer with intruding balconies. The North facade is designed to receive more indirect sunlight the with extruding balconies.

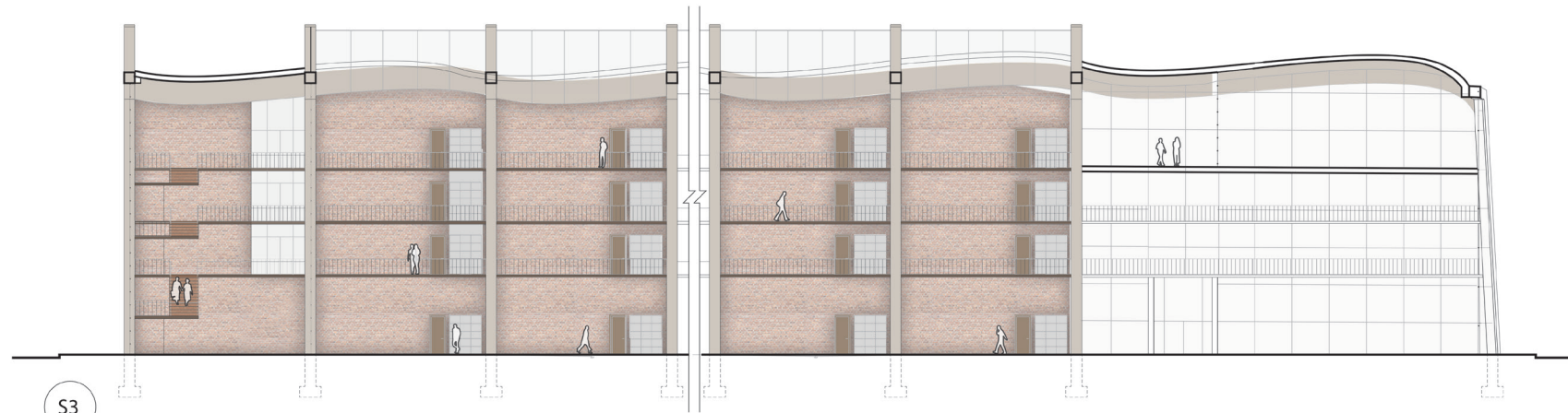
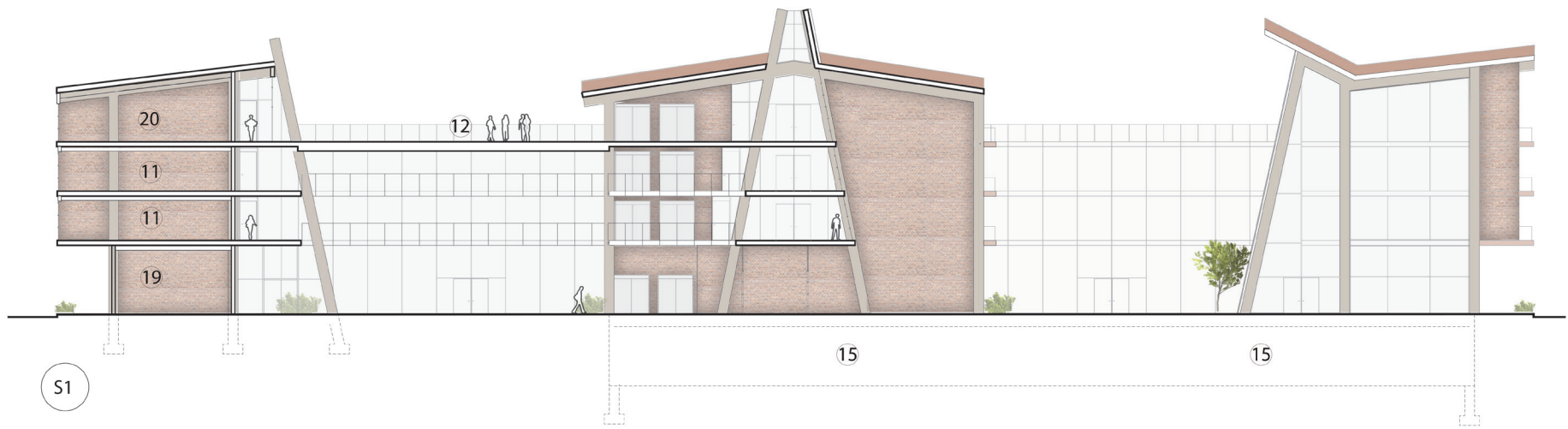
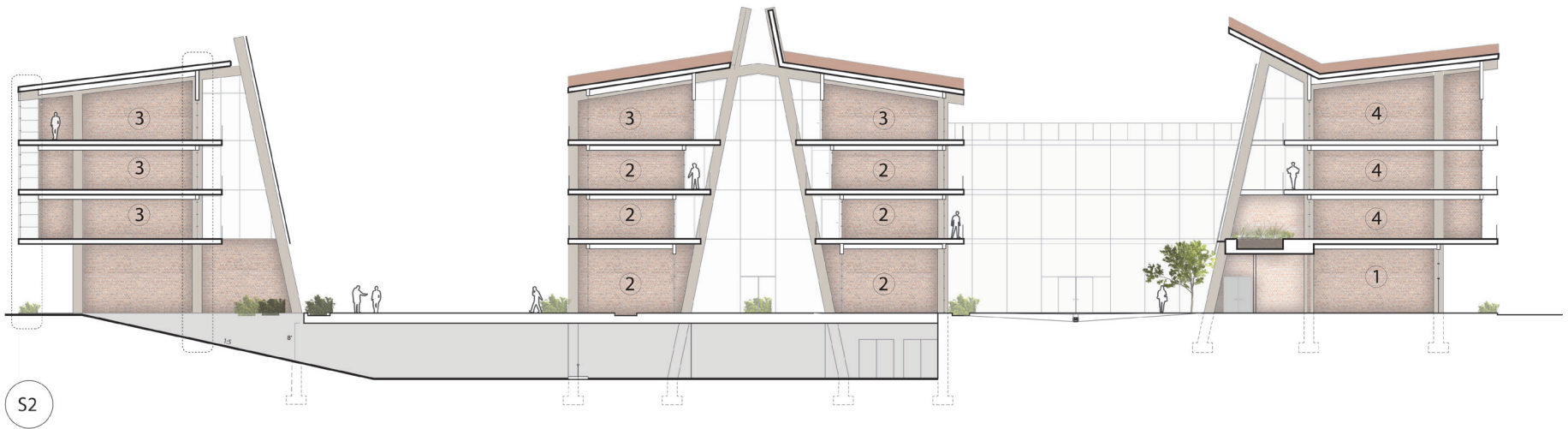
Water is received as rain in all three bars and is experienced as the rain seeps down the undulating roofs converging at the lowest points creating a waterfall effect. It is then received on the ground level by the ponds. The Ponds then Transport the water to the Lower Level for treatment and then pumped for grey water usage.

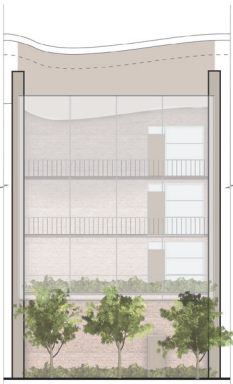


Earth is inspired by the Eastern woodland tribes and is realised in the design through the materials chosen. The Structure mimicking the structure of the longhouse with the timber separating the layers of bark as enclosures. In the design is Cross Laminated Timber is encasing the brick walls.

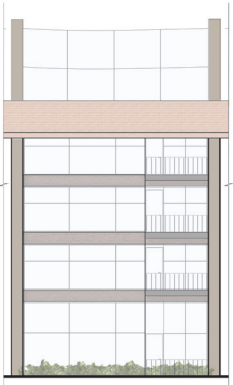


In the Northern bar, the roof acts as a wind catcher and the slanted southern glazing is used to allow the heat to enter the space and rise as the slant creates a more congested area at the top.. Similarly when the windows at both ends of the apartment are opened a current is created through the apartment. The North facade is designed to receive more indirect sunlight in the with extruding balconies.

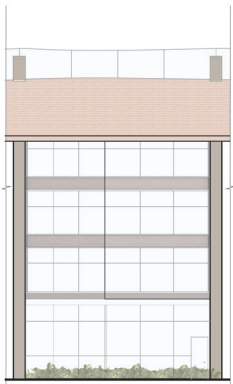




E3

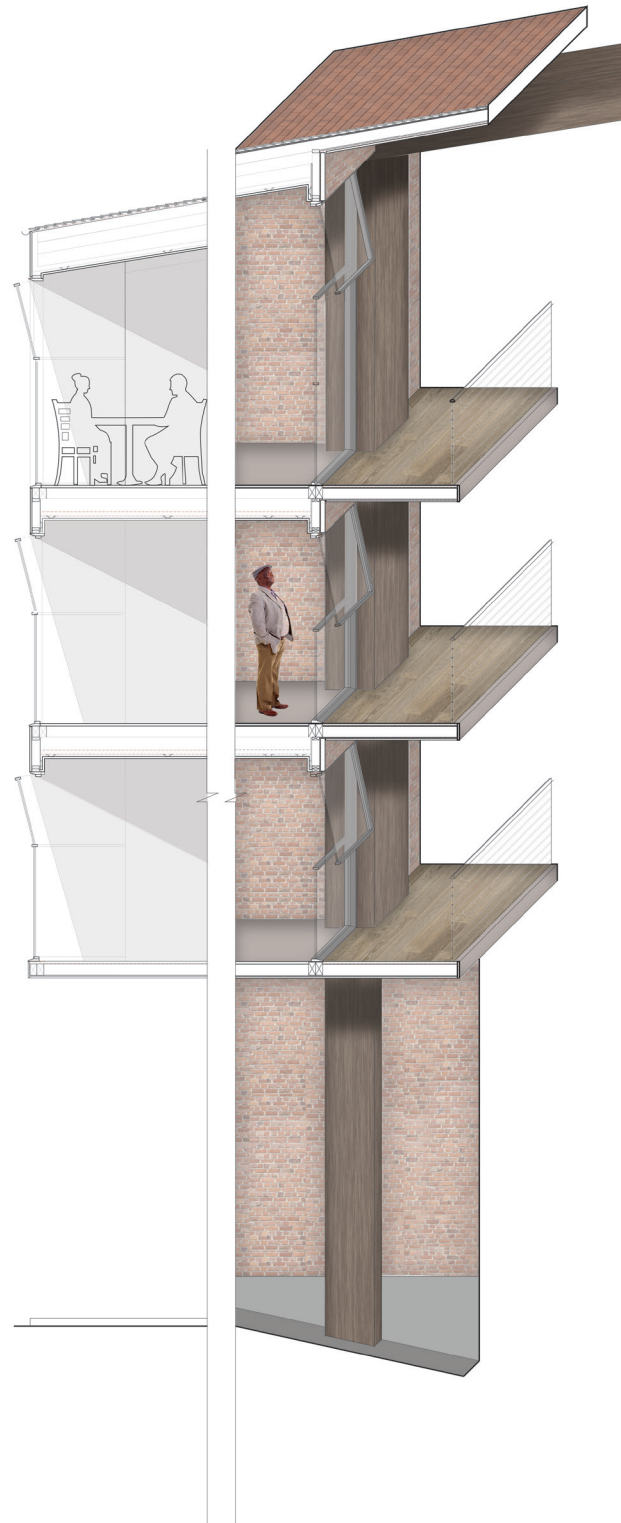


E2



E1

The section perspective/technical section (Location indicated on S2). Illustrate how the process of convection can be initiated by opening the windows on both ends of the units. The sunroom will collect heat that will rise when the windows are opened they will create a current of air due to the pressure differentials as explained above.



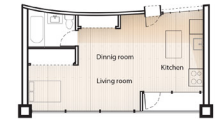
4 2-Bedroom
56 Units
1220 SqFt



2N Studio
45 Units
640 SqFt



2S Studio
45 Units
640 SqFt



3 1-Bedroom
56 Units
1150 SqFt

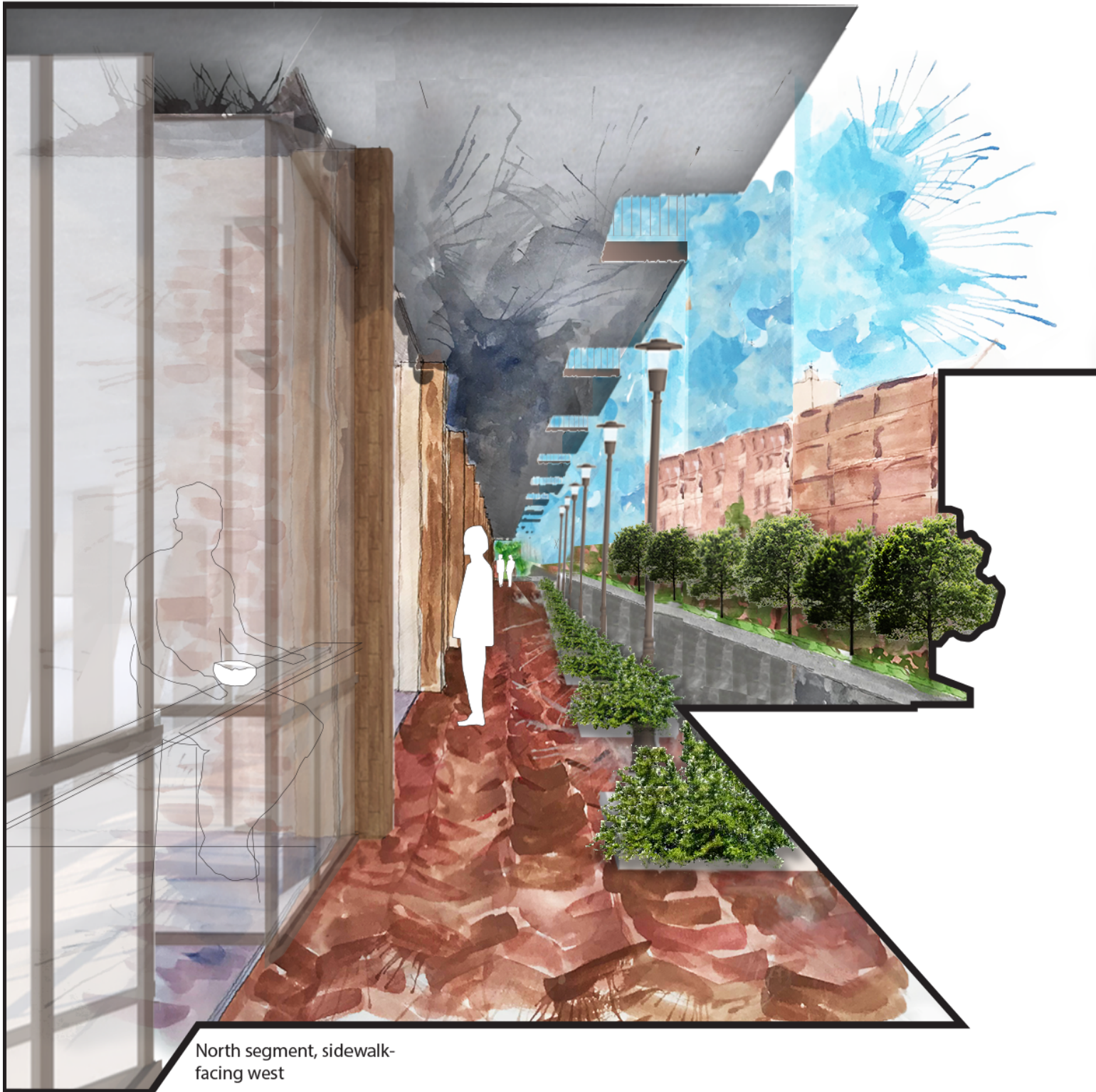


22 3-Bedroom loft
9 Units





North East Entry



North segment, sidewalk-facing west



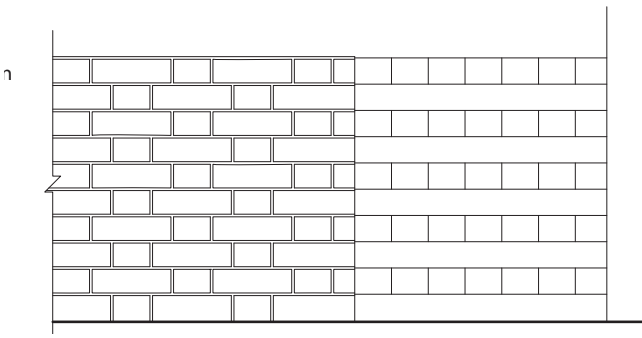
South bar, corridor
facing West



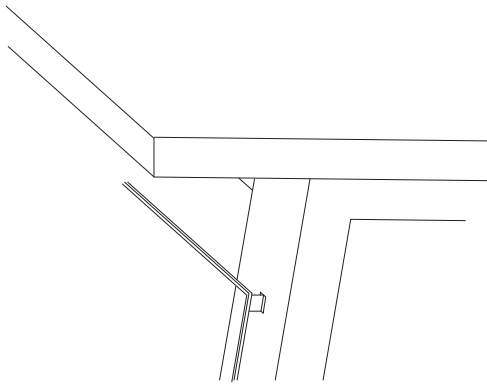
Middle bar atrium



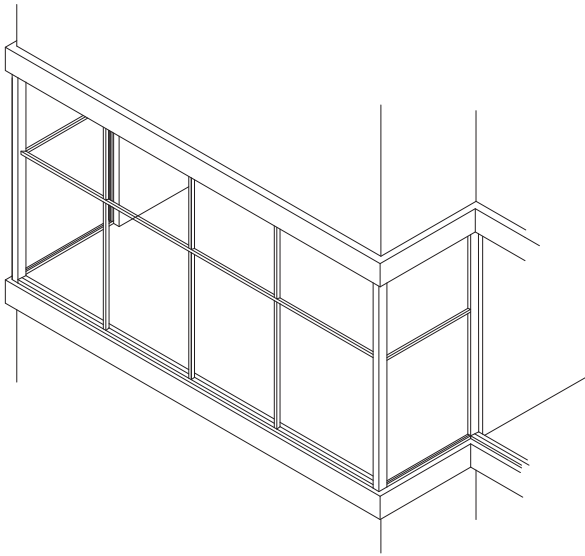
Aerial South-West



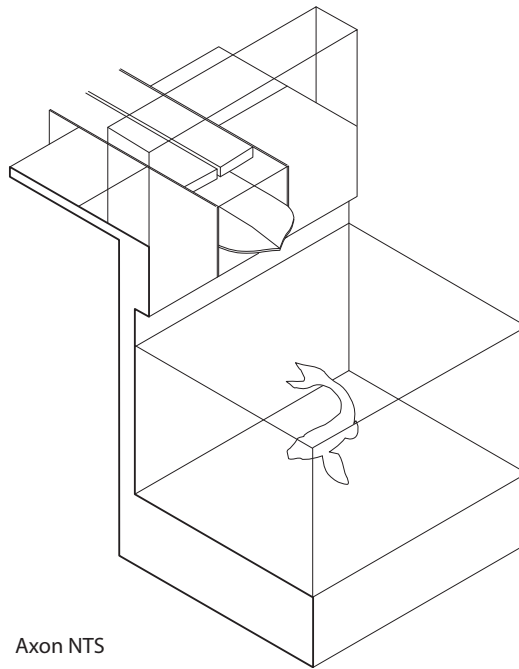
 Typical column to wall detail




 North Malkaf detail

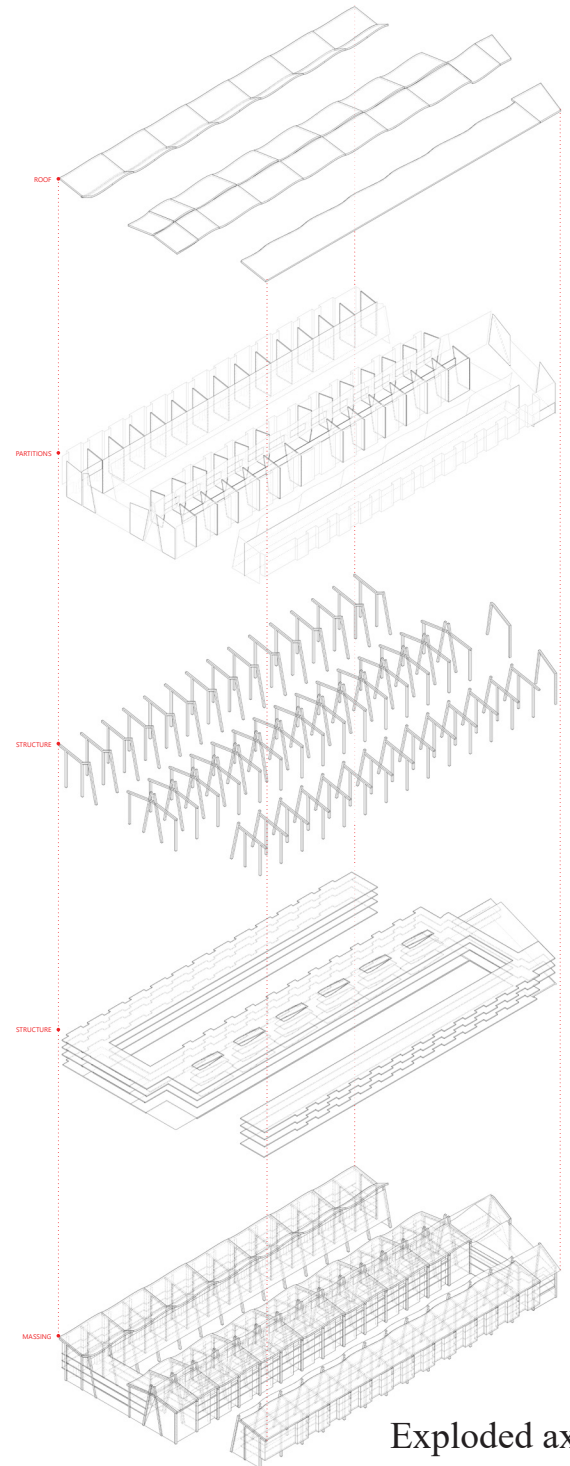


 Typical sunroom detail



Axon NTS

 Typical pond detail



Exploded axon

Conclusion



To conclude, the ambitious program scale still has many challenges to overcome, although I believe that the goal of creating the concept of a building that gave the occupants a deeper relationship with the planet was created by allowing the architecture to work in harmony through the translation of the 4 elements into the occupants daily life thus activating the Spirit of architecture.

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