BEYOND MECHANICAL LIMITS:
COHOUSING AND PERMACULTURE

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Creating a domestic cohousing prototype initiates eliminating building contributions to climate change.
Using architecture as the bridge to optimize the relationships among people and nature is our path toward.
Sanghee Rhie

Beyond Mechanical Limits:
Cohousing and Permaculture

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ABSTRACT

This research aims to achieve two objectives. The first objective is to minimize and eliminate building contributions to climate change starting from a domestic prototype. The second is to increase the role of architecture as a bridge to optimize the relationships among people and surrounding natural elements through an urban mixed use design for Cohousing communities. Detailed reexamination and reverse engineering of conventional design methods supports these goals to achieve an innovative overall building design. Redesigning built forms by utilizing or developing advanced materials and concepts will enhance the successful result. I propose to eliminate conventional central heating and air conditioning system dependence for urban mixed use architecture with careful building envelope and site design to promote a new successful experimental prototype.

A thorough dissection and examination of traditional Korean domestic building systems will support a theoretical sustainable solution as a key methodology. To optimize an urban domestic paradigm, the concept of "cohousing" and selective "principles of permaculture" is utilized as a foundational methodology. I will present the Korean traditional vernacular architecture "Hanok" and selected Cohousing communities for representative case studies as catalysts to ultimately accomplish these goals. The proposed innovative urban domestic paradigm promotes low impact city lifestyles embracing city streetscapes and leads to a healthier environment that focuses on people and nature respectfully. The successful outcome will contribute to the health of human relationships as well as the relationship between humans and nature.

Keywords: Mechanical, Urban, Agriculture, Permaculture, Cohousing, Respect, Nature

INTRODUCTION

Architecture has effectively disconnected communities from nature and each other. The air conditioned dwellings are separating people from the natural world around them. There are many opportunities to help to improve these relationships. My part is to rethink it through an architectural method and build a bridge connecting life architecturally. My intention for an architectural design is to promote the built environment to bind people together with nature and to support a low impact living lifestyle through the proposed urban cohousing paradigm by eliminating the central air conditioning systems for indoor building spaces.

I am from South Korea. The entire country is smaller than the state of Ohio; approximately, South Korea is 38,691 square miles (100,210 km^2), and the state of Ohio is 44,825 square miles (116,096 km^2). I was born and raised in a very small town on the east coast of South Korea. The town is named "Ho-San:호산 (湖山)" which means lake and mountains (hills). All my memories from this town are harmonious pictures of various seasons that are inseparable from people, built elements and natural elements. As pictured in Figure 1, the built elements harmoniously merge into the adjacent natural elements. Since Koreans have lived on a very small piece of Earth, they have studied and perfected land utilization throughout Korean history.

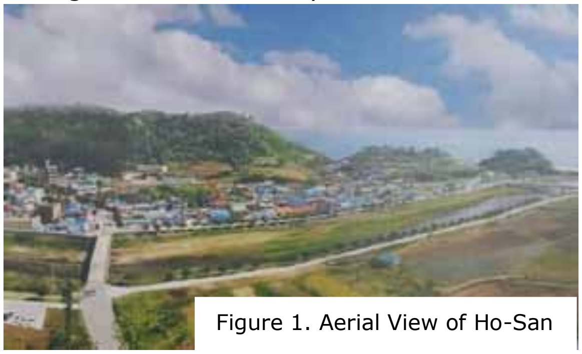

Figure 1. Aerial View of Ho-San

Ho-San has many essential relationship elements which many are missing today in broader society. Everyone knew almost everyone's first and last name, and where each other lived. The kitchen tables were always ready and prepared for unexpected guests who may stop by while the family was eating. In Ho-San, people trusted people and most of their doors were not ever locked. There are mountains (hills), rivers (creeks), ocean, and mostly unpaved roads that connect everyone. Interaction occurred outside, communication was face to face, and it occurred daily. They live close to each other and the ocean and farming space that surrounded the town. People in Ho-San have respected and appreciated nature as a source of many necessary things for their daily lives such as crops from land and fish from the ocean. They didn't own many precious man-made things but had plenty of precious people who cared for each other and plenty of resources from nature. Their lifestyle was same as the way of practicing "permaculture" that the life style based on the patterns in nature.

> "The term permaculture, meaning 'permanent agriculture' was coined in the 1970's by Bill Mollison, an Australian ecologist. He observed that natural systems, such as forests and wetlands, are sustainable. They provide for their own energy needs and recycle their own wastes. He also observed that all the different parts of a natural ecosystem work together. Each component of the system performs important tasks. For example, bees help to pollinate, birds provide pest control. So everything does useful work. He applied these and other insights to design and create sustainable agricultural systems."[1]

Without planning, my hometown provided many parents and grandparents to me and my friends while we were growing up together. I felt as if I had at least ten grandmothers and more than twenty mothers. Our many grandmothers and mothers scolded us about many things, especially our behavior towards them, others, and nature. In contemporary Europe and America today, there are still similar experiences of connectivity among people within communities which originated in Denmark that established itself as cohousing. This is the same concept described in an article authored by Bodil Graae, a well-known voice for Radio Denmark. She wrote in 1967, "Every child should have 100 parents." "The first Cohousers (27 families) in Denmark, close to Copenhagen had been influenced by this article. Since then the cohousing movement has spread rapidly, and today approximately 1-percent of the Danish population – about 50,000 people – live in cohousing communities."[2] The main concept of cohousing is collaborative living, just like I experienced in cohousing communities in Michigan last summer, July, 2015 and my hometown Ho-San.

The difference between the Danish cohousing and life in Ho-San is that Ho-San wasn't developed all at one time intentionally like Cohousing. Ho-San was created by different people over a very long time. It is important to note that the Danish experience has also benefited from a trial-and-error approach to cohousing. Dwellings in cohousing are now much smaller in size than they were 30 years ago, while the common areas have become much bigger as a result of learning from different cohousing experiments over time. I am concerned about buildings, especially the buildings that create wasted space and high maintenance. I am also concerned that these buildings are separating people from each other and people from nature as well. Do we live in a house? Or, do we live in a barricaded fortress that separates us from others and nature for the purpose of? My question begins with; what is the best way that we, as architectural designers, can contribute to minimize the energy consumption in human life? What is the best way to promote the revitalization of the relationships between human beings and nature through architecture in urban cohousing communities? Air conditioning is a big part of the problem that is contributing to greenhouse gases and high energy consumption. These air conditioned air tight and security equipped houses are toxic to both people and nature. I propose a solution that attempts to address the issues of environmental sustainability and promote the cohousing community at the same time through my architectural project.

METHODOLOGY

To find the answers to these questions, this journey examines the utilization of nature's effective domestic creativity (that is nature's ability to provide livable sustainable environments). This will provide clues to designing social spaces and the optimal path to achieve urban agriculture as a productive and sustainable landscape form. To optimize this urban domestic paradigm, I utilize the concept of cohousing and selective principles from permaculture as foundational methodologies for the improvement of relationships between nature and human beings. Particularly, sustainable permaculture contributes as urban agriculture's model to increase the wholesome trustable food source supplies and promotes the transformation of urban hardscape to a green ecological urban landscape. To support the optimization of these relationships through the proposed low impact urban paradigm, I extensively examine the design elements of Hanok and selected cohousing projects for clues to the desired outcome.

To optimize reductions in energy consumption, particularly non-renewable energy, I propose non-mechanical central heating and air systems in new homes which currently operate in most built environments today. Reexamining building construction methods and innovative home design will offer insights into the greatest challenges and provide the best solutions for a new non-mechanical domestic paradigm. I will focus on building heating systems by analyzing the traditional Korean domestic buildings and related systems to replace the conventional mechanical building design. The Korean traditional domestic dwelling, "Hanok" which has been developed and loved over centuries is still functioning efficiently today without mechanical systems. Hanok is a positive example that we can develop and apply to our contemporary architectures, especially suited for urban cohousing complexes. If this solution is developed appropriately, we can reduce or eliminate enormous amounts of energy consumption from the building operations globally.

We need to diligently reexamine and improve methods that we can utilize or develop to minimize building operating costs. This includes careful design method choices utilizing the natural elements for new home designs. Built environment is toxic to people and nature because of building materials and air conditioning systems. People are sitting in a room and think of it as nice and comfortable, but it is actually killing them slowly. This built environment is also a huge factor contributing to separate people from each other.

ARCHITECTURAL RESPONSE TO NATURE

The sustainability expert architect William McDonough stated, in his book "to eliminate the concept of waste means to design things, products, packaging, and systems from the very beginning on to the undertaking that waste does not exist."[3] Korean ancestors had lived life without creating waste, especially with their built forms. Every material they used for their dwellings was a raw material which could return and merge into nature without creating any waste. In today's living style, it is not an easy transition going from that people once had to not having it anymore even though it creates vast amounts of waste in the end; especially those things are some of the elements that make people's life very easy and convenient on a daily basis.

There is a crisis. Within about two centuries, we humans have destroyed more resources than the whole entire history of mankind. So now it is time for people to put more of their concerns and actions into remediating damaged earth. All attitudes and change has to start immediately and continuously flow forward in order for people to hand it off to the next generation and generations beyond. This is the way we will live forever with the "love for the children of all species and for all time not just our own."[4]

In contemporary architectural design, human beings rely heavily on consumptive technologies in built indoor spaces. Currently, societies are leading people to the life of a mono climate, and this issue has become a major element worsening global warming which will increase the danger to the earth's health and directly increasing the risk to human beings and other species on earth. According to Gao Lian[5], we have to "be careful not to contradict the power and influence of the natural weather conditions: nor too much warming to counter cold of winter or too much cooling to counter heat of summer."[6] In most cases people do not consider the individuals perception to climate change. Built environment is completely against Lian's advice. Nowadays, since many people rely on automatic indoor temperature control systems, their living is pretty much set against seasonal weather changes regardless of the different responses of the individual person. Most indoor temperatures are set to one temperature throughout the year, and to maintain this temperature setting for indoor spaces, the energy consumption for building cooling and heating is a huge environmental issue that is one of the biggest contributors that "jeopardizes the conditions of healthy economic, ecological, and social systems."[7] For example, Ohio has four distinctive seasons, but people in Ohio do not live according to the seasons. People can survive in short sleeves and short pants pretty much the whole entire year, and their life is not weather sensitive because "90% of the time people demand a climate controlled environment."[8]

CASE STUDY #1: KOREAN TRADITIONAL VERNACULAR ARCHITECTURE "HANOK"

Hanok describes Korean traditional buildings in a very general sense, and describes domestic living spaces in a very narrow scope. I am researching the narrow meaning of Hanok. "The origin of Hanok dates to 6,000 B.C., the early Stone age "Um house" and continued through the Joseon Dynasty and completed latter Joseon Dynasty."[9] Some of the most important elements in Hanok are the surrounding natural elements such as seasonal weather throughout the year and the raw materials they utilized for indoor and outdoor elements. The materials for Hanok have no toxicity, so most of the materials from Hanok can be recycled. The differences in traditional Korean domestic homes and the contemporary American domestic homes are the centuries of design experience within the inner spaces. Korean homes are very thoughtfully constructed for the haptic experiences, so much so that shoes are not allowed inside the home beyond the entry. Koreans usually sleep on a heated Ondol floor.

> *Sun is no longer wandering outside but the clay wall in a Hanok was still mildly warm from bathing all day in the heat of the sun, and the floor was getting warmer from the wood burning fire being used to cook rice, so dwellers could be sitting on the yellow earthen floor and leaning against a clay wall while they were waiting for dinner. This was one of the most cherished and relaxing moments in their homes.*

The original Hanok had no automatic mechanical operating system, but Ondol, Figure 2 (the Floor Heating method from the cooking oven), a carefully built adobe wall

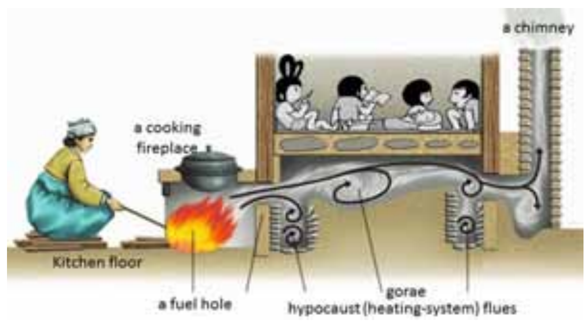

Figure 2. Ondol Section (Warm Floor: Floor Heating from Cooking Oven)

structure, and all operable openings (doors and windows) have provided warm and cool spaces that people can dwell in comfortably. Koreans have enjoyed this lifestyle for hundreds of years. These Hanok windows and doors were made of wooden muntin bars with a rice paper liner. Natural air flow and light can penetrate through these doors and windows and enter the room naturally. Hanok also allows outdoor sounds to travel to indoor spaces as well as the indoor sounds traveling outdoors and to the neighbors around it. Most houses were ideally oriented in a south-east direction with a mountain (hill) in the back, so it could receive enough heat from sun in winter and be well ventilated in summer from drawing cool breezes through the open doors on the front and rear side of the home as described in Figure 3. These houses could withstand the harsh winter (strong ocean winds with below 20ºC temperatures) weather and hot summer (over 30ºC) maritime weather. Old Korean people who lived in Hanok reacted positively as

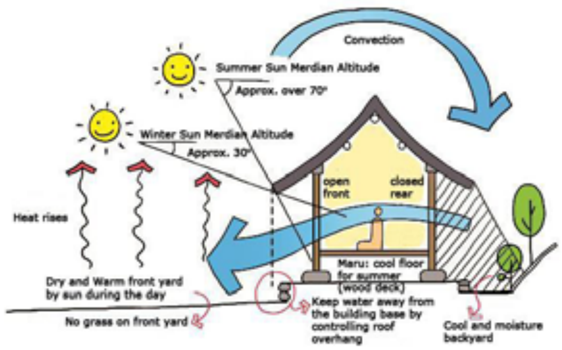

Figure 3. Hanok Building Section (Cool Floor: Analysis for the Response to Climate Changes)

they lived through routine seasonal weather changes and fought to build a strong body to withstand the changes.

The yard had no manicured grass lawn, but just light colored clay to reflect sun which was compacted over time from use. A four-foot tall fence was constructed with rock and clay mined from nearby the site, and this fence traveled along the property line and opened to the street with no gate. Near the fence, there were various flowering plants, fruit trees provided enough nutrition through the year as delicious fresh fruits initially, and dried fruits for use during the winter to the following spring. Every element and structure of this house was built of natural materials, usually raw materials from onsite or nearby. The house and fence were originally made of clay, wood, stone, and straw for the roof which all these materials provided a natural air purifier. It seemed like a random structure built without care but actually had so much care and consideration from hundreds of years of tested experience and techniques from Korean ancestors' knowledge. All these systematic construction choices, methods and natural material utilization created a minimal or no impact lifestyle on the earth and her resources. By examining Hanok, I can see Korean ancestors cared for their world and for their descendants, in which they believed that their children's wealth was their own wealth.

EXAMINING FOR POSIBILITY OF "HANOK" & "ONDOL" TO REPLACE THE CURRENT MECHANICAL DOMESTIC PARADIGM

To prove that "Old is gold", I reexamine old heating and air ventilation methods that Korean ancestors have been using for centuries. Examining these methods of the past and analyzing them with current technology to improve the efficiencies of the old methods for new contemporary architectures. I would like to reintroduce and redevelop the old types of building heating systems Ondol heating. Ondol is a traditional heating system in Korea that has been used since the 13th century. This is the origin of radiant panel heating systems people are using now throughout the world. But the difference is as shown on the Figure 2 that Ondol systems have more to offer than just using it for building heating but also utilizing it for cooking as well. So this system was usually operated when people prepared for dinner and while they cooked their meals the floor become warm and the heat would last throughout the night and into the next morning. The main source of fuel is wood which they usually gathered from broken tree branches, dried pine needles, and pine cones. The energy source can be changed to a green energy source, such as "Solar Photovoltaic Electricity" or the Electrical power generated from a wind turbine.

CASE STUDY #2: ANN ARBOR COHOUSING COMMUNITIES

Little Lake Drive, Ann Arbor, MI

- **Sunward Cohousing-** 40 units on 20 acres with mostly wood land, completed in1998
- **Great Oak Cohousing**- 37 units, completed in 2003
- **Touchstone Cohousing**-34 units on 6 acres, completed in 2014

These three cohousing projects are the design collaboration of the Cohousing Company McCamant & Durret (who are known as the pioneers of the cohousing movement in North America,) and the Cohousers. McCamant & Durrett Architects are credited with the introduction of the word "Cohousing" into the Oxford English Dictionary.[10] The three cohousing communities are located adjacent to each other and located less than ten minutes from downtown Ann Arbor, MI. Together they own 35 acres of land, featuring two ponds, a small wooded area with trails and picnic areas which they are very proud of. Although they own a large piece of land, their buildings sit on only a small portion of their property. This is another way of showing their consideration of a low impact lifestyle.

When we entered Little Lake Drive, we could easily see the Sunward Cohousing sign and their common house with a few children playing near it. The Sunward Common House is two stories tall and was designed to use less area for the building footprint. This two story structure contains a communal kitchen, a dining area, children's play room, laundry room, guest rooms and many other spaces that open for the whole entire community members. People can access both levels of the common house from a ground level, and they also provide an elevator for the building accessibility. The children's play room is on a different level from their main gathering area. The kitchen area is well equipped with mostly commercial grade appliances and their recycling activities are very proactive. A few members wish to have a bigger food storage space, and other members do not think having a bigger storage area is necessary because their idea is to utilize the grocery stores as their fresh food storage, which provides easy access to food at very little additional cost.

Learning from Sunward Cohousing experiences with a two-story common house, the next community, Great Oak Cohousing built a single story common building with a larger footprint to promote their diverse communal activities. This is one example of how these communities help each other to develop better communities through their experiences. Most yards are filled with vegetable plants and native flowers, and a few spots are covered with grass near the emergency passage required by local fire code. Only rain is used to irrigate the grass. A large portion of paved area other than parking lot space is required by local fire code, but they use these paved areas as the children's play

Figure 4. Hardscape Emergency Fire Lane Utilized as Children's Play Area

areas as shown on Figure 4, 5 posting signage to prohibit vehicle access. They also have a

Figure 5. Hardscape Emergency Fire Lane Utilized as Children's Play Area

very pleasant natural landscape as shown on Figure 6 that helps to remediate damaged nature and provide fresh vegetables to share with each other. They care considerably for others and nature.

Figure 6. Edible Landscape

Their architecture contains a great amount of consideration for a low impact lifestyle; elements include solar panels and preserving wild areas as much as possible. Some elements they have had to add into their buildings to meet the local building code requirements, such as sprinkler systems in individual units. They respect an individual's privacy as much as they value the community activities. Sharing is the biggest life habit for these Cohousers. I confirmed from visiting these communities that everything on their websites and any other books about cohousing communities are real, true and practiced. The Cohousers live and exercise how/what they say they live.

I learned that as an architectural person, to study local conditions is very important and the key to providing better indoor spaces for clients. Even though local architects and contractors in Ann Arbor assisted with the planning and design, the California architects (not experiencing snow and severe winter weather) did not provide enough closets or mud rooms near entries of the private units and this does not satisfy the local needs of the people in these cohousing communities. Overall, the site layouts, individual unit layouts, and common house are designed based on typical cohousing community design guidelines that they have practiced for many years. But lacking the experience and consideration for local life patterns and weather conditions lessened their professional performance. Just like people from my home town Ho-San, these members in the Ann Arbor Cohousing communities are diligently striving for building a better life with others and nature.

CASE STUDY #3: LILAC (Low Impact Living Affordable Community) in Leeds, United Kingdom, 2013

LILAC is the UK's first affordable ecological cohousing project (Figure. 7) built on the site of an old primary school in the Victoria Park area of Bramley/ Kirkstall in West Yorkshire.

Figure 7. the UK's First Affordable Ecological Cohousing Project LILAC

This area connects with fascinating and diverse parts of Leeds and some great established communities in all directions. It offers access to both urban and green space and is well connected to take advantage of sustainable transport options.[11] This cohousing community is designed by 20 households of the community members and White Design Associates (Architects) based in Bristol United Kingdom. It is a domestic project that accommodates people's essential necessities and minimizes the unnecessary disturbance of nature. Their goal is to have less impact on the earth by living as lightly as possible. Reducing their impact on the wider environment has become an urgent task in the face of climate change. To achieve this goal, "they work together to consider the environmental impact of daily activities through car sharing; pooling resources and tools; and looking to the local area to provide as many needs as possible and eat as locally.

The 20 units over 5 blocks with a common house and two parking lots are laid out on 1.5 acres in land size. "In Denmark, compared to the first cohousing projects, the new trend in cohousing projects, individual residents' sizes are much smaller than 30 years ago and the common spaces have become much bigger as a result of learning from different cohousing experiments."[12] Even though LILAC is a fairly recent project and they claim that "Their intention for this project is not about building their convenient dwelling but about building community life."[13] Their provided common building is not very big compared to their private units despite having a large common house is the one of the most unique elements in cohousing communities today. Providing compacted individual units without losing the character of the privacy and larger common house would be more efficient for this low impact affordable community, especially LILAC members plan to open their common house to wider community events and provide additional access to facilities.

Figure 8. House Built by ModCell

To promote low impact living, they used locally sourced building materials for their construction, and the walls made from super-insulated straw bale (Figure 8), and timber panels pre-fabricated in ModCell's local 'Flying Factory'. The buildings use passive solar design, which means that the insulating materials and design of the buildings combine to store solar heat in the winter and reject solar heat in the summer, thus reducing the need to input heating energy. LILAC also responds to the situation through adopting a "Mutual Home Ownership Scheme (MHOS). An MHOS is a new way of owning a stake in the housing market."[14] It is designed to remain permanently affordable for future generations.

The site utilizes a previous developed site already equipped with existing infrastructure and utilities. The buildings occupy a minimum area of land and most of the property is covered with green, based on the provided site plan (Figure 9). This allows more spaces for

Figure 9. LILAC Site Plan

gardens and safe play areas for children. Their plan utilizes compacted private space layouts as shown on the provided floor plan and guest room between two units (Figure 10).

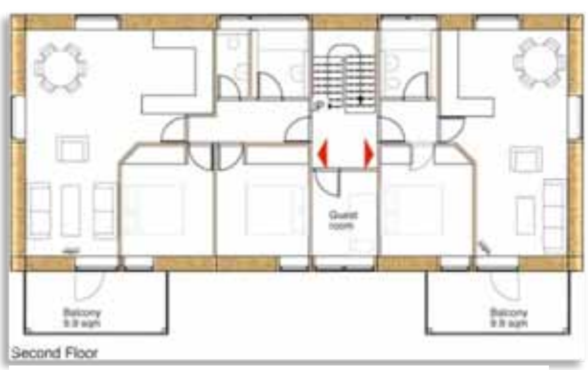

Figure 10. Typical Layout 1 and 2 Bed Flats

"In total there are six 1-bed, six 2-bed, six 3-bed and two 4-bed houses in this cohousing community."[15] Their site design is based on co-housing principles, which brings individuals and families together in groups to share common aims and activities while also enjoying their own self-contained accommodation and personal space. The site plan design is still shows too much focusing on privacy that loses the unique part of community living. The layouts of private sectors are not much different than conventional duplex or condominium. Each block could be closer to the common house, and this will decrease the paved walkway surfaces and add more green spaces that can be potentially community garden.

CONCLUSION

The effective ways of designing and constructing a low impact built environment for human beings have been diligently developed and produced with many innovative ideas. We architectural designers must not design built forms against the Earth, but with the Earth just like the intention of building Hanok. We need to focus on utilizing the right man-made materials, natural material, and reutilizing old materials to fit new conditions to prove that "Old can be gold." Utilizing natural site conditions as major elements of architecture will transform architecture to an organic live form. My goal is to create built environment to go along with nature, coexisting, and minimal disturbance, expecting maximum utilization.

From the case studies, I studied various elements and different conditions from each case study for developing the new urban domestic paradigm that promotes a low impact lifestyle on the natural environment and better relationships between humans and nature. Each project explains very clearly how the site is utilized for human life and responses to natural conditions with minimal impacts. I also learn that all three case studies use permaculture to live in a more sustainable way, consciously or without realizing it. The best and most positive attributes from the projects from different design conditions creates a better format for designing the best domestic paradigm for specific site conditions. These case studies provide insights into the goal of this project and will provide much needed insight to achieve an optimal solution to promote a cohousing living style with permaculture landscape in many conditions.

By learning from Hanok and the cohousing communities, I propose an urban paradigm that does not have a central air conditioning system, but has natural raw material building envelope with effective natural ventilation through openings. I will develop heating system derived from Ondol system that will satisfy human's necessary dwelling spaces without creating toxic indoor spaces. This will hugely impact not only individual residential areas, but eventually large scale multi-family facilities, and commercial buildings. It will be a challenge to eliminate the convenient systems we are accustomed to and know they are available; however, the positive outcome will be much greater. This sound transparent paradigm will also promote people to communicate with neighbors and surrounding nature while respecting each one's privacy. No more segregating people each other and nature with built forms. Freeing people from being trapped by a toxic envelope is vitally urgent. Architecture cannot be the divider, disconnecting people from people or the wedge between people and nature. Architecture must be the connecting fiber between nature and people. Those people who create built forms must build for the Earth, not just building on the Earth!

DEFINITION:

- Permaculture:

  "Permaculture (Permanent Culture/ Agriculture) is the conscious design and co-creative evolution of agriculturally productive ecosystems and cooperative and economically just social systems which have the diversity, stability and resilience of 'natural' systems. It is the harmonious integration of landscape and people providing their food, energy, shelter and other material and non-material needs in a sustainable way. It seeks to provide a sustainable and secure place for living things on this Earth." [Dan Hemenway]

  Principles of Permaculture:

  1. Observe and Interact
  2. Catch and Store Energy
  3. Obtain a yield
  4. Apply Self-Regulation and Accept Feedback
  5. Use and Value Renewable Resources and Services
  6. Produce No Waste
  7. Design From Patterns to Details
  8. Integrate Rather Than Segregate
  9. Use Small and Slow Solutions
  10. Use and Value Diversity
  11. Use Edges and Value the Marginal
  12. Creatively Use and Respond to Change

- Cohousing:
  Cohousing is pedestrian friendly, designed, managed and governed by residents using a refined consensus decision making process. Cohousing strives to create a village of all ages where neighbors know and support each other.

  The two Korean old sayings which I grew up with that support the concept of cohousing:
  "It is lighter to lift together even though it is just a sheet of paper."
  "It will bring more joy to share, even though it is just a tiny piece of bean."

END NOTES

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FIGURE SOURCES

Figure 1: View of Hosan, Photo by MeeSeon Kim (Author's aunt who has been living her entire life in Hosan). August 21, 2010.

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Figure 3: Diagram Created by Garisangod. September 15, 2014, accessed June 5, 2015, modified by Author, June 5, 2015, http://blog.daum.net/garisan/15749912

Figure 4: Photo by Author, July 6, 2015.

Figure 5: Photo by Author, July 6, 2015.

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Figure 7: Photo Source: ESBG2015 (EUROPEAN STRAWBALE GATHERING MONTARGIS/PARIS): "Straw Bale: LILAC Cohousing in Leeds, UK", accessed June 15, 2015, http://esbg2015.eu/lilac-cohousing-in-leeds-uk/

Figure 8: Photo Source, LILAC: Low Impact Living Affordable Community, "House Design", accessed April 23, 2015, http://www.lilac.coop/about-lilac/house-design.html

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ADDENDUM: POST-DESIGN CRITIQUE

NARRATIVE

Contemporary architectures are like energy eating hippopotamuses. The buildings that are dividing indoor spaces and outdoor spaces have many energy consuming roles. Modern day buildings provide mono climate living spaces for humans and their belongings around the world, regardless of local climate conditions. To operate the buildings to manage these mono climate indoor spaces, these man-made built forms are responsible and continue to damage the earth's health that is directly connected to our own human health.
As an architectural person, I feel strongly responsible for stopping this damage and remediating the damages to nature from the built environment, so I will examine the best ways to eliminate the energy consumption from the building operating systems.
I think the cure for these cancerous diseases attacking nature is to eliminate the energy eating machine. For humans ignore the climate changes and fuming toxic breath from this mechanical system to operate the architecture as an air tight envelope and barricading individuals from neighbors and nature will consume us.
For the solutions, I will propose a new urban mixed use domestic paradigm for the cohousing community. This prototype will contain the resident users (Cohousers who will deliver positive impact to adjacent neighbors), work spaces to reduce the energy from car-dependent commutes that will eventually eliminate urban sprawl, and non-conventional mechanical systems that have been created to power the mono climate indoor environment. My ultimate goal is to provide indoor and outdoor spaces to create 24 hour weather responding communities through low impact energy producing architecture.

Architecture must exist as a space in a space that humans can build history of daily life in forms of many, unlike other art works that are to please eye of human beings. Because of this role, a built form of architecture has to coincide embracing humans daily life activities and providing haptic space with ideas of critical regionalism. When this role succeeds, I believe that social problems can be solved through architecture.

INTRODUCTION

My thesis title began with "A New Urban Domestic Paradigm Integrating Urban Agriculture in Mixed Use for Urban Revitalization" then "Beyond Mechanical Architecture Integrating Urban Agriculture in Mixed Use Cohousing" and finally "Beyond Mechanical Limits: Cohousing and Permaculture". I had a dream about designing eye opening cool buildings especially the building exteriors. Since my main goal had changed to designing non-mechanical urban paradigm for building aspect, I had to dig deeper to research building operation systems that are not consuming limited fossil fuels or any mechanical systems that require on-going maintenance to mid and low income residents. The neighbourhood near the site that I am proposing is not a high income community, so my design needs to be very moderate to harmonize with the surrounding neighbourhood, particularly the residential sector. This motivated me to select a simple rectangular building foot print shape; unlike my first building scheme which was curved plan shapes with almost every single unit displaying a slightly different shape and size. But when I researched and studied through my thesis journey, I learned from many sources articles, interviewing with Cohousers and my thesis committee members that I really have to consider not only building operation cost but also initial building construction cost as well. Many low income households cannot afford high construction costs.

BUILDING CONSTRUCTION COST

More and more architects and architectural designers are attempting and trying and emphasizing "Sustainable Design, going green, eco-friendly design for built forms, but it requires paying extra. Based on a recent Nielsen global survey on corporate social responsibility, "a willingness to pay extra for sustainable products is comparatively lower in North America (42%) than Asia-Pacific (64%), Latin America (63%) and Middle East/Africa (63%)."[1] I can assume that the low income homeowners would not even attempt to renovate their existing housing or constructing new. Minimizing building construction cost is very critical to provide ideal mid-income housing units. So I will provide residential buildings with various building façades that each homeowner can add on overtime as they need.

Building landscape aspects, I maintain as much open land as possible to secure farming spaces. The portion of the land other than buildings can be potential farming spaces including the front and back of each housing unit and the rooftops. My purpose for an optional greenhouse enclosure façade is to promote year around farming for the Cohousers.

TARGET COHOUSING MEMBERS

Targeting residents by other factors than income level became clearly needed overtime. I began with no limit for the cohousing members, but I do like to encourage young couples (mid-30s to mid-40s) with school children and singles (mid-20s to mid-30s) to become members. They can teach their children and learn themselves to respond to nature's patterns and mimic the pattern of nature to apply to their daily living and lives. Their children can learn this life lesson and pattern harmonizing with nature to be the norm for their life time and beyond.

LIFE OF CONVENIENT

Completely eliminating mechanical air conditioning systems is not an easy task for me especially since it is very humid throughout the year in the Miami valley area. So the design journey was on-going study and research of sustainable air control systems that do not consume fossil fuels and create toxicity releases to the air. Directly using Korean floor heating method "Ondol" is not feasible in American society because American culture is not a "living on floor" culture. People in America rely on and touch more furniture than feeling and using the actual building inner materials. Unlike Korean culture where shoes are not welcome inside the house, people accustomed to wearing shoes inside houses will not appreciate heated floors. So I learned from my research and committee about the "Earth Tube Heat Exchanger System" which can be a very passive system that is not considered a mechanical system.

CONCLUSION

Through this thesis journey, especially during design processing time, I learned that architects are not just providing spaces to fill with furniture and hide from outdoor weather changes. Architects are professionals who should provide clothes (in the form of architecture) to people that can breathe in and out. Particularly, professionally educated architectural people have been neglecting to take care of the residential built environment. People need to be more conscious to design and build forms with regards to materials and operating methods. There are many useful inventions human beings can utilize with very little additional cost and minimal disturbance of nature to make their lives meaningful and comfortable and convenient if there is more consideration undertaken. Another thing I learned through this thesis topic is that true architects are like inventors who seek non-stop better ways to provide forms of the built environment to harmonize with nature and all species on earth with innovative creations. This will prove that social problems can be solved through architecture when built forms can create "power of place".[2]

I am hoping that the time will come soon that my thesis project will not end as a paper design but will become a real design in a built form for people and nature to enjoy.

END NOTES

[1] USGBC: The Business Case for Green Building. Published on 10 February 2015, accessed May 4, 2016, http://www.usgbc.org/articles/business-case-green-building

[2] Tony Schuman, *Forms of Resistance: Politics, Culture, and Architecture* (in Voices in Architectural Education: Cultural Politics and Pedagogy, Thomas A. Dutton, ed. (New York: Bergin and Garvey, 1991), 17.

Many thanks to all who helped me through my thesis journey!

I would like to thank everyone who helped me physically, mentally, or spiritually through my thesis journey. Coming back to school after a long break was not an easy transition for me, but I am now ready to go back and practice and provide for better services to people and communities. I can share my learning experiences from Miami University with the world.

I would like to thank all of the Cohousers in Sunward, Great Oak, Touchstone, and Genesee Garden cohousing communities for allowing me to interview them without hesitating and being welcoming and very generous to a stranger like me, and Mr. Robert Church who also allowed me to interview him as a previous Cohousers and helped me as my thesis journey started from beginning to the final presentation.

I particularly want to thank my committee, Professor Mary Rogero, Professor John Reynolds, and Professor Ben Jacks. I feel very lucky to have had such wonderful people as my thesis advisors and I learned many great things and ways to achieve my education goals which I never experienced through my undergraduate architectural program. Without their help and guidance, I do not think I could have achieved what I am about to achieve.

Lastly I wish to thank my husband George Strobel who helped me many ways including pinning up for the final presentation until 6 o'clock in the morning on presentation Monday. I cannot say enough to thank him with these few sentences. Without his support, I would have never even dream about finishing my two year thesis program. I owe him half of my degree that I will achieve soon.

Thank you!

Sincerely,

Sanghee Rhie

SITE LOCATION

USA and Korea Highlighted on the World Map
(showing Ohio and Korea on the same latitude line)

Modified by Sanghee Rhie: Original map source - http://maxsstuff.net/photobov/map-europe-latitude-longitude, 07-16-15

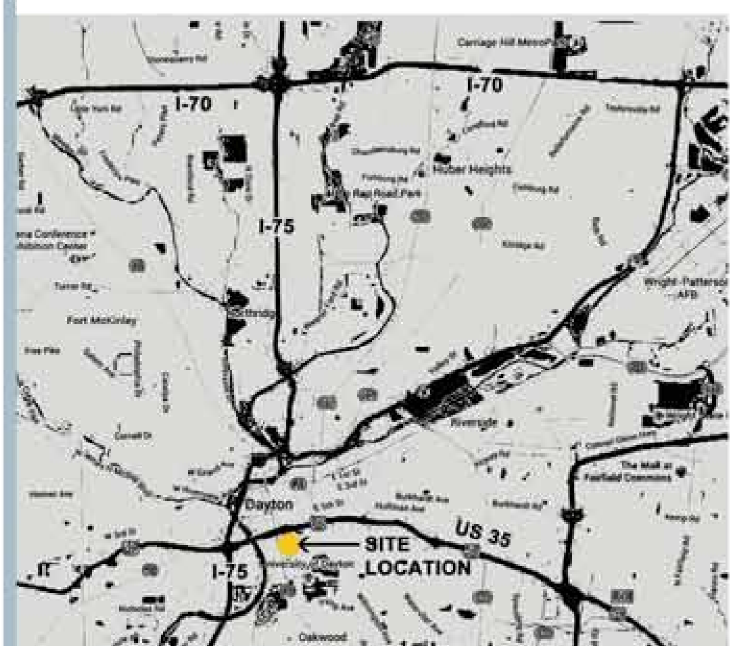
Ohio Highlighted on the USA Map

Dayton Metro Area : located in SouthWest Ohio

The Greater Dayton Area Highlighted on Ohio Map

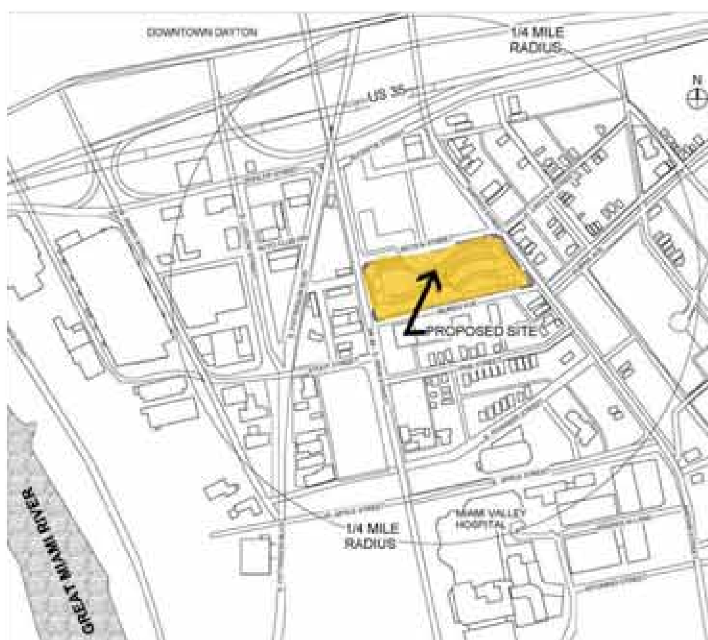
Modified by Sanghee Rhie: Original map source - http://ohiolmi.com/maps/MapofMSAs2000.htm, 08-13-15

Dayton Metro Area Highlighted on the Greater Dayton Map



Proposed Site Location Map

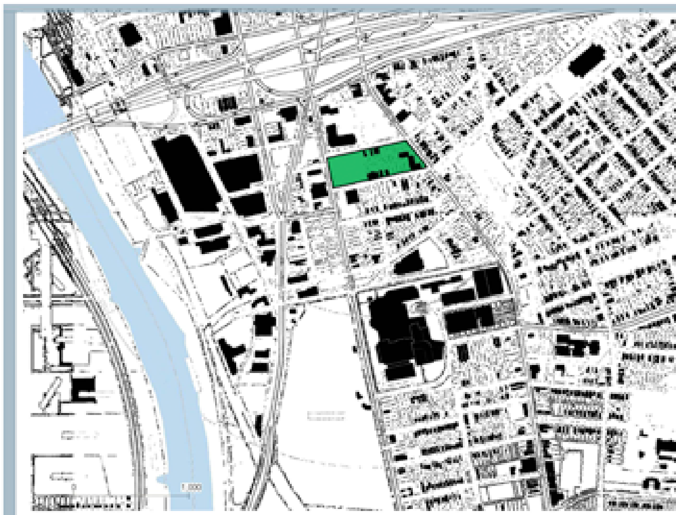
Modified by Sanghee Rhie: Original map source - Google Maps, 07-16-15



Vicinity Map

PROPOSED SITE ADDRESS: 11~99 BURNS AVE, DAYTON, OHIO 45402

SITE ANALYSIS



URBAN STREET/ DENSITY PATTERN

MIXED USE URBAN PATTERN

PAINTARY SITE LANDSCAPE PLAN

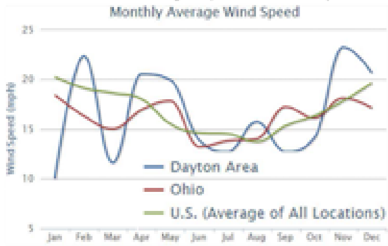
SITE ANALYSIS - DAYTON METRO AREA CLIMATE DATA

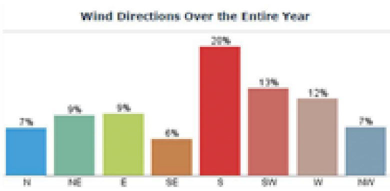
The typical weather at the Dayton Wright Brothers Airport (Dayton, Ohio, United States) weather station over the course of an average year. It is based on the historical records from 1999 to 2012.

The temperature, snow fall, and precipitation information from the historical data of 18,000+ U.S weather stations for the period of time from 1980 to 2010. The humidity and wind speed information data from 15,000 worldwide stations for the period of time from 1980 to 2010.

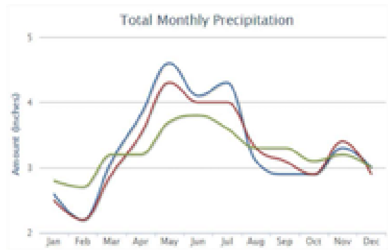
1. Macro Climate Data:

o Wind: annual average Speed: 16.44 mph

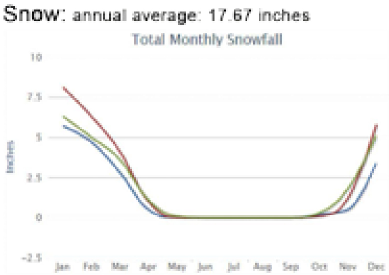




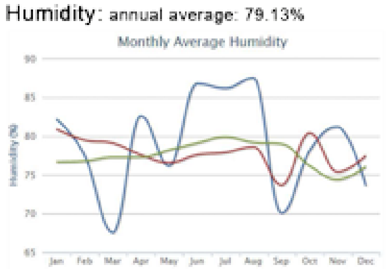
o Precipitation: annual average: 36.6 inches



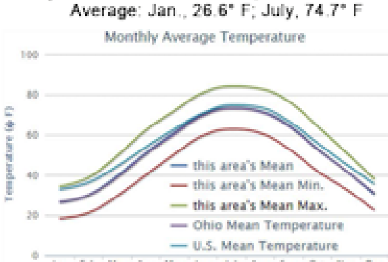
o Snow: annual average: 17.67 inches



o Humidity: annual average: 79.13%



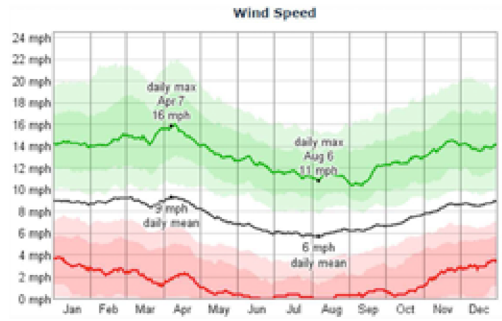
o Temperature: annual average: 51.16° F
Average: Jan., 26.6° F; July, 74.7° F



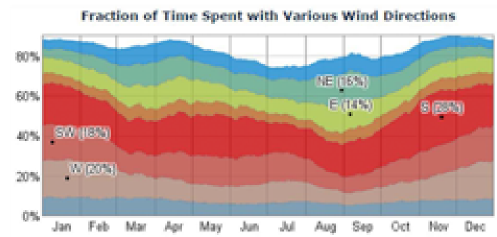
Data source - http://www.usa.com/dayton-oh-area-weather.htm 07-13-15

2. Micro Climate Data:

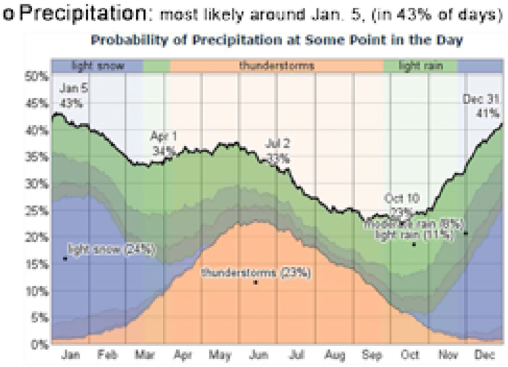
o Wind: average daily min(red), max(green), & average(black)



Wind blowing from the various directions on a daily basis. Stacked values do not always sum to 100%.
(The wind direction is undefined when the wind speed is zero.)

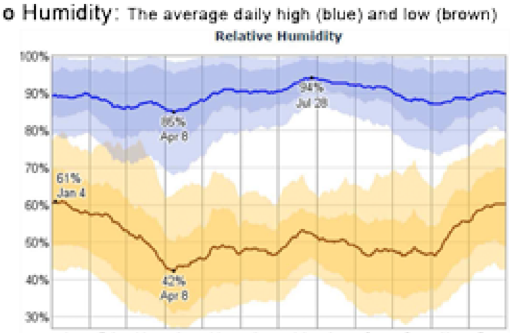


o Precipitation: most likely around Jan. 5, (in 43% of days)

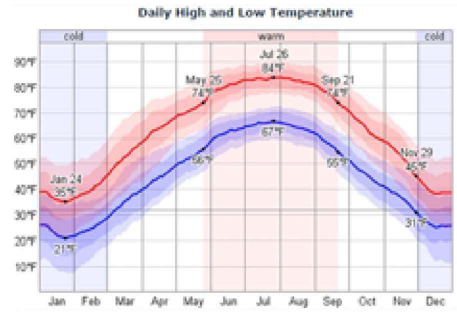


o Snow: likely for snow to fall spans from Nov. 19 to Mar. 22

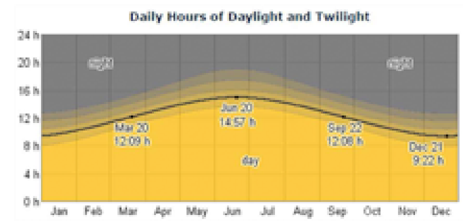
o Humidity: The average daily high (blue) and low (brown)

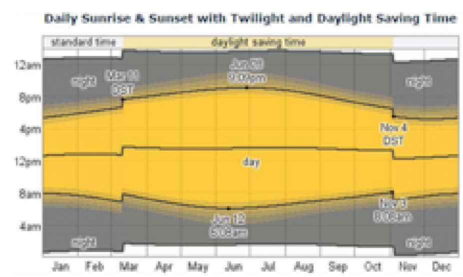


o Temperature: warm season-from May 25 to Sept. 21
The cold season -from November 29 to March 1

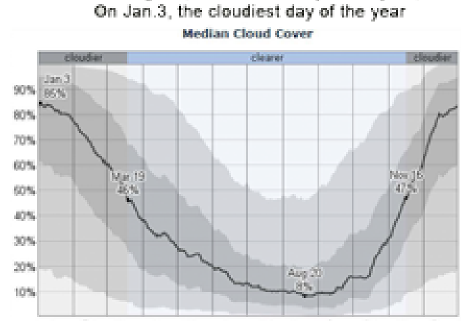


o Sun: The shortest day-Dec. 21 w/ 9:23 hrs. of daylight;
the longest day-June 20 with 14:57 hrs. of daylight.

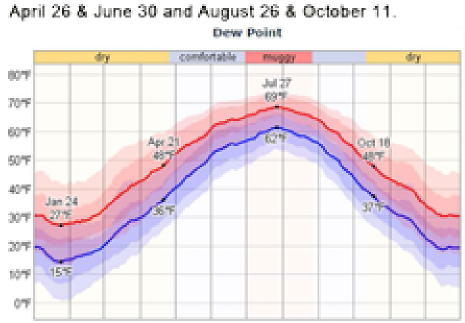




o Clouds: On Aug. 20, the clearest day of the year,
On Jan.3, the cloudiest day of the year



o Dew Point: two most comfortable periods: between April 26 & June 30 and August 26 & October 11.



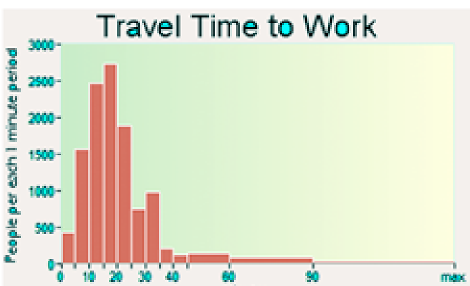
Data source - https://weatherspark.com/averages/30873/Dayton-Ohio-United-States, 08-14-15

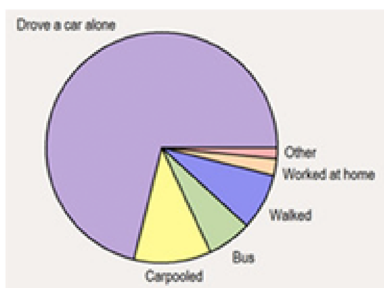
SITE ANALYSIS - DEMOGRAPHY AND WEATHER INFORMATION

Demography : Dayton Metro Area

Location: Southwest Ohio.
Dayton is situated near the center of the Miami River Valley. The Mad River, the Stillwater River, and Wolf Creek, all tributaries of the Miami River, join the master stream within the city limits.

Population: 841,502 (2010)
Population by County:
Montgomery County: 535,153, Greene County: 161,573
Miami County: 102,506, Preble County: 42,270
Population Density: 490.18 people/sq mi
* The state average : 257.36 people/sq mi
* The national average: 81.32 people/sq mi
The most prevalent race: white (79.96%)
The average education level: about the same as the state average and about the same as the national average
Median Household Income: $47,421 at 2008-2012—0.59% increase since 2005-2009
Median House Price: $125,900 at 2008-2012—-0.32% increase since 2005-2009
Total Area: 1,717 sq mi
Water Area: 11 sq mi (0.62%)
Latitude: 39.76o N, Longitude: 84.20 W
Elevation: 750 feet above sea level





Population by Race

White: 672,906 (79.96%)
Black: 125,815 (14.95%)
Hispanic: 17,211 (2.05%)
Asian: 15,364 (1.83%)
Native (American Indian, Alaska Native,
Hawaiian Native, etc.):2,234 (0.27%)
One Race, Other: 5,889 (0.70%)
Two or More Races: 19,294 (2.29%)

Education for the 25 Years and Over

Total 25 Years and Over Population: 563,714, 100%
Less Than High School: 62,724, 11.13%,
High School Graduate: 174,418, 30.94%,
Some College or Associate Degree: 184,231, 32.68%
Bachelor Degree: 83,727, 14.85%
Master, Doctorate, or Professional Degree: 58,614, 10.40%
*Based on 2008-2012 data. View historical education level data.

Population by Gender

Male: 407,415 (48.42%)
Females: 434,087 (51.58%)
*Based on 2010 data. View historical gender data.

Population by Age

Median Age: 39.20 years old
Median Age, Male: 37.60 years old
Median Age, Female: 40.50 years

Household and Family

Total Households 343,971, 100%
Average Household Size 2.38
1 Person Households 102,937, 29.93%
2 or More Person Households: 241,034, 70.07%
Family Households: 220,249, 64.03%
Average Family Size 2.95
Married-Couple Family: 157,484, 45.78%
Nonfamily Households: 123,722, 35.97%
*Based on 2010 data.

Weather : Dayton Metro Area

Dayton, Ohio has a humid continental climate with hot summers and no dry season. The area within 25 miles of this station is covered by croplands (84%), built-up areas (10%), and grasslands (4%).
The Miami Valley is a fertile agricultural region because of evenly distributed precipitation and moderate temperatures. High relative humidity throughout the year can cause discomfort to people with allergies. Winter temperatures are moderated by the downward slope of the Miami River; cold polar air from the Great Lakes produces extensive cloudiness and frequent snow flurries.

Heating and Cooling Cost:

o Heating Cost Index: 262.76

o Cooling Cost Index: 61.80

* The Heating Cost Index and the Cooling Cost Index are indicators of the relative heating and cooling cost of an area.
They were calculated based on the average temperate and duration of the hot and cold days for the area. The actual heating cost and cooling cost are also dependent on other factors specific to individual residences such as the size of the house, the insulation condition, and the equipment efficiency, etc.

Based on the researched weather data, choosing a site within this Dayton Metro area will be very feasible for harvesting solar energy and the electricity from wind turbine on site (for example, Low start wind speed at 4.5 mph and charging speed at 9 mph wind turbines are available). Considerable building envelope design with effective insulation and building orientation study for the winter solar heat gain will dramatically reduce heating cost. Reducing the heating cost will contribute exceptionally minimizing energy consumption to operate buildings since cooling cost is over four times higher than building cooling cost.

SITE PHOTOGRAPHS

Proposed Site Outlined on Aerial view by Google map

Site Pictures-Taken by Author, July 14~Aug. 12

VIEW 1

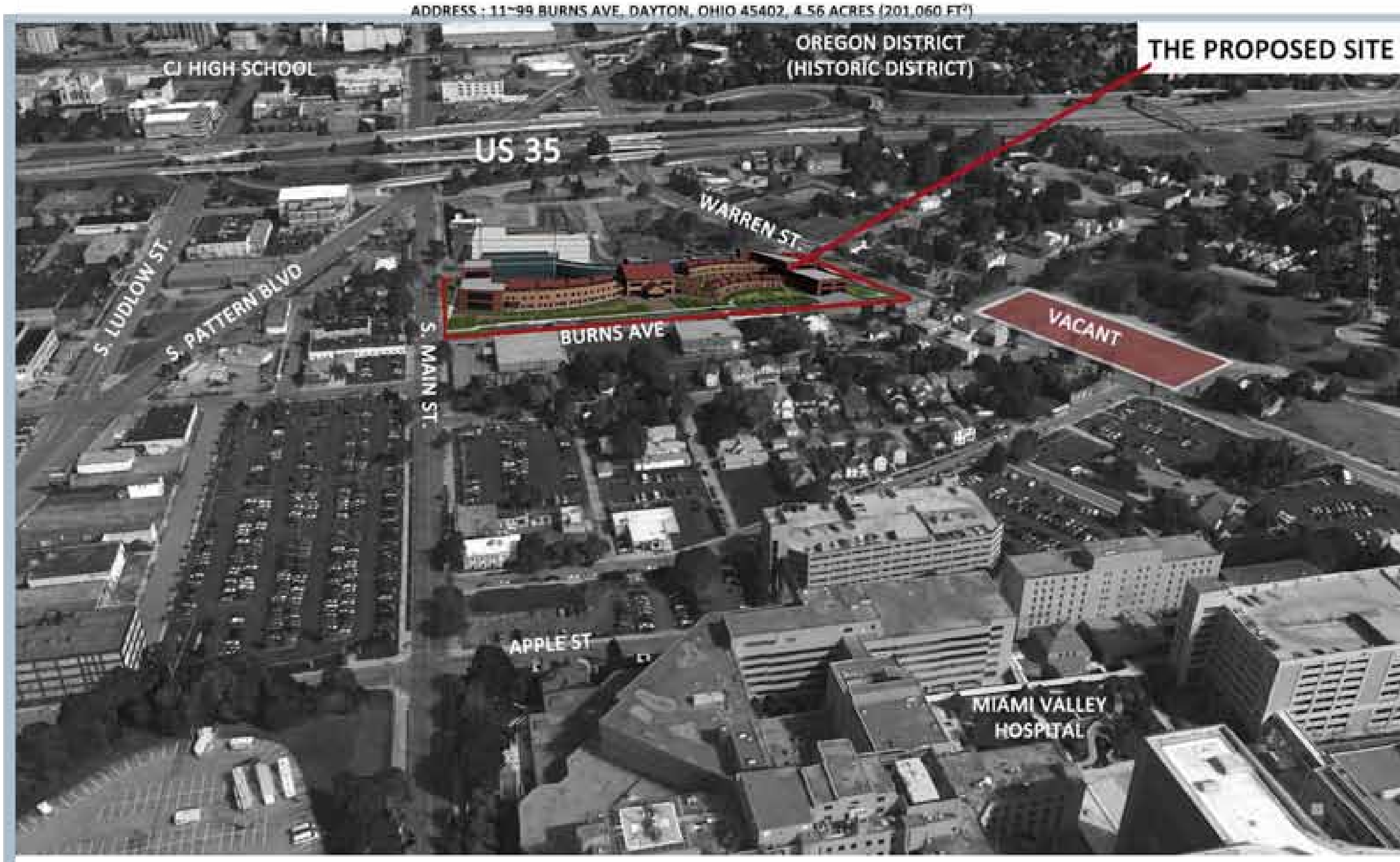
VIEW 2

VIEW 3

VIEW 4

SITE PHOTOGRAPHS

ADDRESS : 11~99 BURNS AVE, DAYTON, OHIO 45402, 4.56 ACRES (201,060 FT^2)

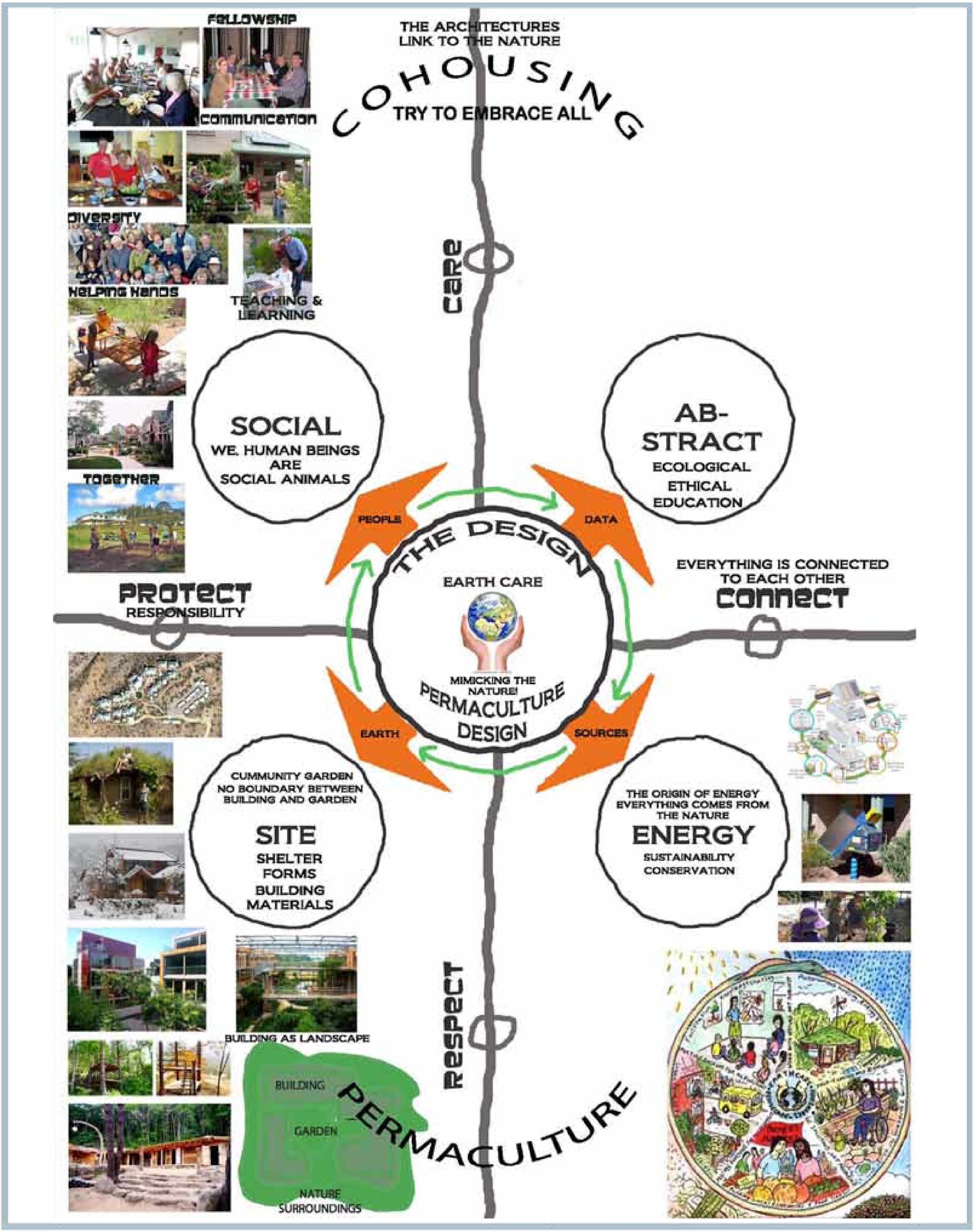


Proposed Site Outlined on Birds Eye View by Google map
Modified by Author

Site Perimeter Pictures-Taken by Author, July 14~Aug. 12

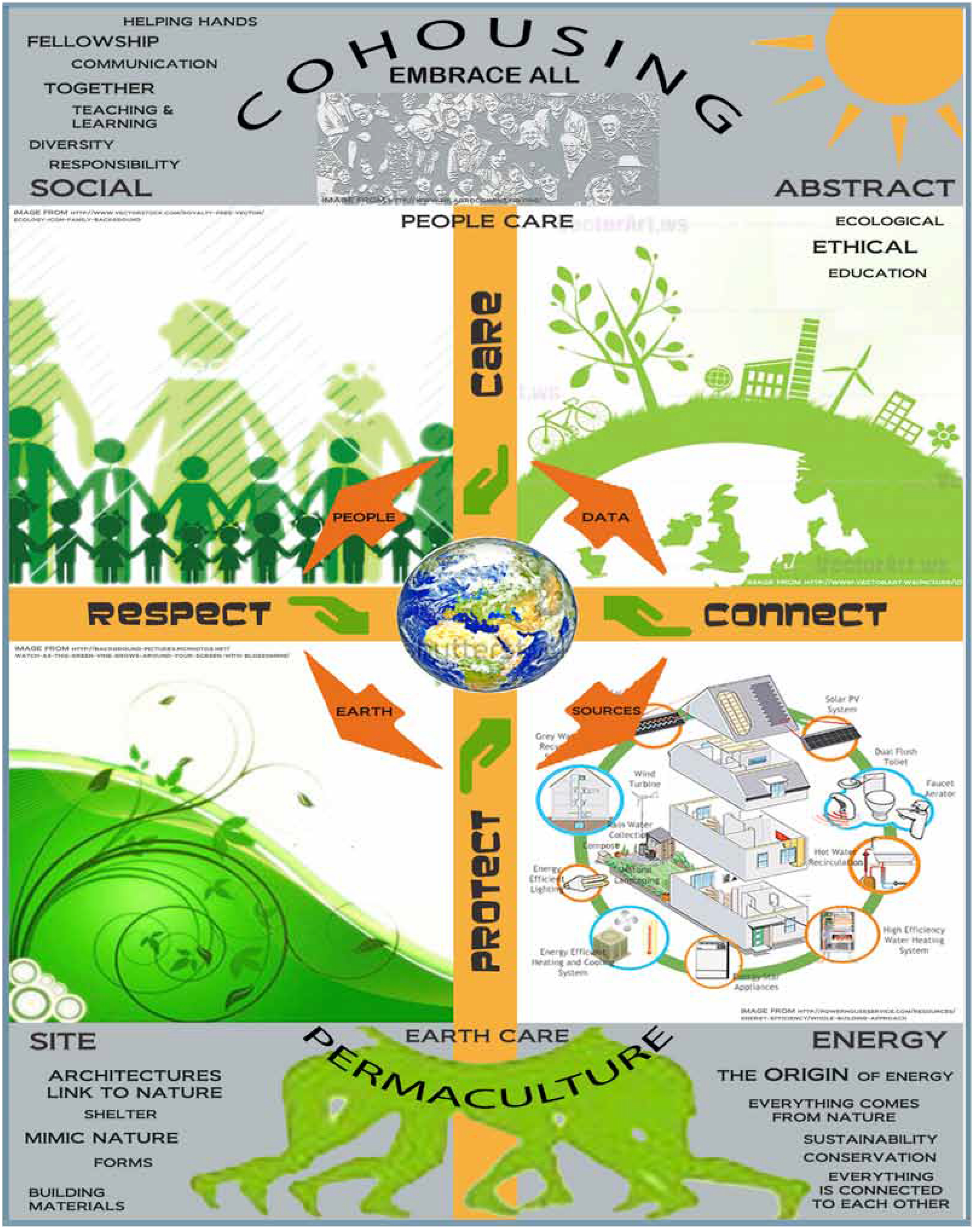
SITE PHOTOGRAPHS - NEIGHBORHOOD

POSTER - ROUGH DRAFT



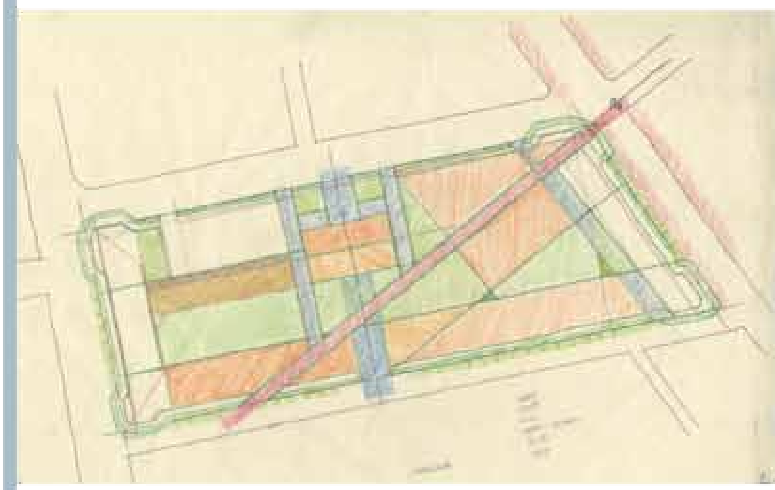
DESIGN PROCESS

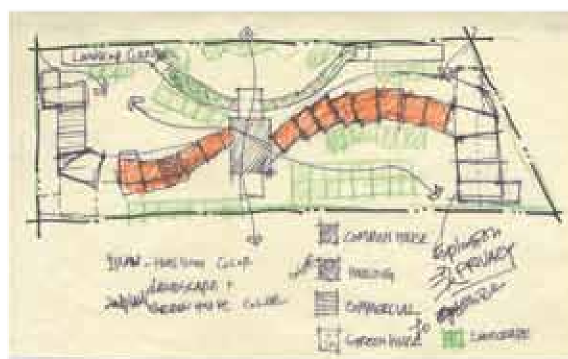
POSTER

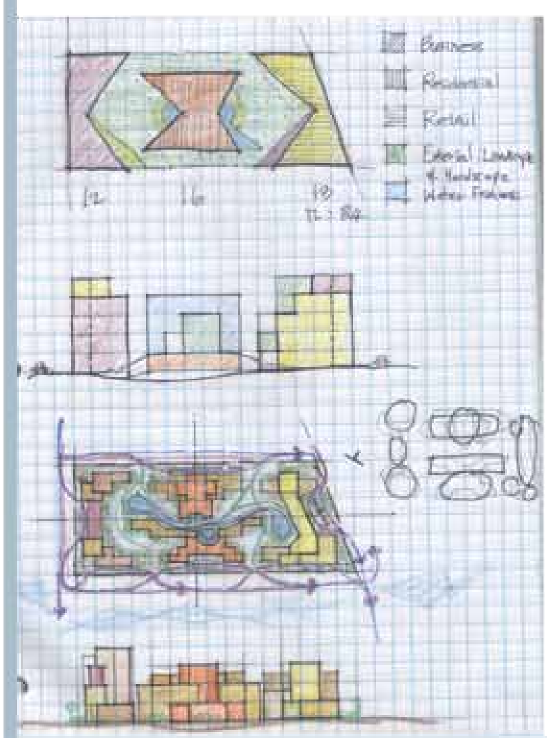


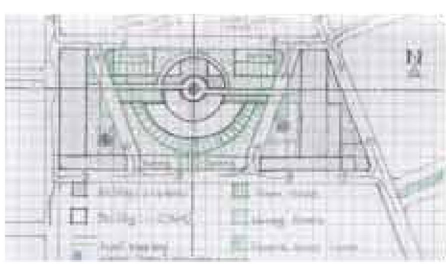
COHOUSING
EMBRACE ALL
HELPING HANDS
FELLOWSHIP
COMMUNICATION
TOGETHER
TEACHING &
LEARNING
DIVERSITY
RESPONSIBILITY
SOCIAL
ABSTRACT
PEOPLE CARE
ECOLOGICAL
ETHICAL
EDUCATION
CARE
PEOPLE
DATA
RESPECT
CONNECT
EARTH
SOURCES
PROTECT
EARTH CARE
PERMACULTURE
SITE
ARCHITECTURES
LINK TO NATURE
SHELTER
MIMIC NATURE
FORMS
BUILDING
MATERIALS
ENERGY
THE ORIGIN OF ENERGY
EVERYTHING COMES
FROM NATURE
SUSTAINABILITY
CONSERVATION
EVERYTHING
IS CONNECTED
TO EACH OTHER

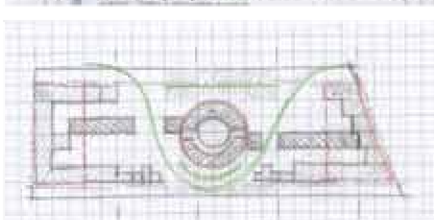
SITE SCHEMATIC DESIGN PROCESS



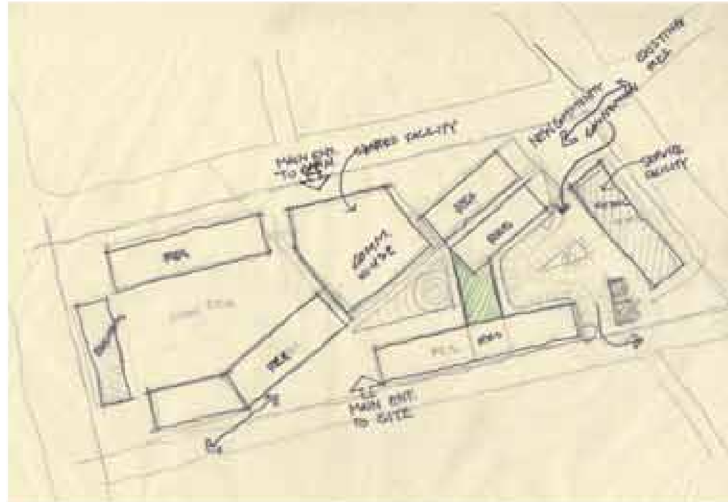


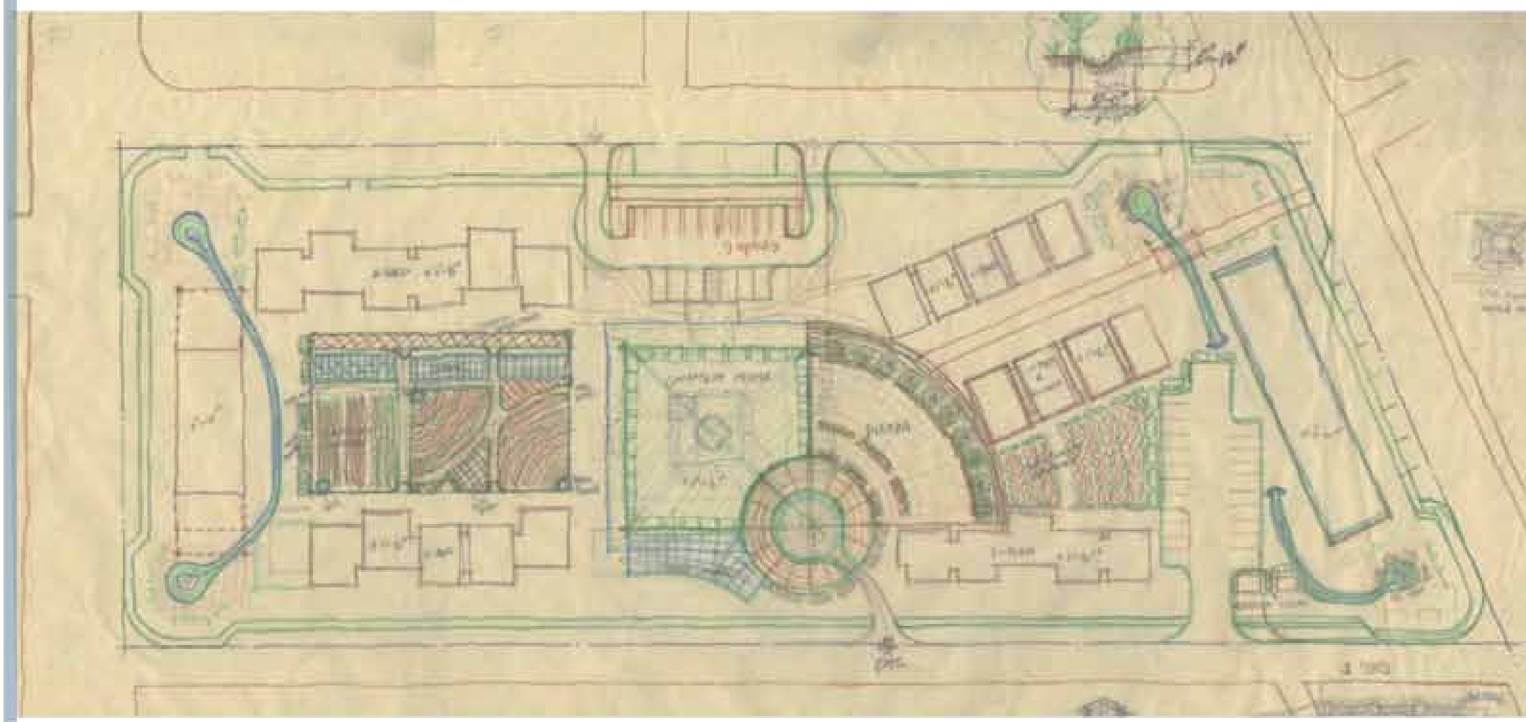


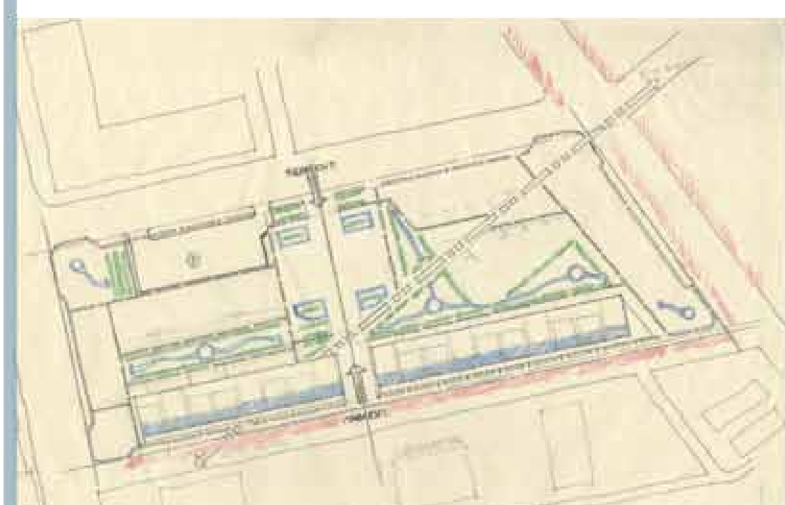


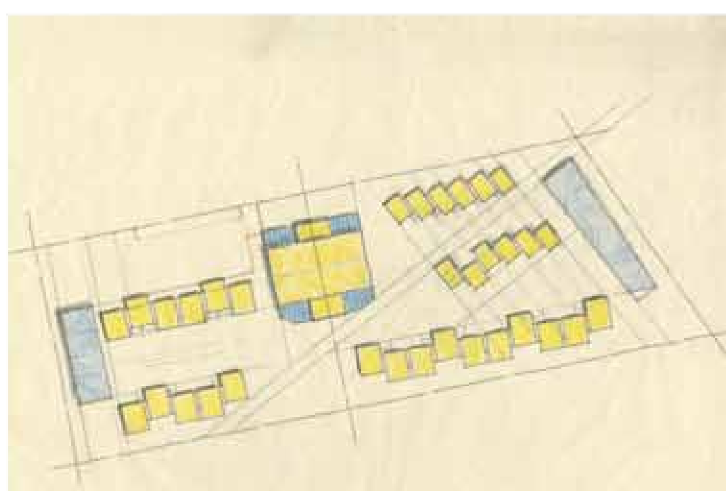


SITE DESIGN DEVELOPMENT PROCESS

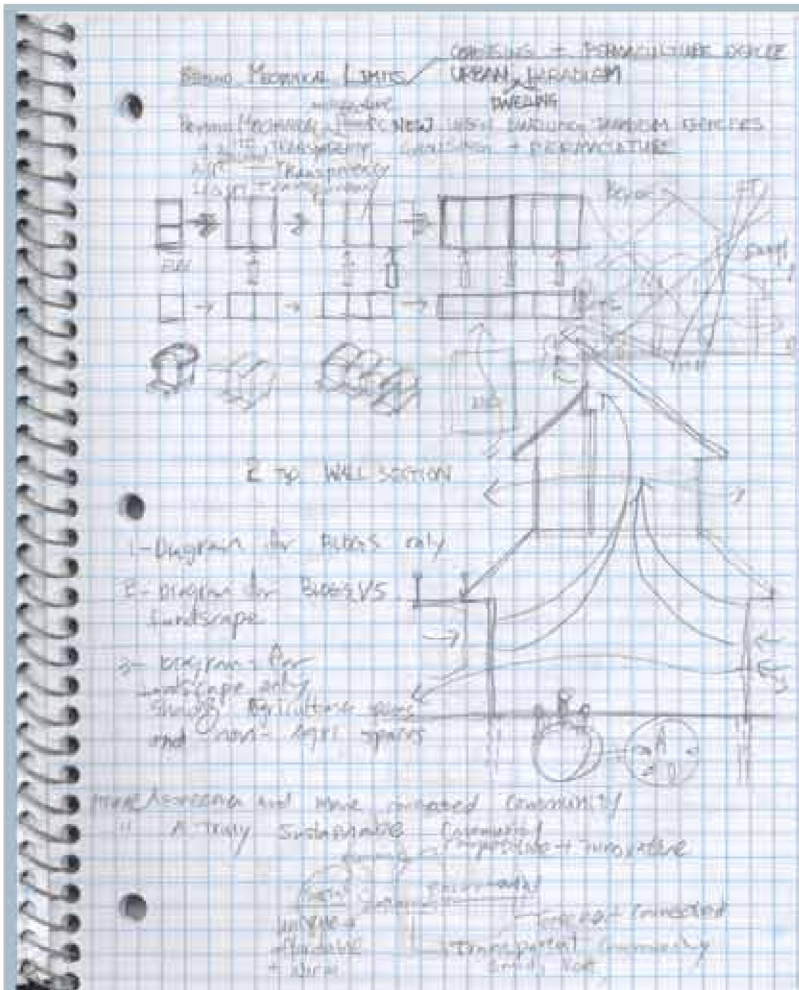


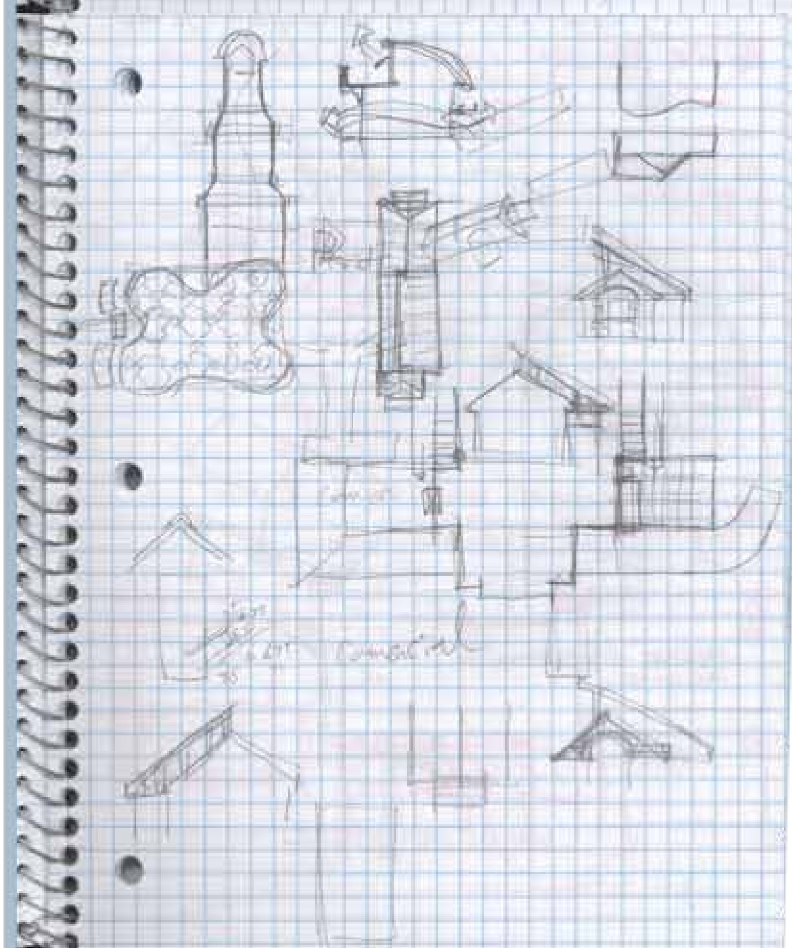


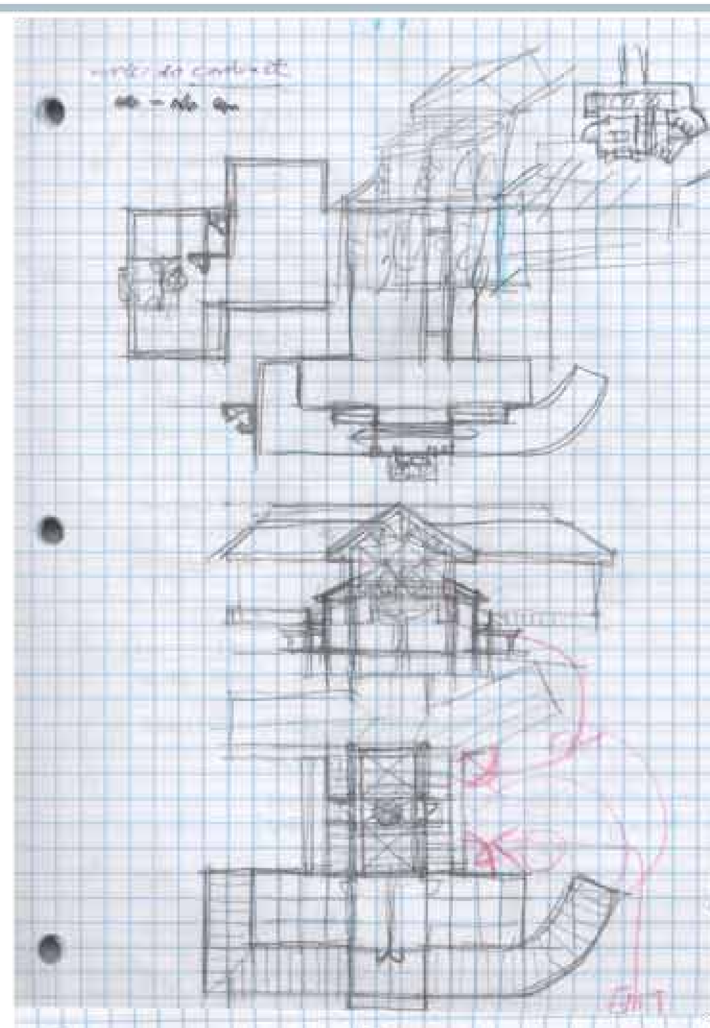


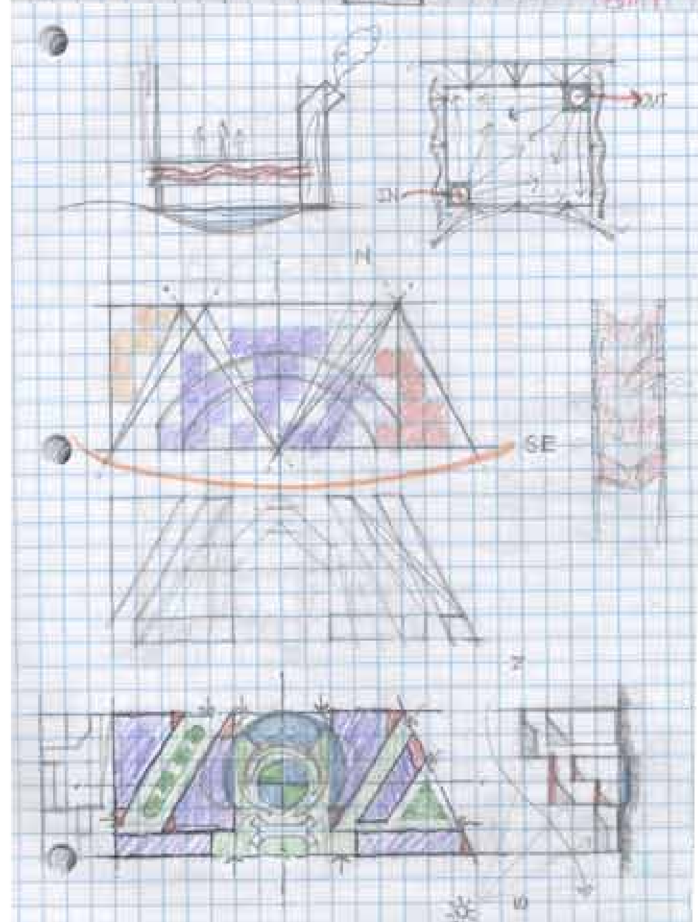


NOTEBOOK SKETCHES/DOODLING

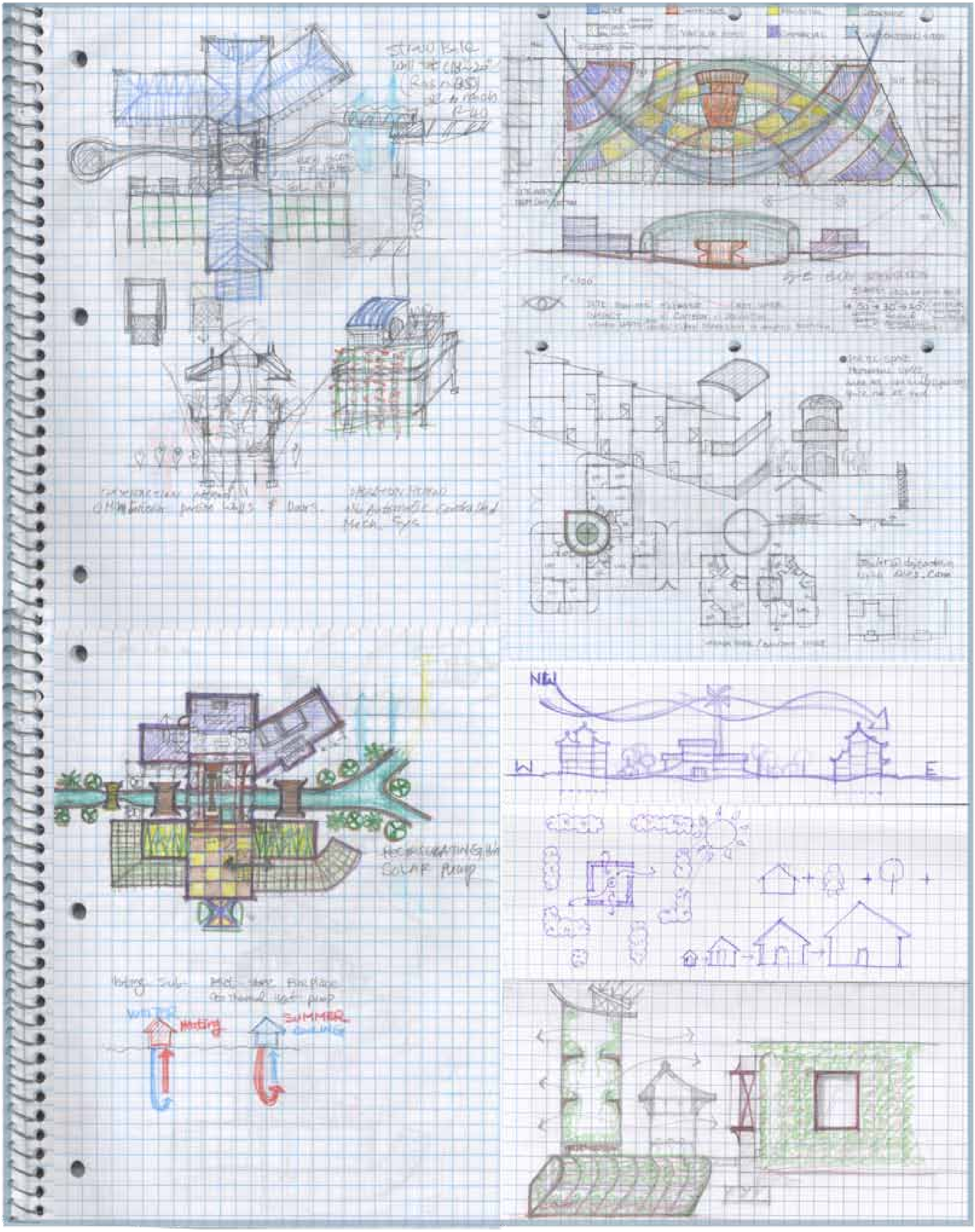






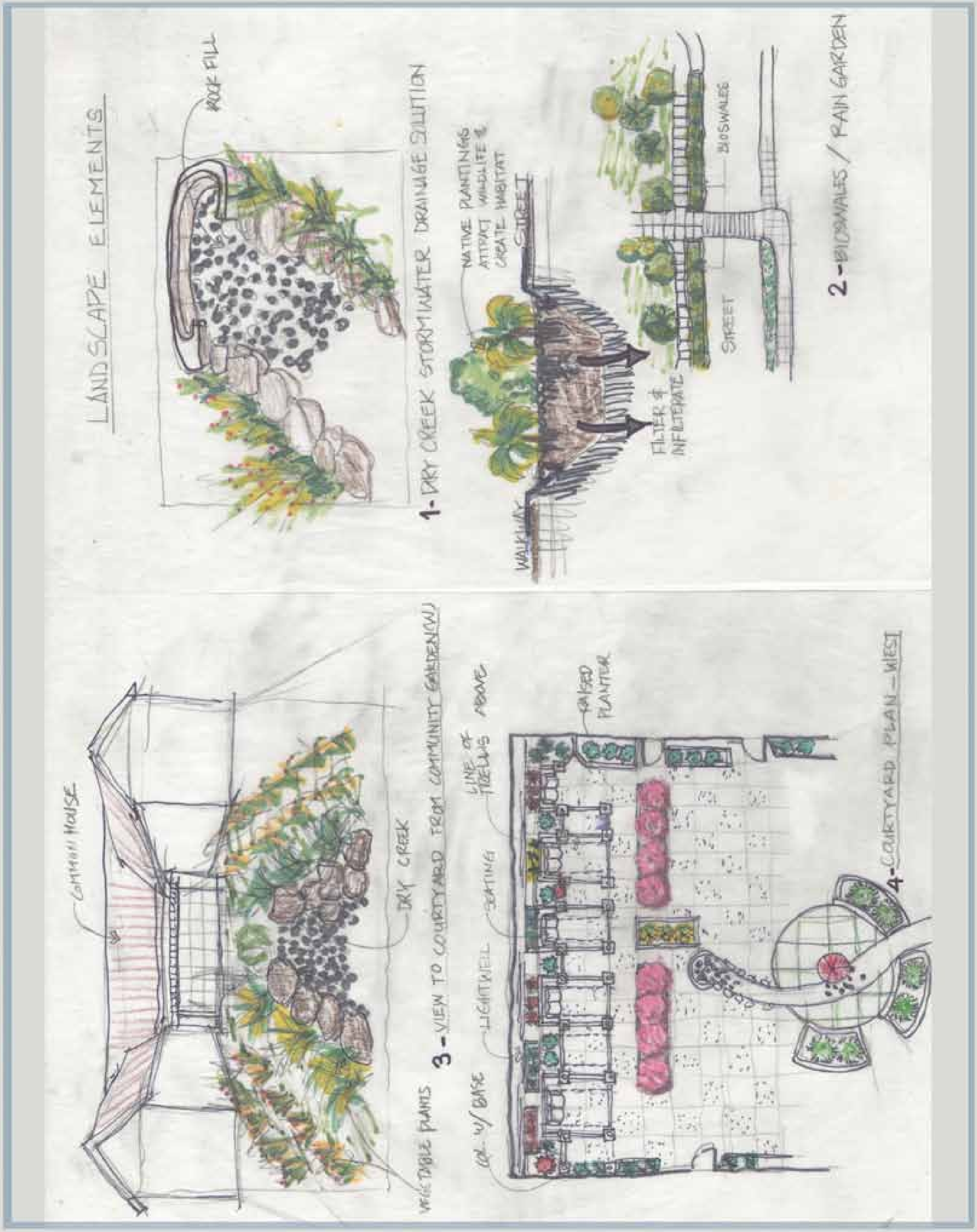


NOTEBOOK SKETCHES/DOODLING

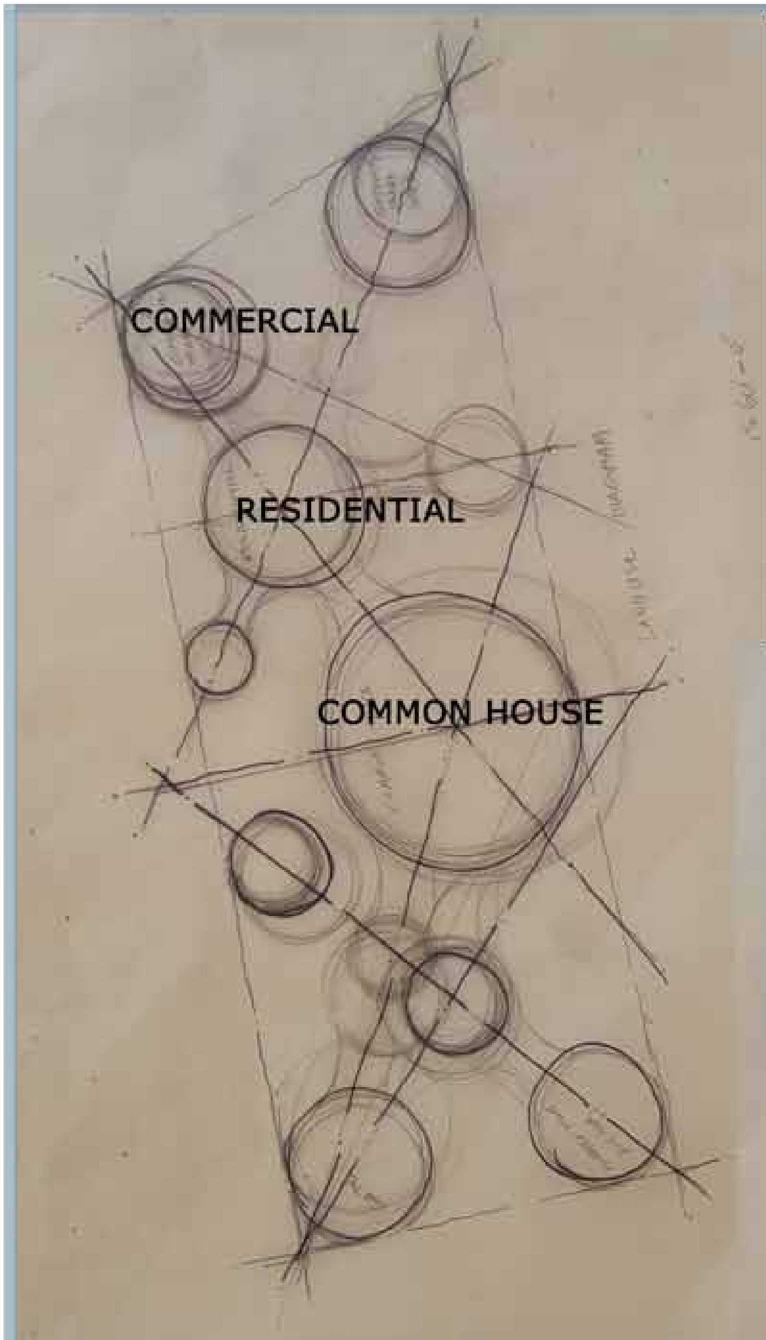


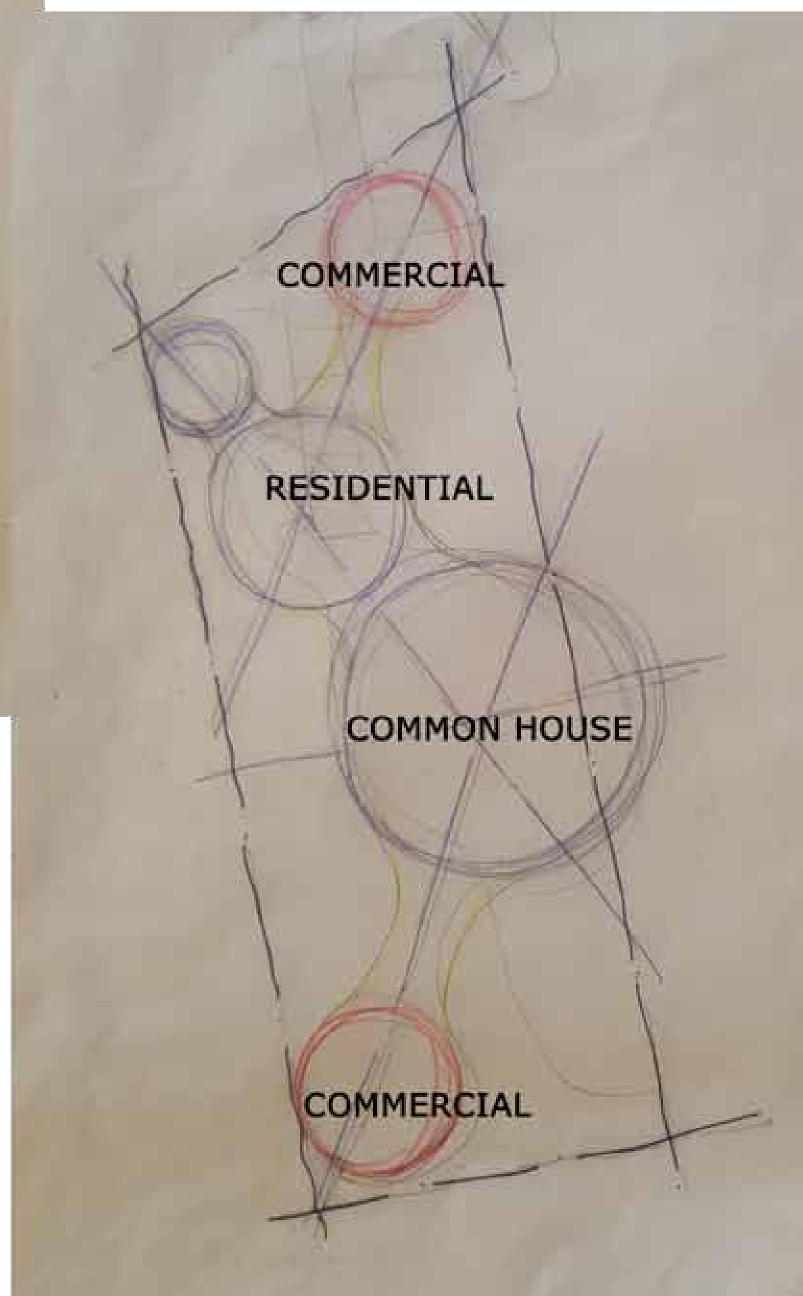
SKETCHES - SITE DESIGN

SITE DETAIL SKETCHES

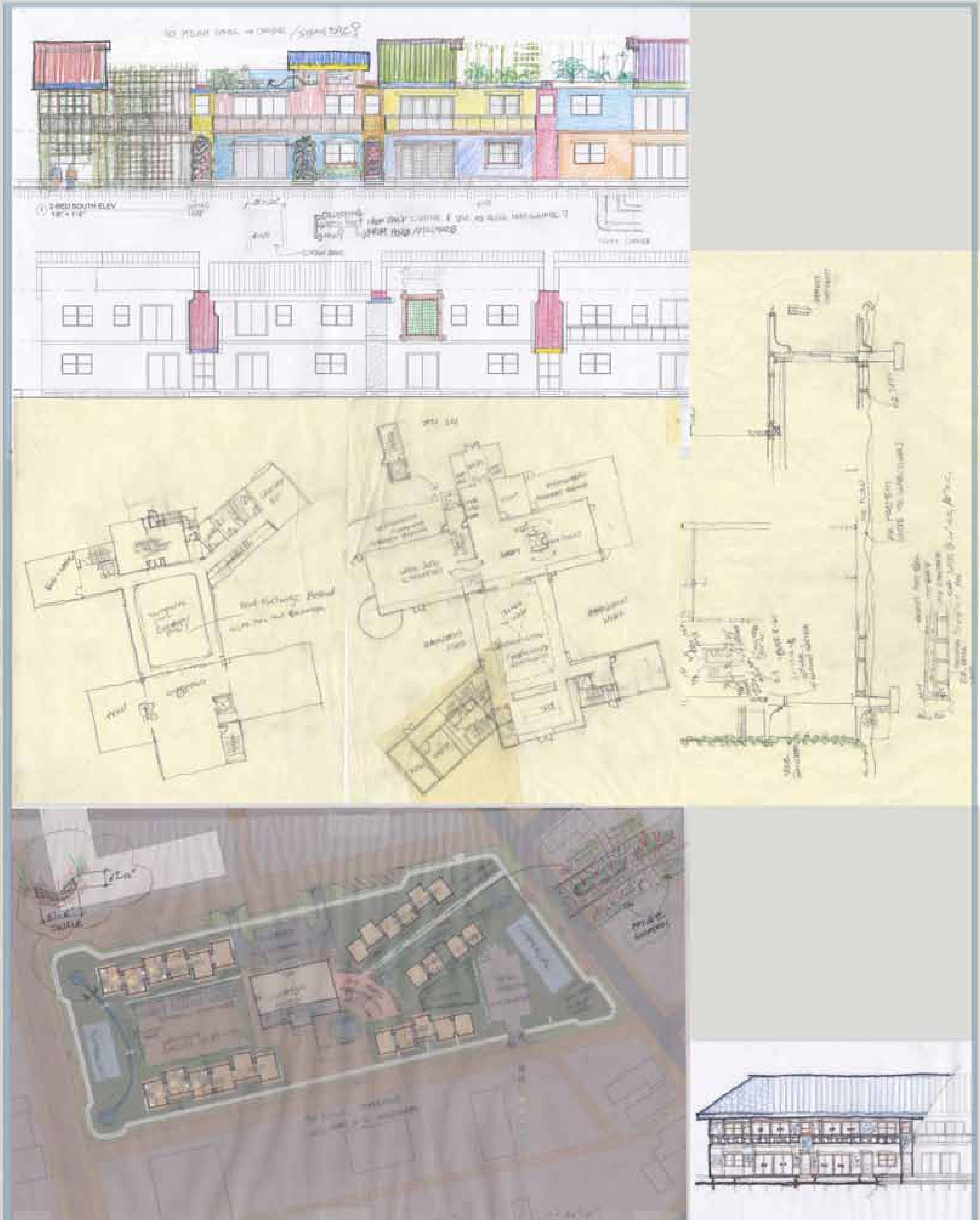


SKETCHES - SITE USE GROUP BUBBLE DIAGRAMS



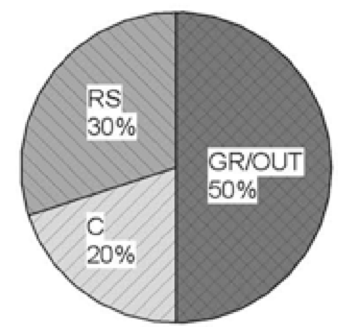


SKETCHES



PROGRAM- SCHEMATIC DESIGN

PROJECT PROGRAM (URBAN MIXED USE COHOUSING) 11~99 BURNS AVE, DAYTON, OH 45402, 4.56 ACRES (201,060 FT2)

USE GROUP	LAND USE %	USE GROUP DETAIL	QUANTITY	
RESIDENTIAL	30		40 ~50 UNITS	
		● TYPE "A" : 600~900 FT2 ● TYPE"B" : 1,000~1200 FT2 ● TYPE "C" : 1,500~2,00 FT2 ● COMMON HOUSE(S) : 10,000~1,200 FT2	10 UNITS 20~30 UNITS 10 UNITS 1~2 UNITS	* USA MEDIAN S.F. FOR SINGLE-FAMILY HOUSES : OVER 2,000 FT2
COMMERCIAL	20			
		● PROFESSIONAL OFFICES : LAWYER'S OFFICE, DR.'S OFFICE, DENTAL OFFICE. ● ARCHITECTURAL DESIGN STUDIO SMALL BUSINESSES : REAL ESTATE, MUSIC- ● STORE, HAIR STUDIO, DANCE STUDIO, CHILD CARE, LAUNDROMAT, AFTER SCHOOL-LEARNING CENTER ● RETAIL : CONVENIENT STORE, ICE CREAM-SHOP, SMALL GROCERY STORE, COFFEE/ TEA SHOP (SELLING & DRINKING), RESTAURANT(FAMILY, HEALTHY FAST FOOD)		 SPACE DIAGRAM
GREEN HOUSE	10			
		● INDOOR FARMING SPACES ● HORTICULTURE LABS	2 UNITS 2 UNITS	
OUTDOOR SPACE	40			
		● FARMING SPACE:EDIBLE GARDEN, FRUIT TREES (20% MIN.) ● LANDSCAPE (LESS THAN 10%) ● HARDSCAPE (LESS THAN 5%) ● PERMEABLE PAVEMENT(LESS THAN 5%)		

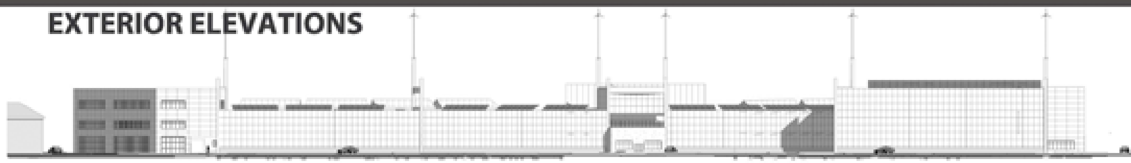
FALL 2015 SEMESTER PIN-UP

FALL 2015 SEMESTER PIN-UP

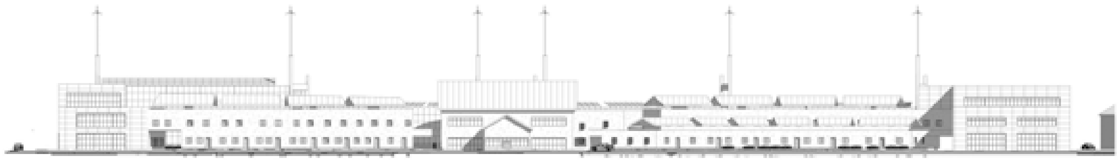
Beyond Mechanical Architecture

Integrating Urban Agriculture In Mixed Use Cohousing

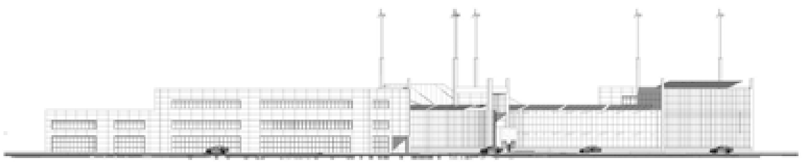
EXTERIOR ELEVATIONS



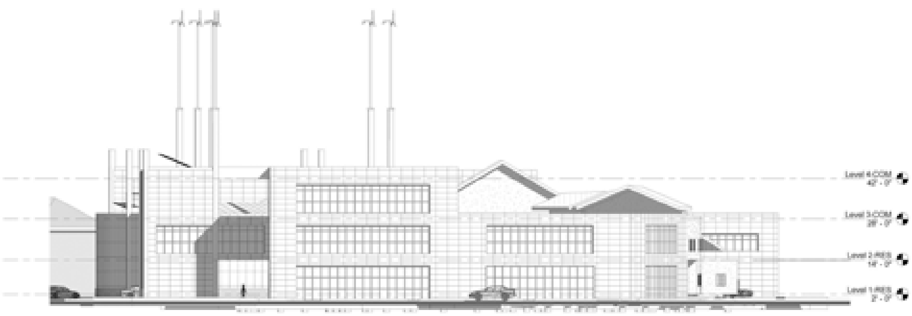
1 NORTH ELEVATION 1/32" = 1'-0"



2 SOUTH ELEVATION 1/32" = 1'-0"



3 EAST ELEVATION 1/32" = 1'-0"

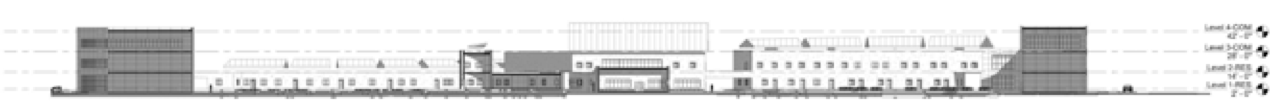


4 WEST ELEVATION 1/16" = 1'-0"

BUILDING SECTIONS

5 SECTION THRU N-S 1 1/16" = 1'-0"

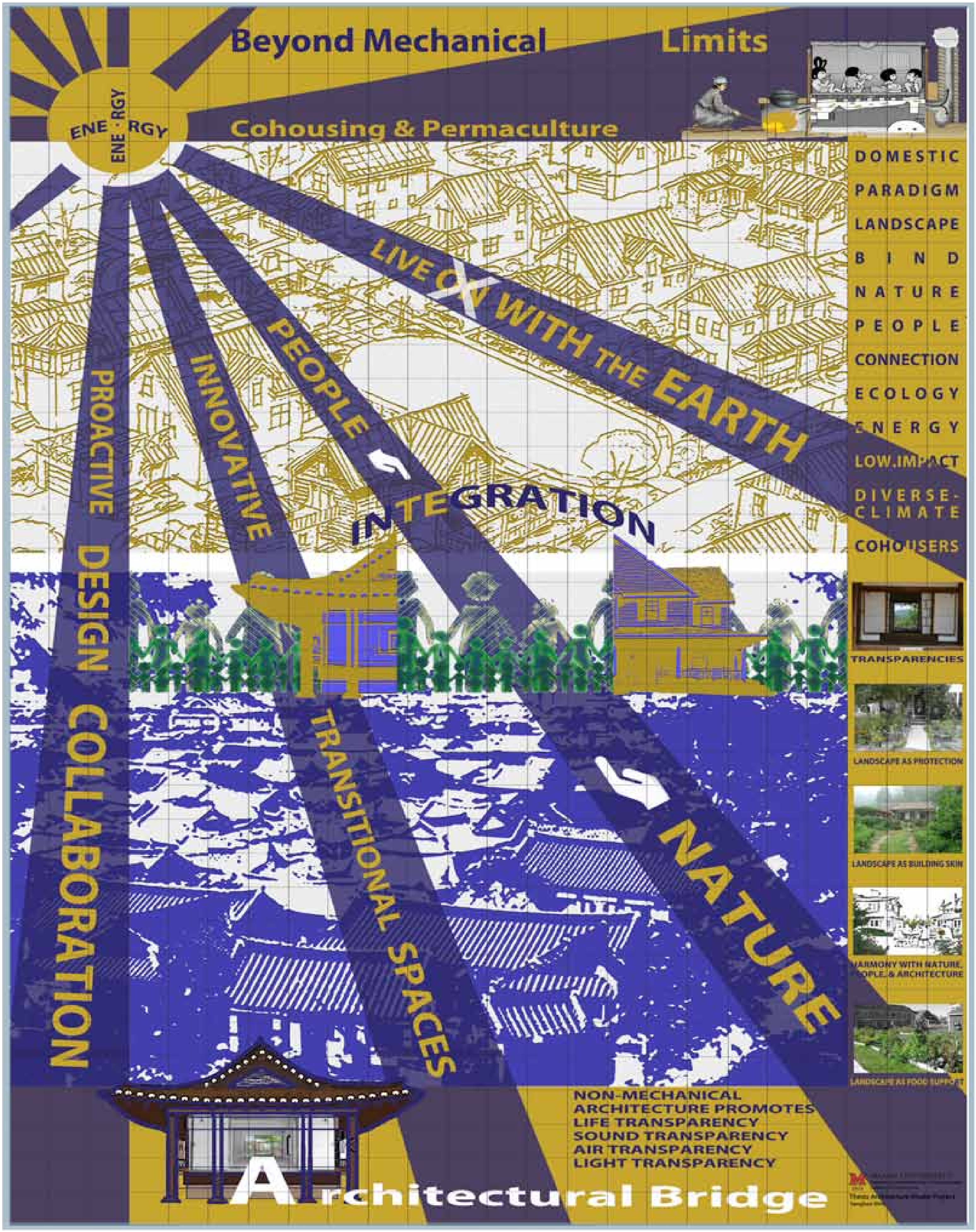
6 SECTION THRU N-S 2 1/16" = 1'-0"



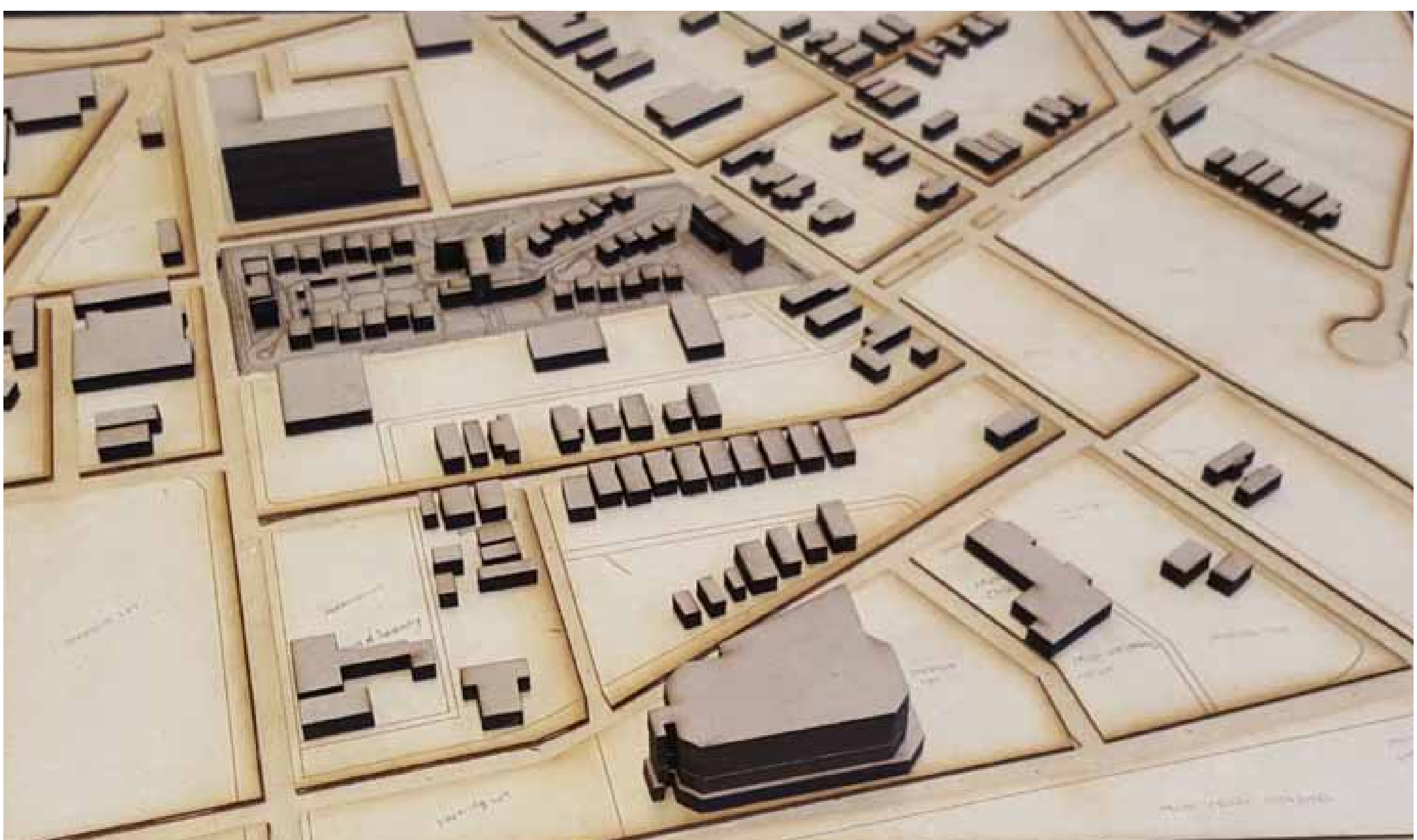
7 SECTION THRU W-E 1/32" = 1'-0"

FALL 2015 SEMESTER PIN-UP

FINAL THESIS POSTER



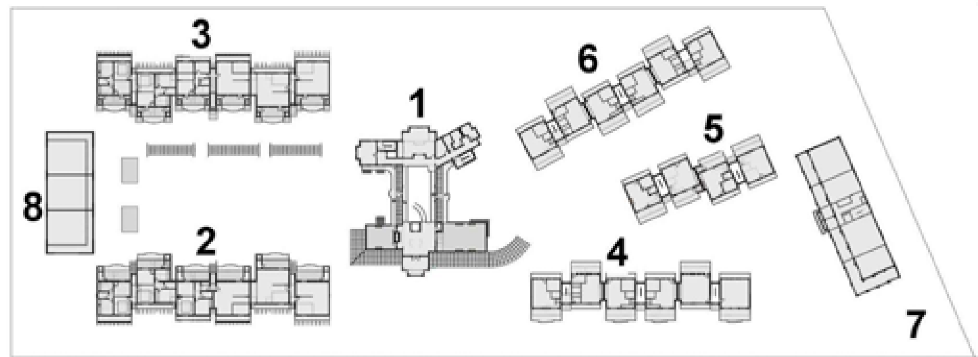
FINAL DESIGN



PROGRAM

PROJECT PROGRAM

PROJECT LOCATION : 11~99 BURNS AVE DAYTON, OHIO 45402
SITE AREA : 4.56 ACRES (APPROX. 5 ACRES) (201,060ft2)
SITE USE-GROUP : MIXED USE (COMMERCIAL, RESIDENTIAL, & INDUSTRIAL)
MAX. BUILDING HEIGHTS :
COMMON HOUSE : 32 FEET (PARTIAL BASEMENT & 2 STORIES) - BUILDING "#1"
RESIDENTIAL : 27 FEET (2 STORIES) - 5 BUILDINGS "#2 ~ 6"
COMMERCIAL : 42 FEET (PARTIAL BASEMENT & 3 STORIES) - 2BUILDINGS "#7 & 8" ON EAST AND WEST SIDE PROPERTY LINES
* NON MECHANICAL BUILDINGS WITH PERMACULTURE PRINCIPLES ADOPTED FOR THE SITE LANDSCAPE (MAJOR EDIBLE GARDEN - URBAN AGRICULTURE).

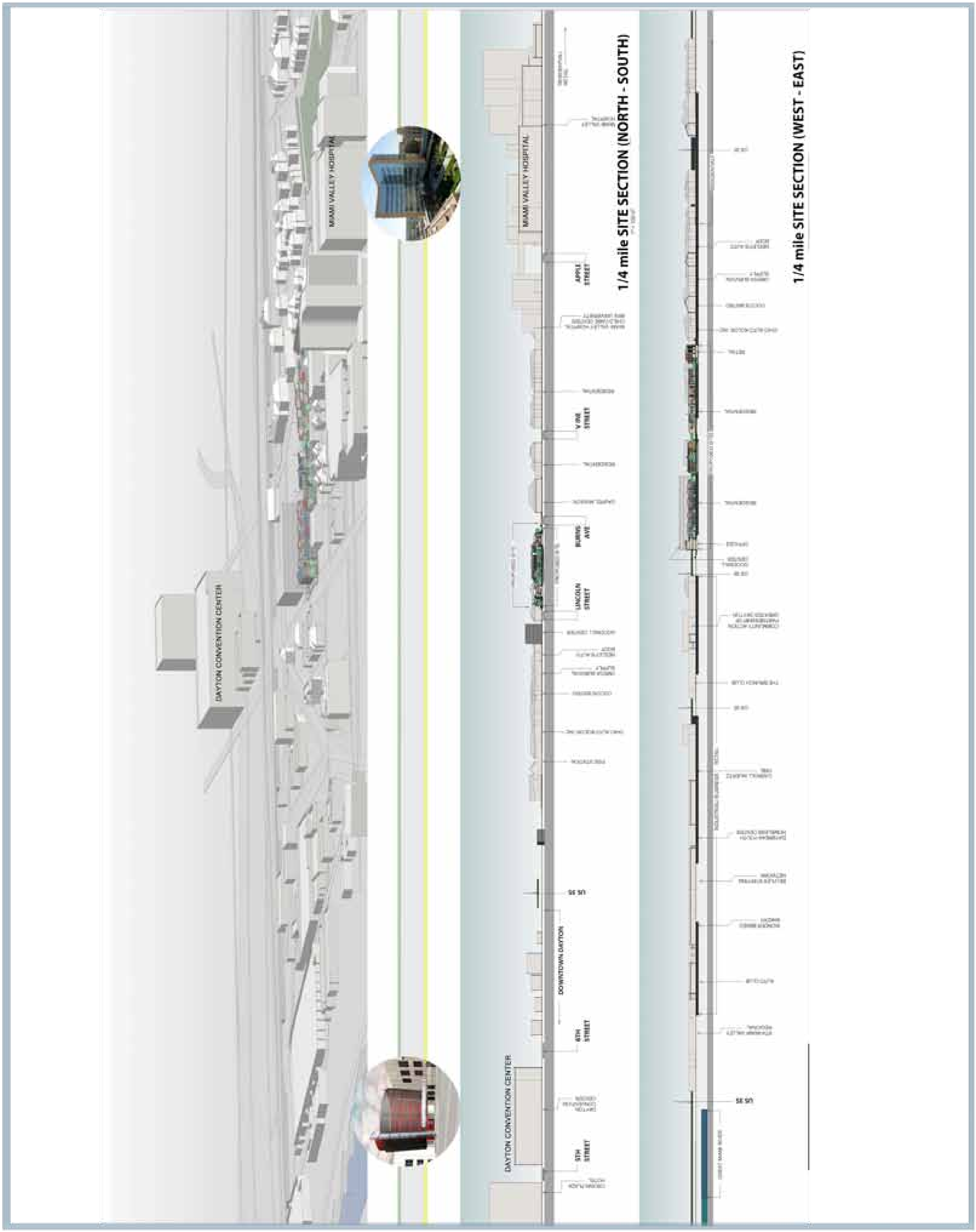


PROGRAM KEYPLAN- site Level 2
1" = 100'-0"

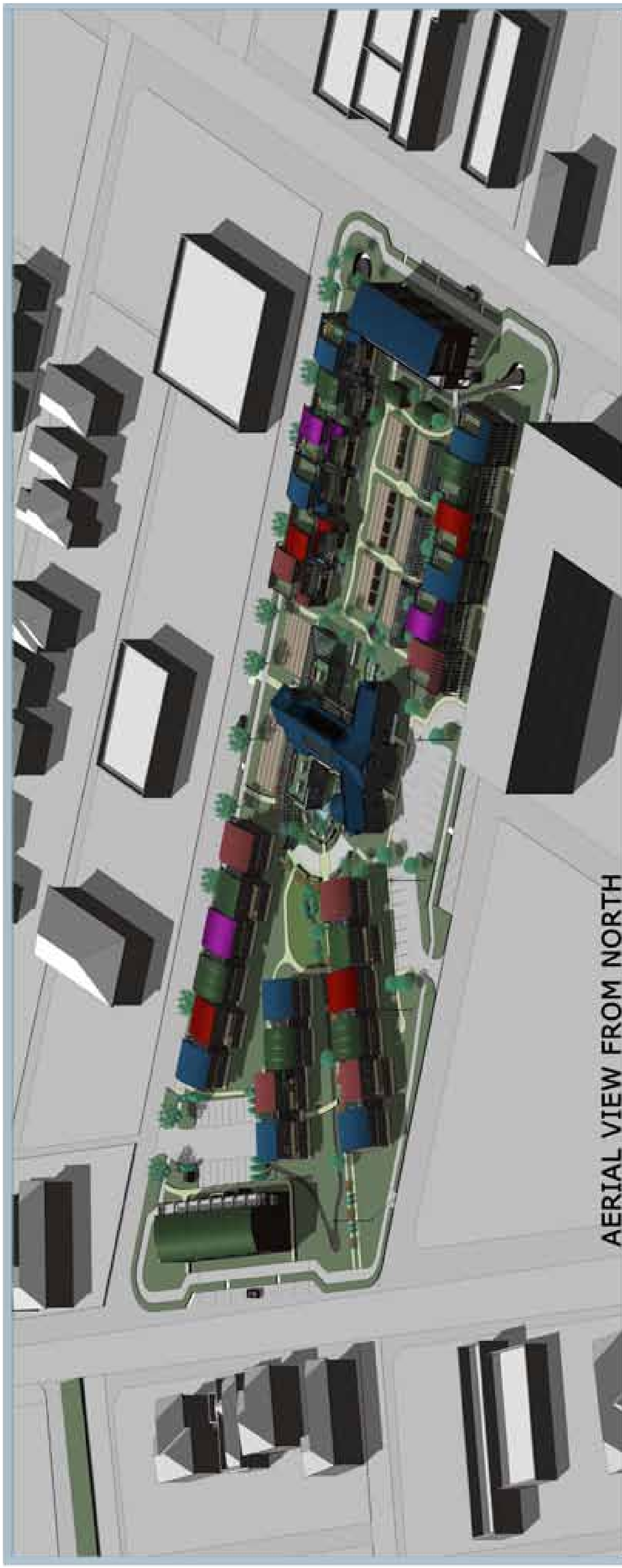
BUILDING PROGRAM

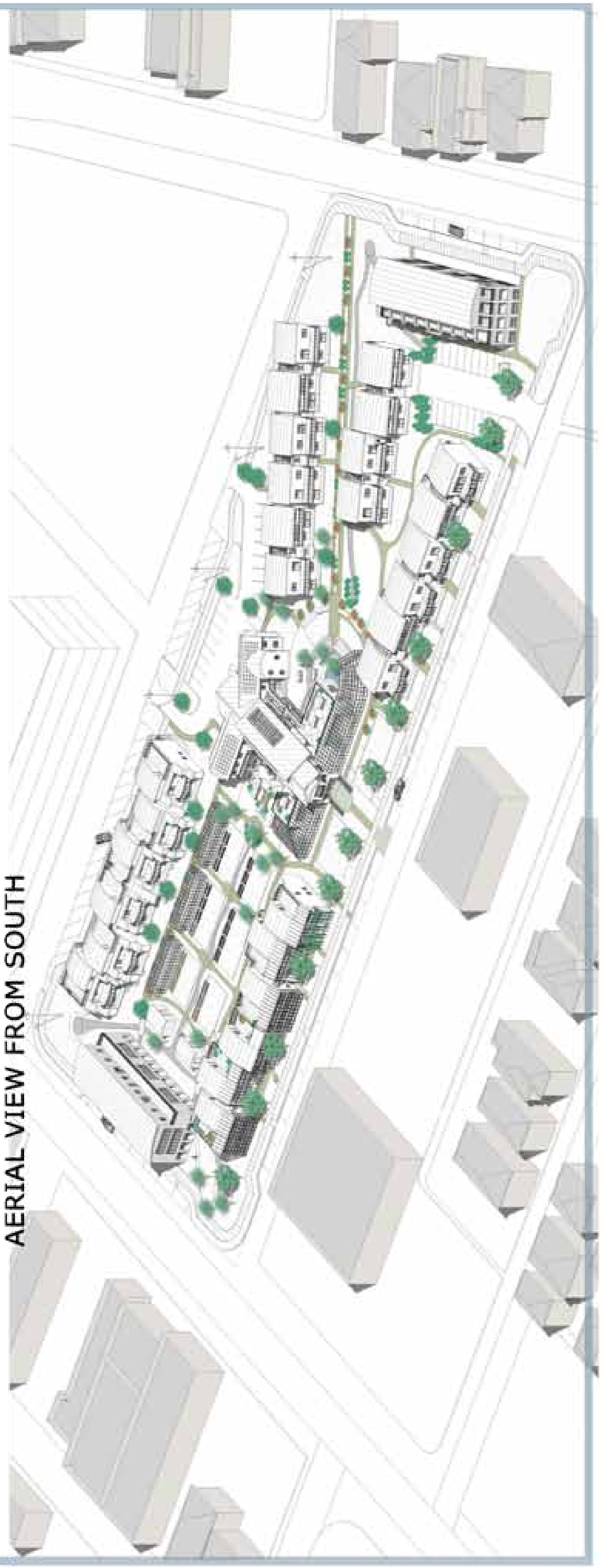
USE GROUP	BUILDING NO.	TYPE	QUANTITY	UNIT AREA (ft2)	EACH FLOOR TOTAL AREA(ft2)	BUILDING TOTAL FLOOR AREA(ft2)	MATERIAL(S)	COOLING/ HEATING SUPPORT	NOTE
COMMUNAL SPACES	1	1ST : 6,578 SF, 2ND : 3,130 SF, BASEMENT : 2,250 SF				128,38 SF	LIME STUCCO OVER CMU INT. & EXT.	EARTH TUBE HEAT EXCHANGER	
RESIDENTIAL	2	A	6	1,140 SF	1ST: 7,240 SF	13,124 SF			* CORE AREA IS INCLUDED IN THE BUILDING FLOOR & TOTAL AREA, TYPICAL FOR ALL RESIDENTIAL
RESIDENTIAL	2	B	6	900 SF	2ND:5,884 SF				16' X 12' SLEEPING LOFT PROVIDED
RESIDENTIAL	3	A	6	1,140 SF	1ST: 7,240 SF	13,124 SF			
RESIDENTIAL	3	B	6	900 SF	2ND:5,884 SF				16' X 12' SLEEPING LOFT PROVIDED
RESIDENTIAL	4 & 6	C	6 X 2EA	832 SF	1ST: 5,512 X 2	10,088 X 2 = 20,176 SF			
RESIDENTIAL	4 & 6	D	6 X 2EA	676 SF	2ND:4,576 X 12				
RESIDENTIAL	5	C	4	832 SF	1ST: 3,736 SF	6,848 SF			
RESIDENTIAL	5	D	4	676 SF	2ND:3,112 SF				
COMMERCIAL	7	BASE: 2,800, 1ST:5,200, 2ND: 3,600, 3RD: 3,600 SF				15,200 SF	BRICK VENEER OVER CMU, STUCCO INT.	1. PROVIDE COMBINATION OF DUCTLESS AIR CONDITIONING SYSTEM AND EARTH TUBE HEAT EXCHANGER	
COMMERCIAL	8	BASE: 1,020, 1ST:3,360, 2ND: 4,200, 3RD: 2,570 SF				11,150 SF		2. RAINWATER HARVESTING CISTERN BELOW BASEMENT AS INDICATED ON THE BASEMENT PLANS	

1/4 MILE SITE SECTION - AERIAL VIEW

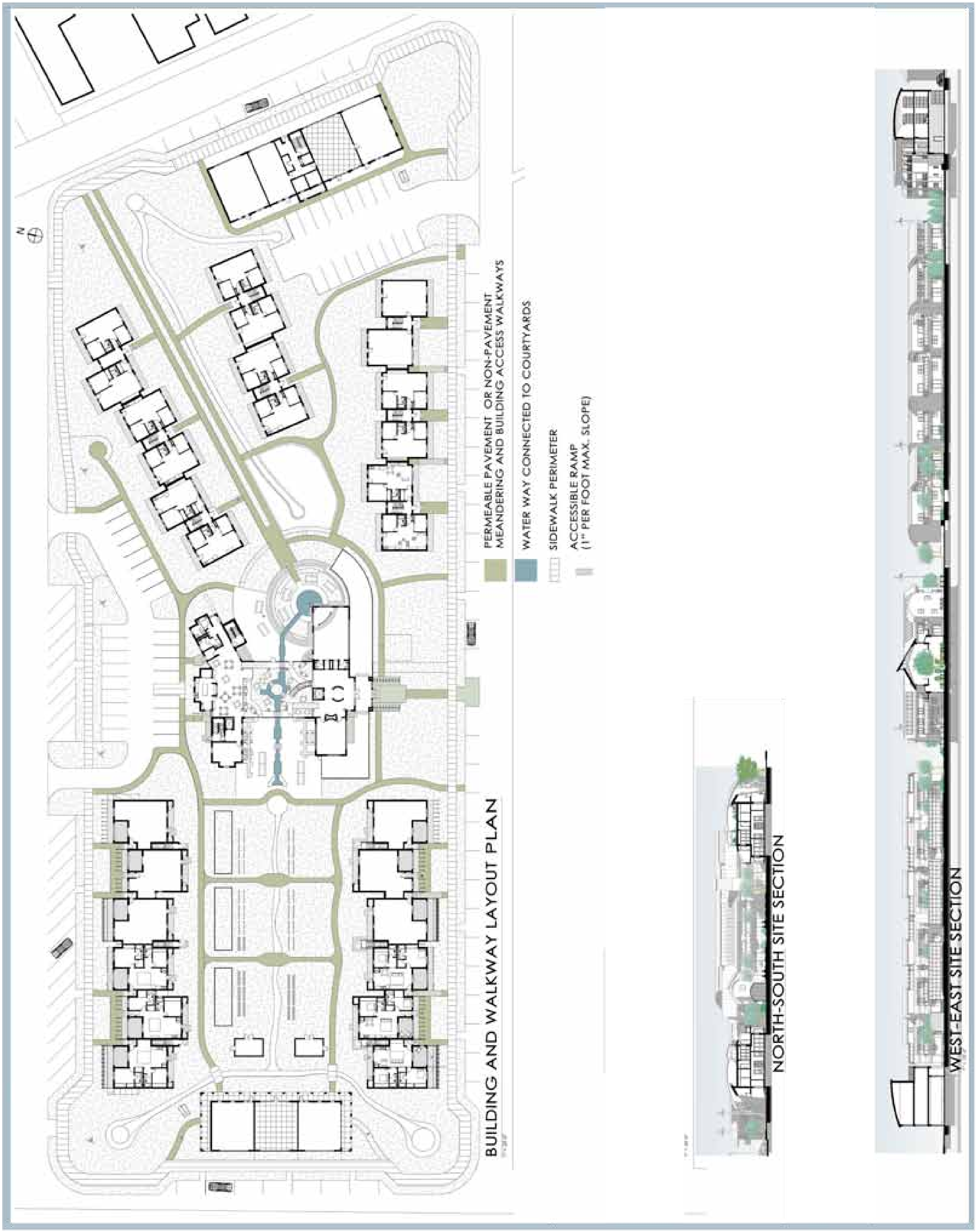


MASTER PLAN - AERIAL VIEWS

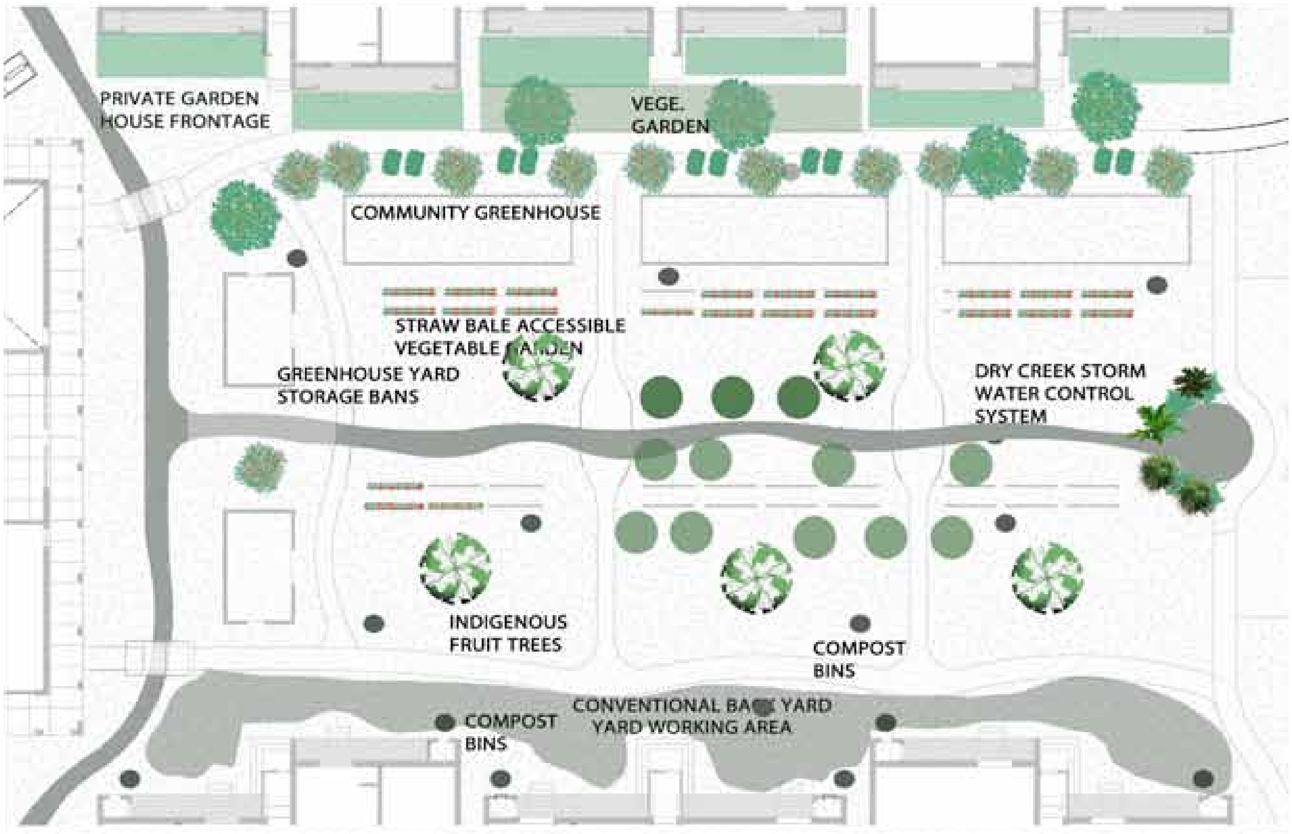




SITE BUILDING LAYOUTS AND SECTIONS

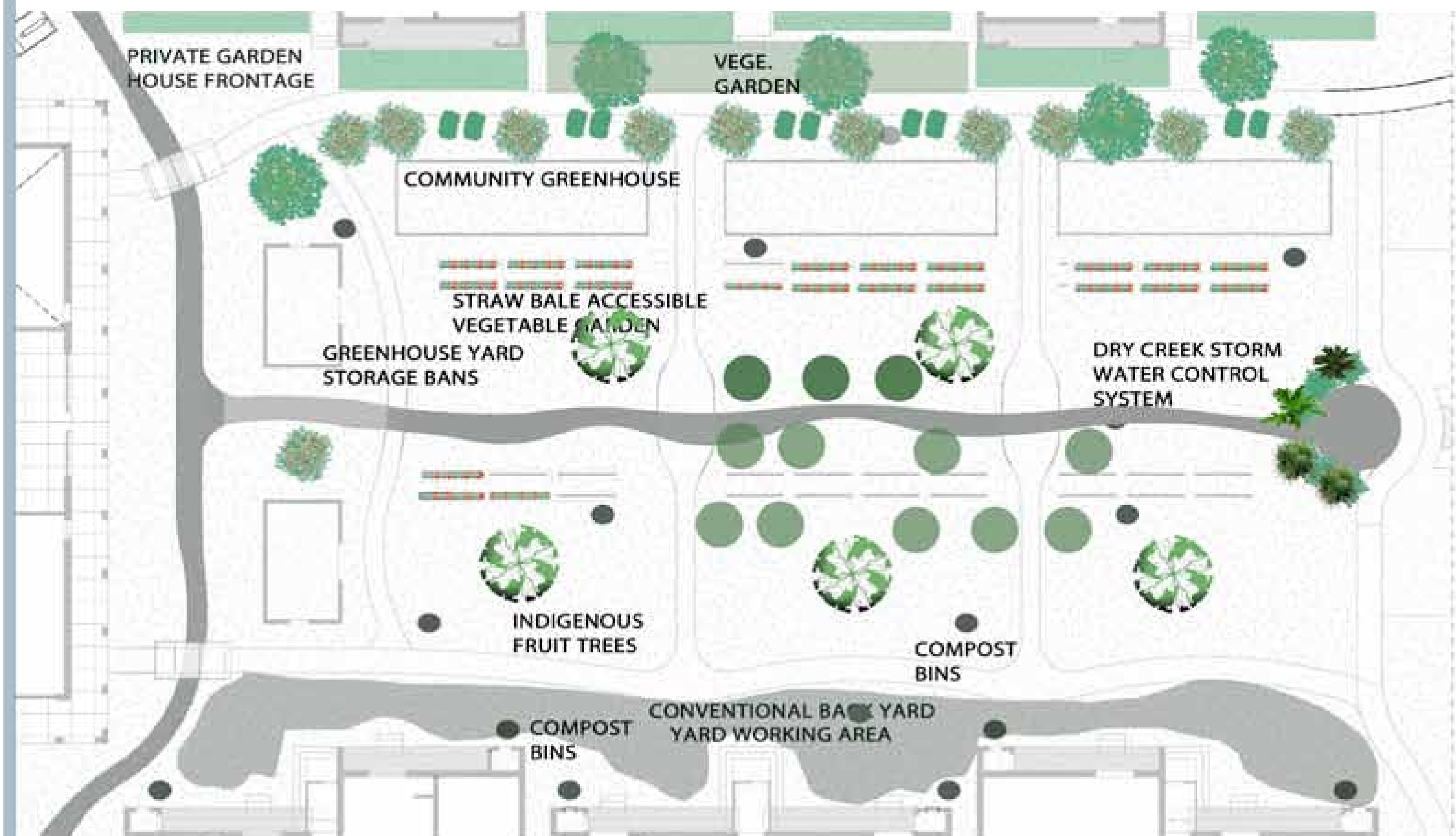


PAINTED SITE IMAGES- PRACTING PERMACULTURE



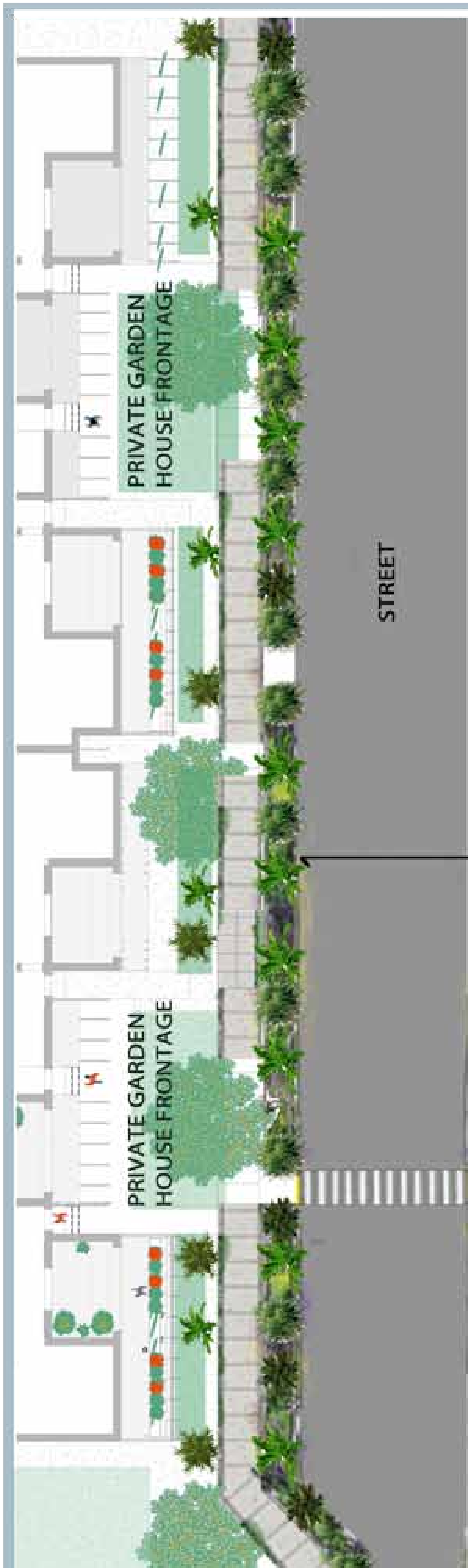
PARTIAL SITE PLAN AT COMMUNITY GARDEN AREA

EDIBLE GARDEN - EXERCISING PERMACULTURE

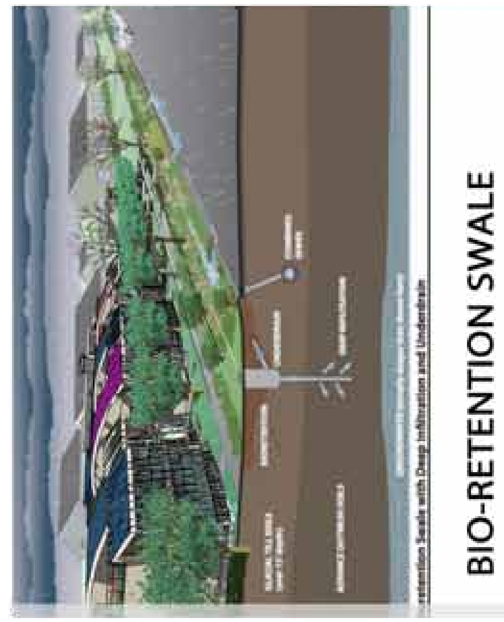


PARTIAL SITE PLAN AT COMMUNITY GARDEN AREA

SITE ELEMENTS



PARTIAL SITE STREET EDGE PLAN
4 1" = 10'-0"
BIO SWALE RAIN GARDEN STREET EDGES



BIO-RETENTION SWALE

DRY CREEK AT THE COMMUNITY GARDEN

DRY CREEK

GREEN SOLUTION ELEMENTS TO CONSIDER



Greenhouse



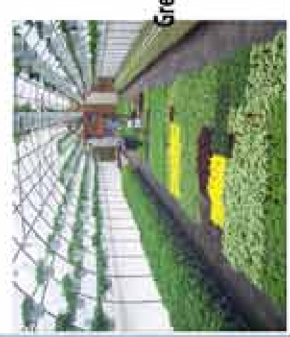

Green Walls

Naman Spa / MIA Design Studio, 2015

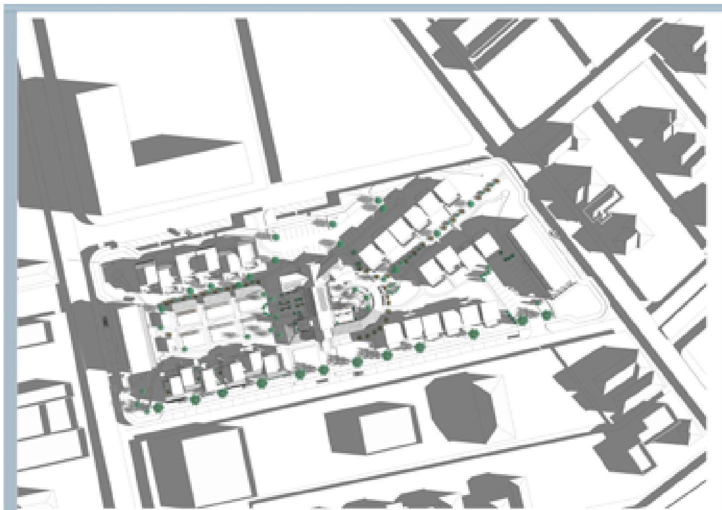


Dry Creek

Greenhouse

SOLAR SUN STUDY - DATE : APRIL 16, 2016

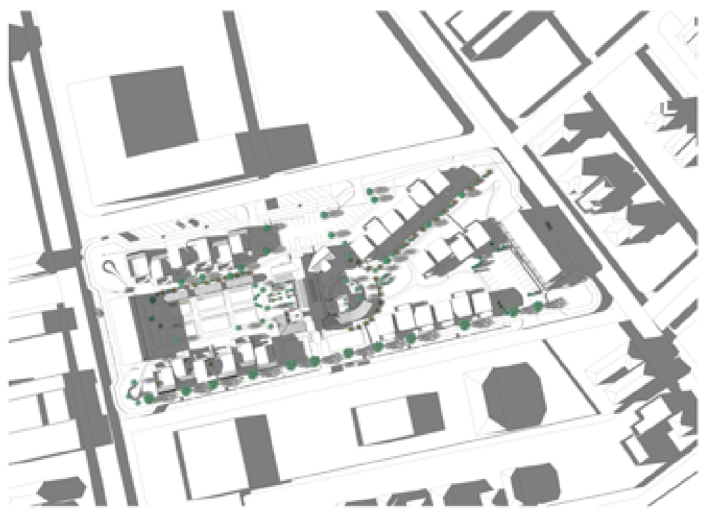


9 AM

11 AM

2 PM

4 PM

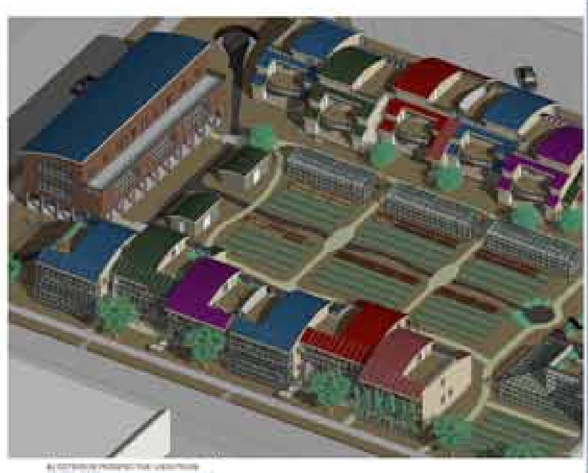


6 PM

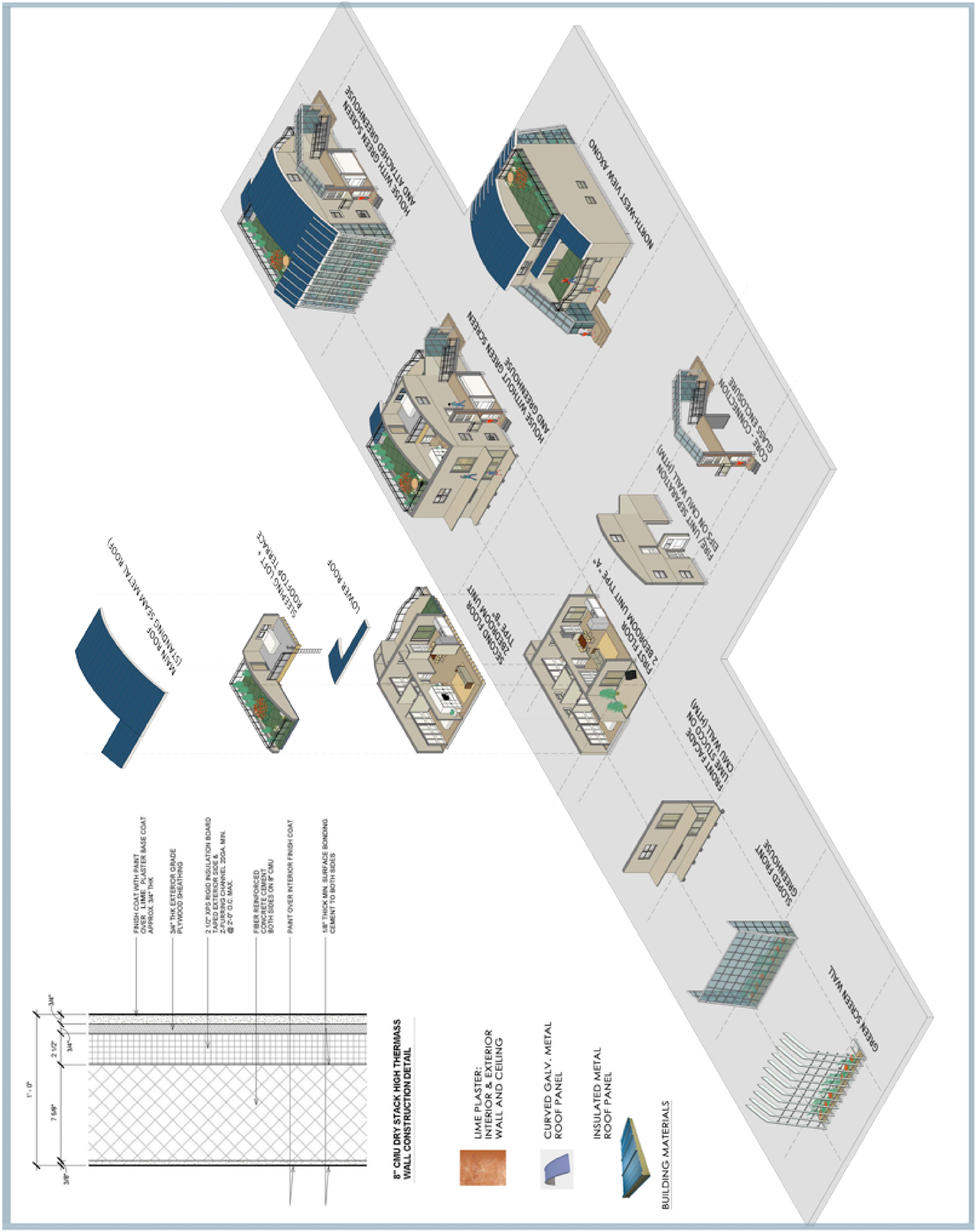
RESIDENTIAL BUILDING

#2 SOUTH ELEVATION - TYPICAL RESIDENTIAL BUILDING

#2 NORTH ELEVATION - TYPICAL RESIDENTIAL BUILDING



EXPLODED AXONOMETRIC - RESIDENTIAL PROTOTYPE

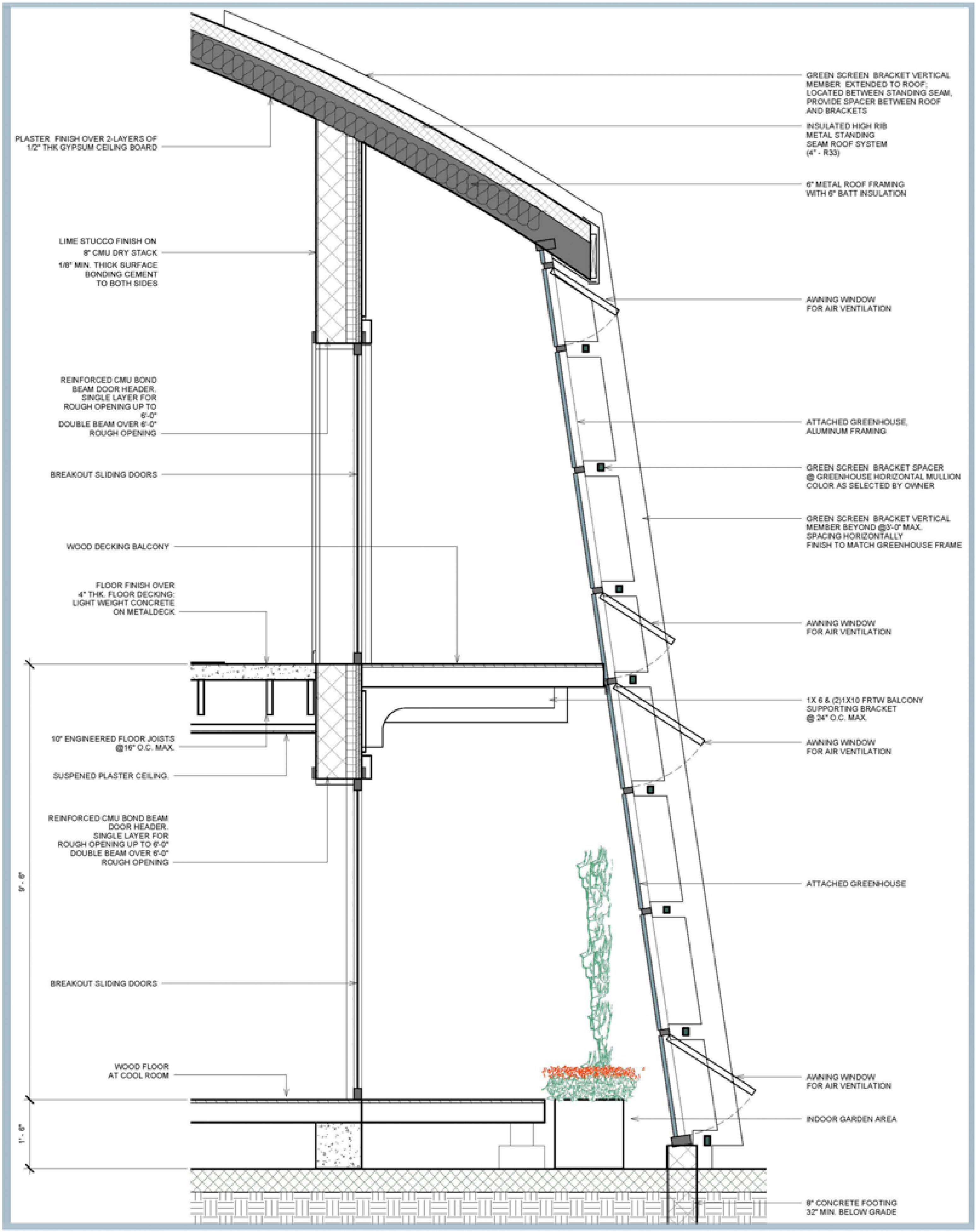


FLOOR PLANS - RESIDENTIAL BUILDING PROTOTYPE

SECOND FLOOR PLAN - 2 BED UNIT TYPE "B"

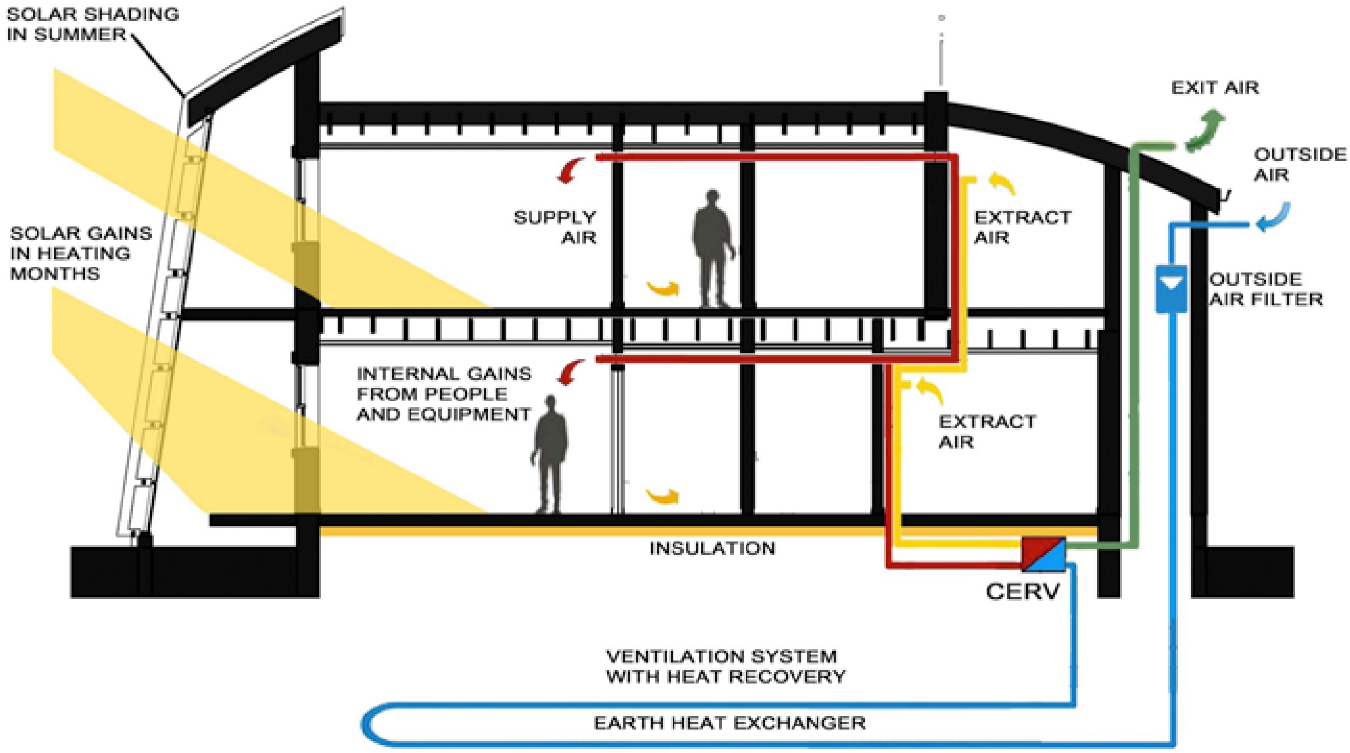
FIRST FLOOR PLAN - 2 BED UNIT TYPE "A"

SECTION - RESIDENTIAL PROTOTYPE BUILDING FRONT



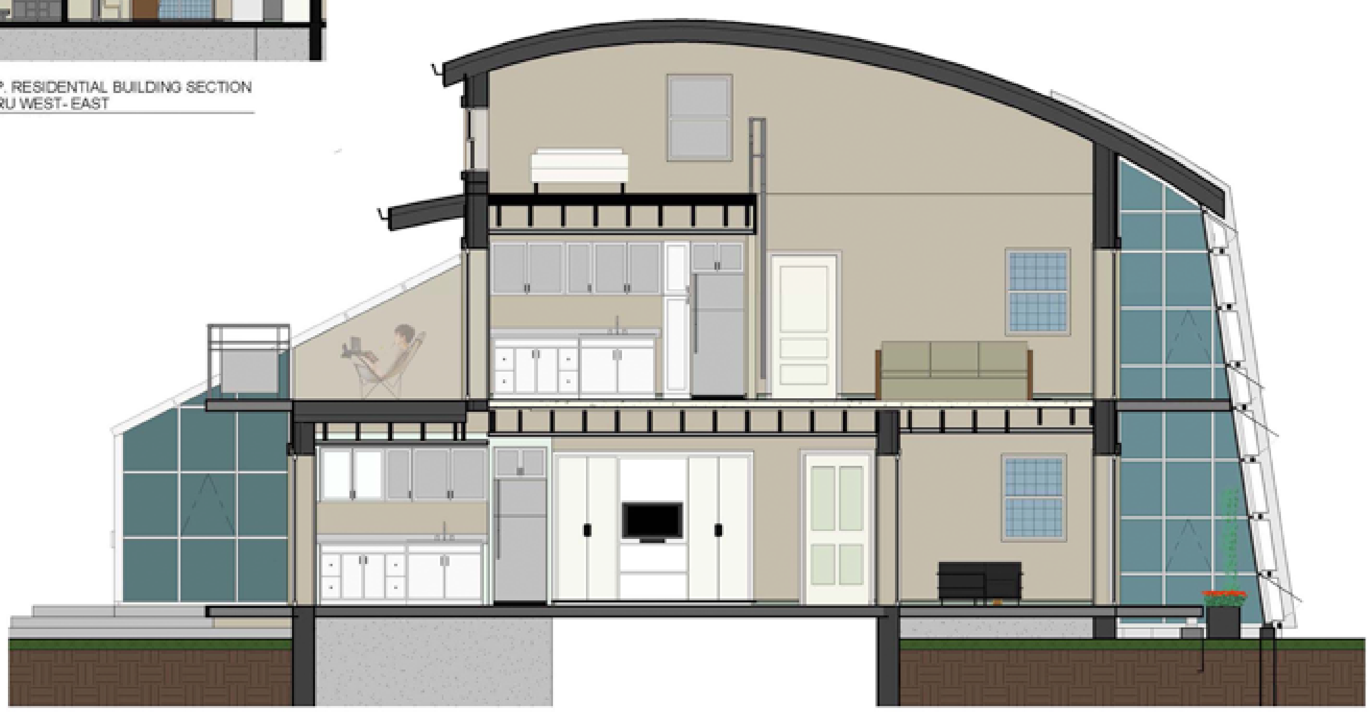
GREEN EXTERIOR CORRIDOR - BUILDING FRONT

SECTION - RESIDENTIAL PROTOTYPE BUILDING



EARTH TUBE HEAT
EXCHANGER DIAGRAM

TYP. RESIDENTIAL BUILDING SECTION
THRU WEST- EAST



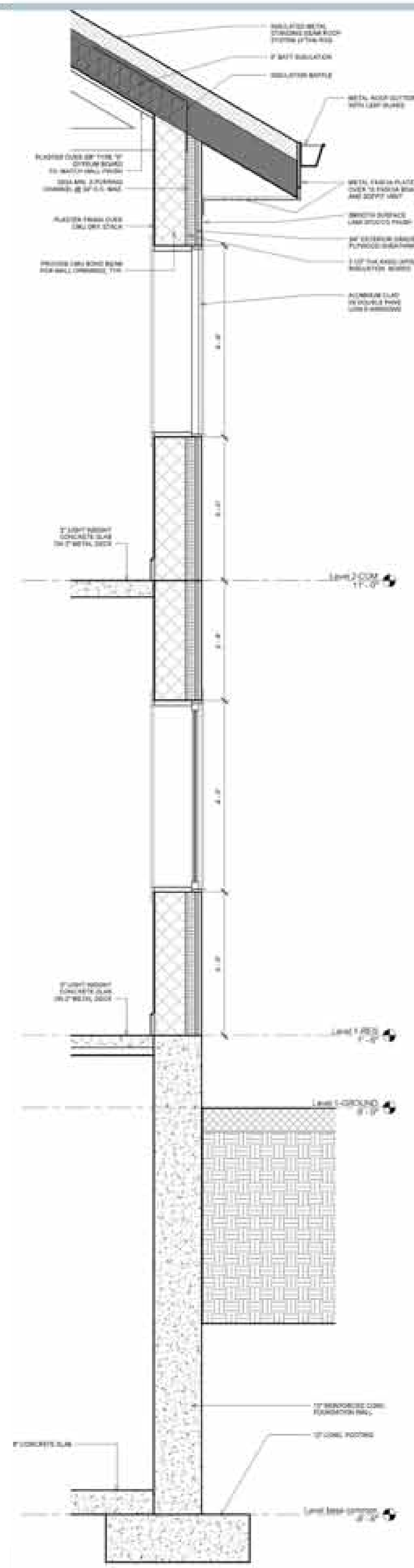
BUILDING SECTION, TYPE "A" & "B"

INTERIOR ELEVATIONS - RESIDENTIAL PROTOTYPE

FIRST FLOOR - KITCHEN & LIVINGROOM

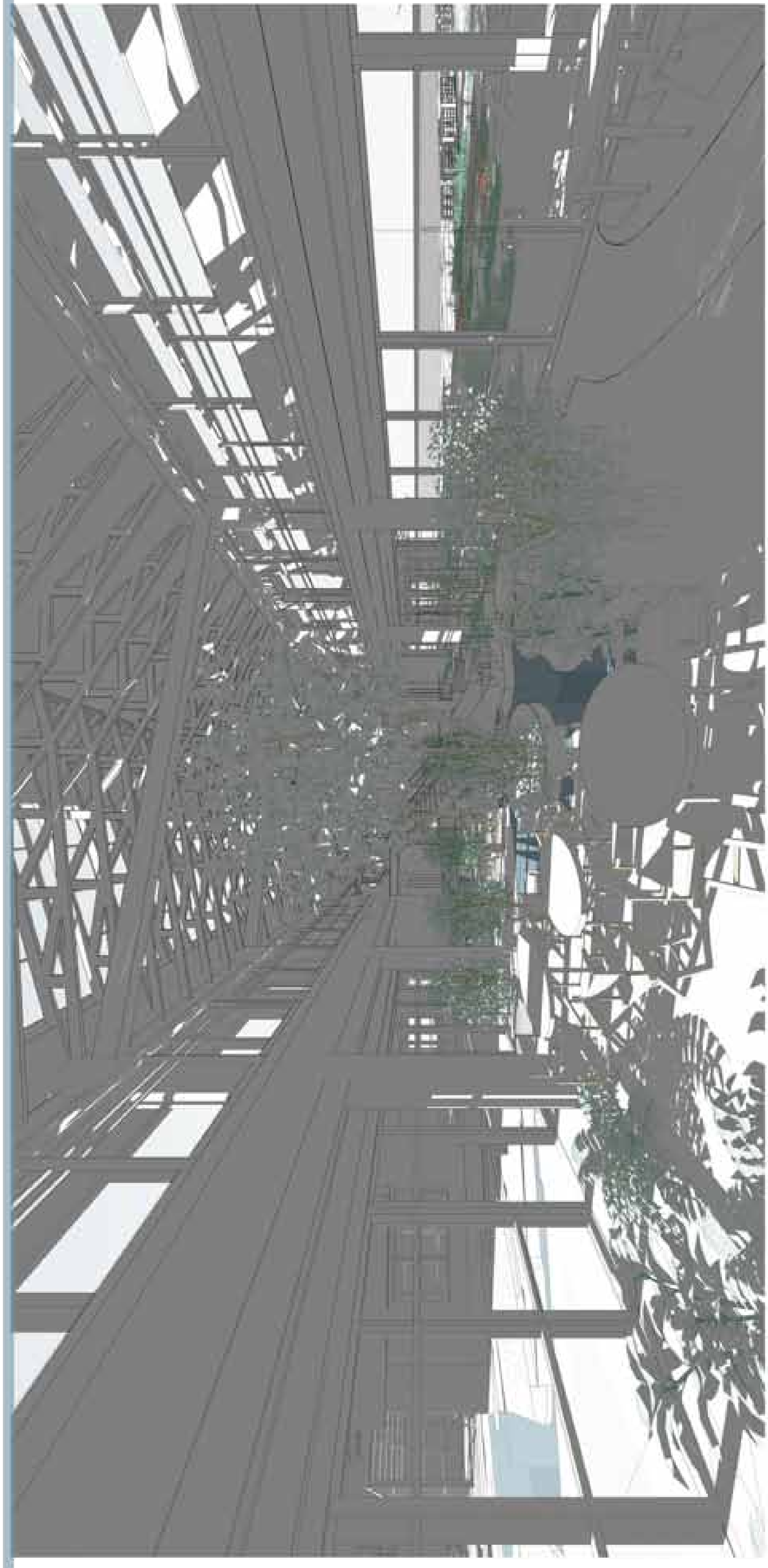
SECOND FLOOR - VIEW TO LOFT

COMMON HOUSE

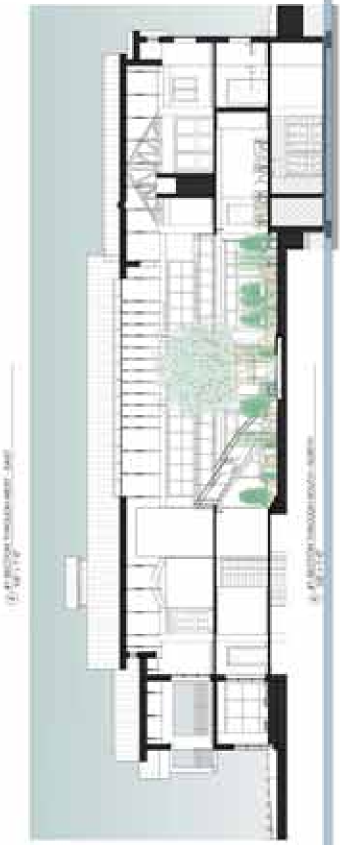


WALL SECTION DETAIL

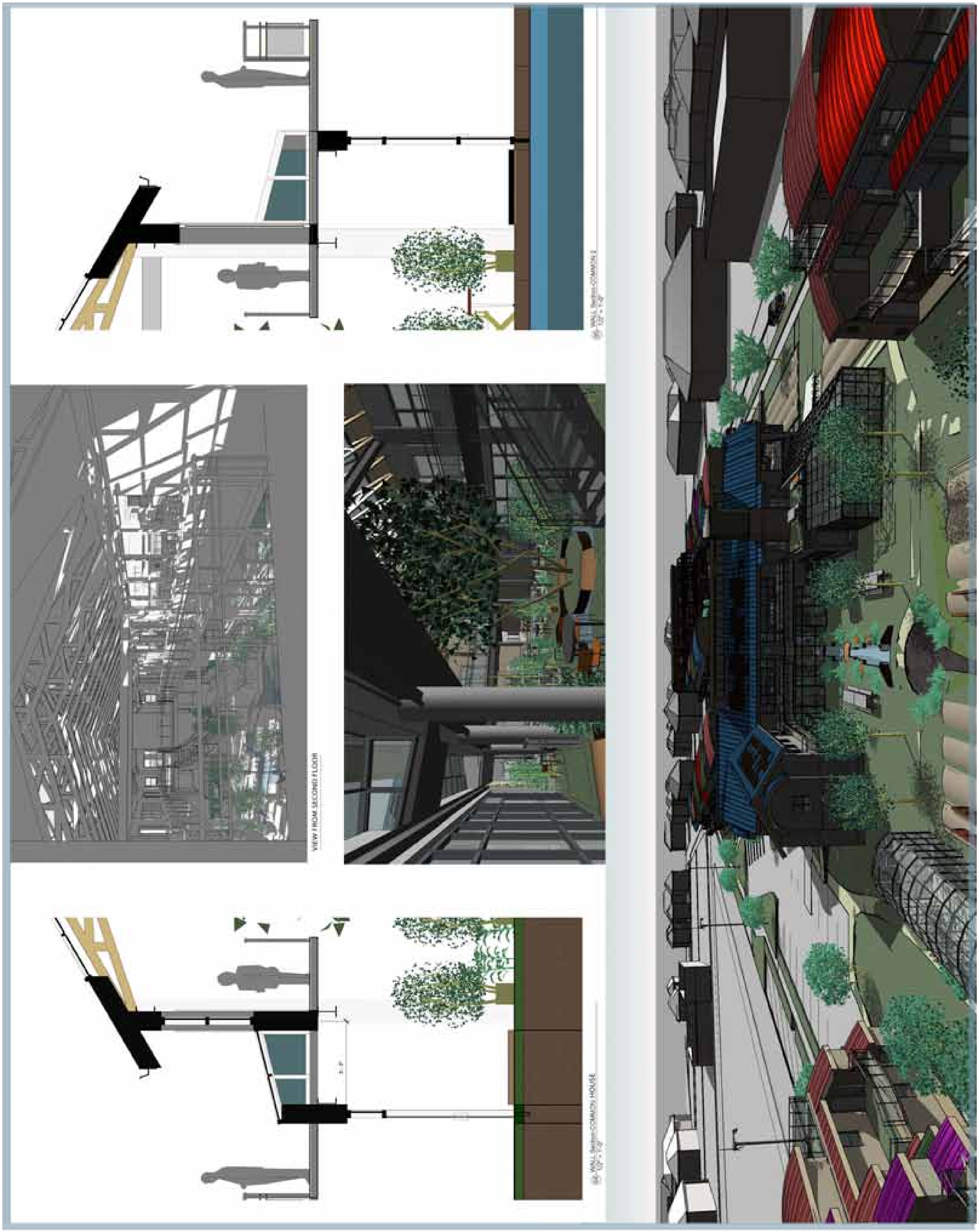
COMMON HOUSE



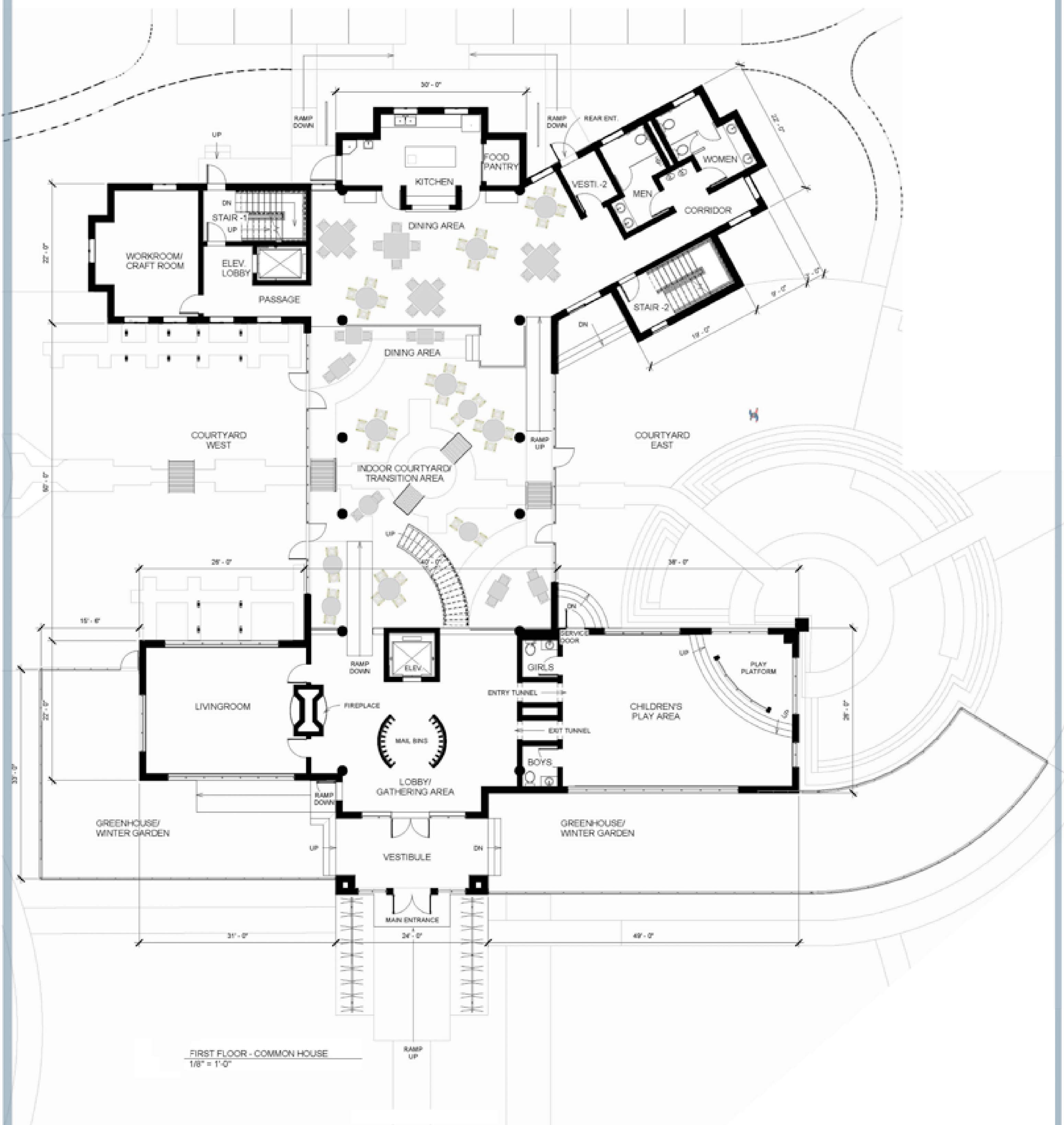
VIEW FROM FIRST FLOOR



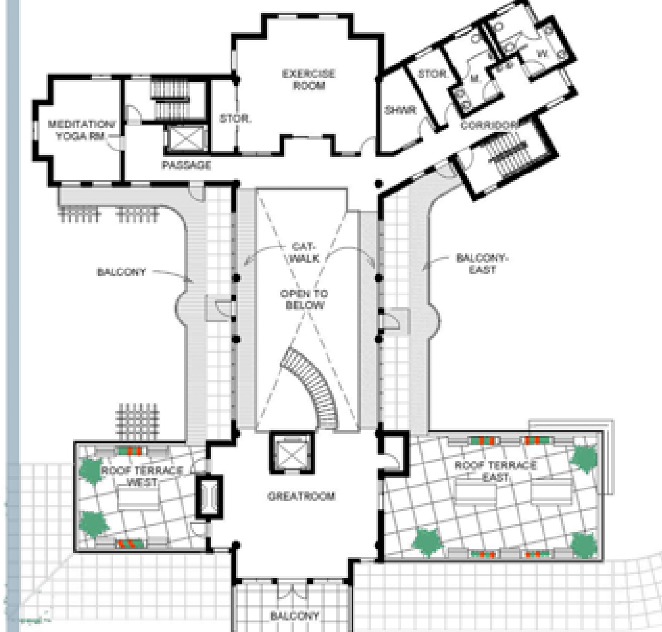
COMMON HOUSE



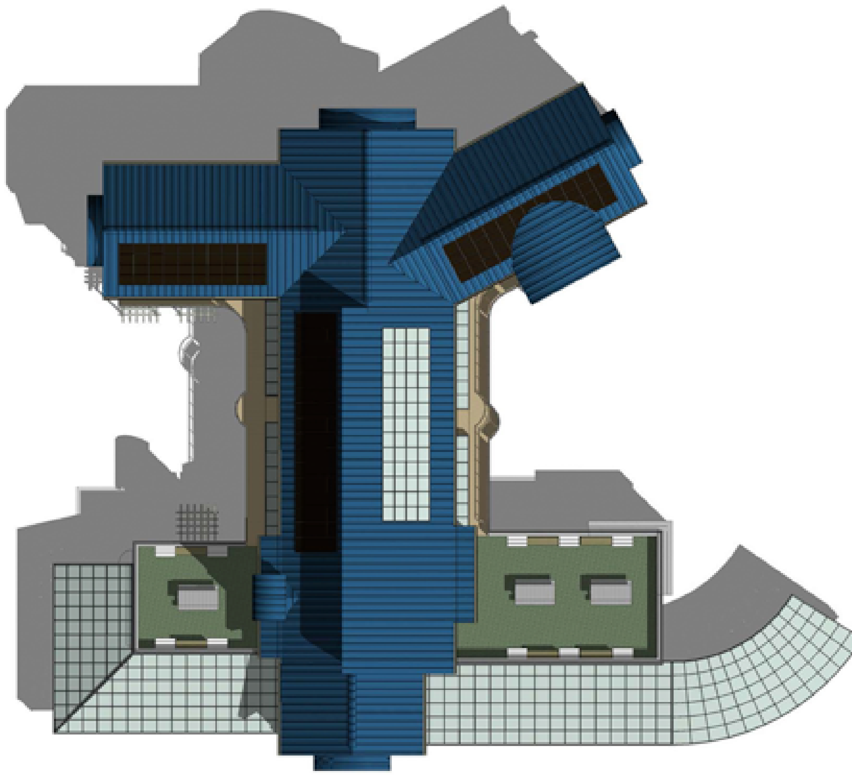
COMMON HOUSE



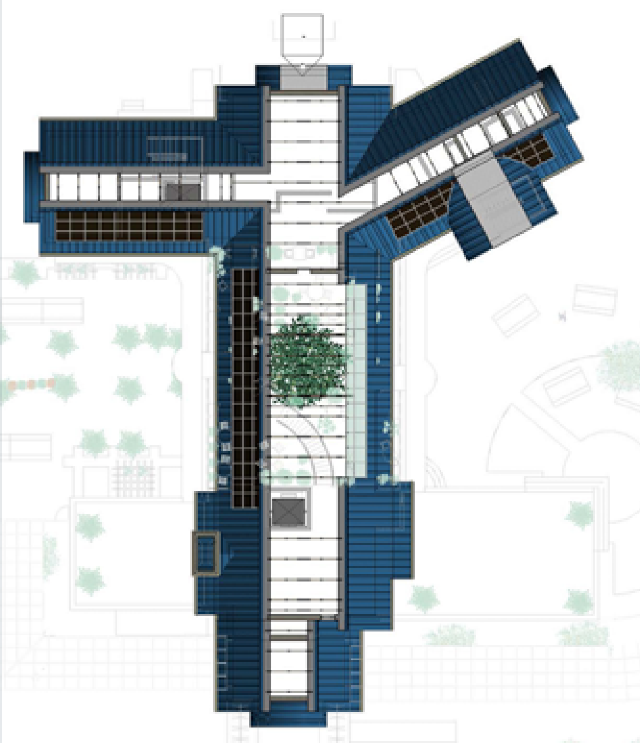
COMMON HOUSE



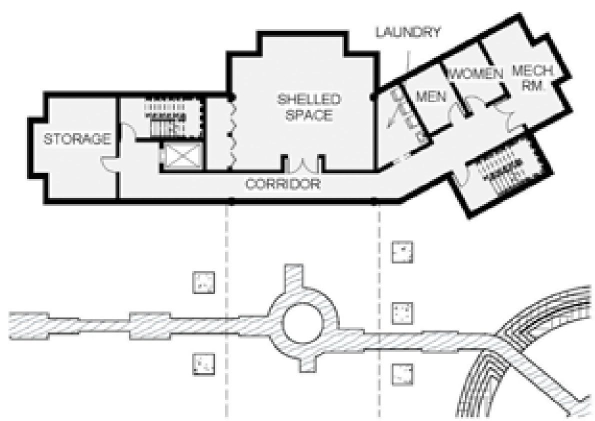
3 #1-SECOND FLOOR - COMMON HOUSE
1/16" = 1'-0"



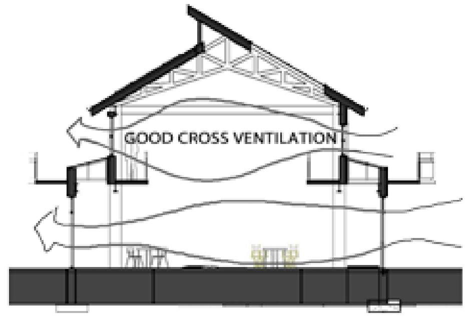
5 #1-ROOF PLAN - COMMON HOUSE



4 #1-ROOF TRUSSES - COMMON HOUSE
1/16" = 1'-0"

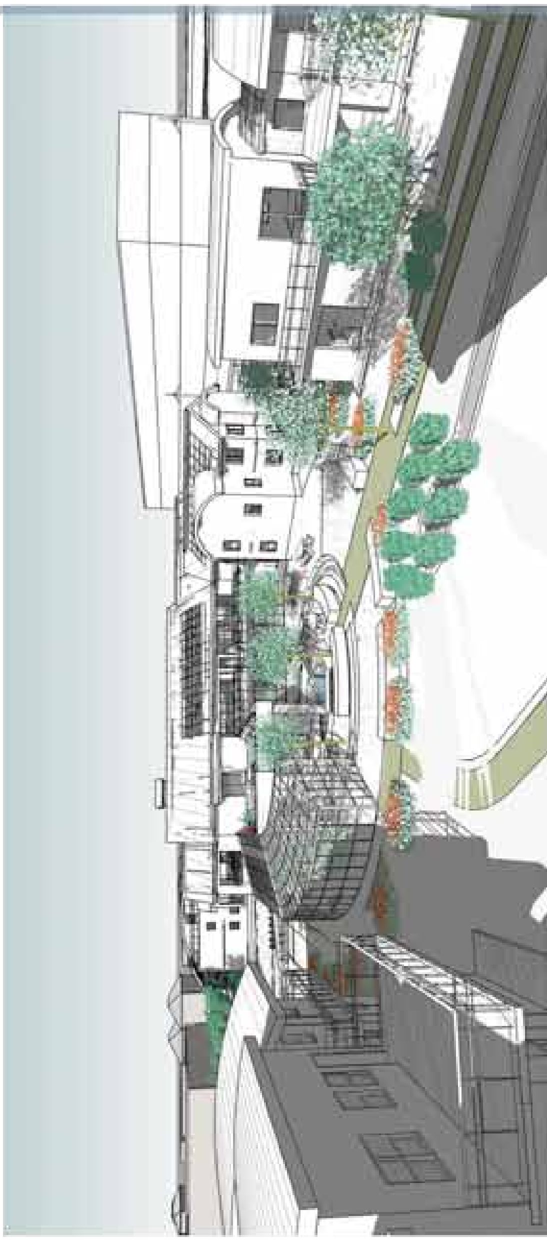


BASEMENT - COMMON HOUSE
1/16" = 1'-0"



NATURAL VENTILATION DIAGRAM

COMMON HOUSE



COURTYARD-EAST SIDE

FRONT ENTRY VIEW- COMMON HOUSE

CHILDREN'S PLAYROOM-
LIME STUCCO WALL FINISH

LIME STUCCO WALL DETAIL-
VIEW FROM EAST COURTYARD AT COMMON HOUSE