
light
flexible
expand/contract
adaptive
family
dwelling
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jared weismantel

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DWELLING UP | ON THE DOCK

A Design Thesis Submitted to the Department of Architecture and Landscape Architecture of North Dakota State University

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In Partial Fulfillment of the Requirements for the Degree of Master of Architecture

05/11/11
Primary Thesis Advisor

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May 2011
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Name: Jared Weismantel

Date: 5-12-11

thesis abstract

typology: The building through which this problem will be examined is a multi-family residential dwelling.

location: The project location is in Superior, Wisconsin in Superior Bay.

abstract: This thesis project will explore the aspects of dwellings that can contribute to making the floor plan more efficient through flexibility and adaptation to the users and environment.

The focus of this project is to deliver an
adaptive multi-family dwelling
constructed on an
abandoned taconite ore dock
that can accommodate environmental changes (annual)
and user changes (periodic).

key words: adaptive, flexible, dwelling, multi-family, ore dock

problem statement

How can dwellings properly adapt to the needs and demands of the users and seasonal changes?

statement of intent

typology: The building through which this problem will be examined is a multi-family residential dwelling.

claim: A dwelling is a place of residence that should be designed to change with the activities and ways of life of the people who inhabit it.

The dwelling is where people spend most of their day when not at work and should be designed directly for them and what they do, depending on their current stage of life.

The act of changing will be an implemented (series of) adaptation(s) based on the current states of the surrounding environment.

The person(s) who reside in this adapting environment will be able to change the dwelling throughout the seasons to allow for a higher efficiency of living.

theoretical premise: a deeper understanding of the cycles of both the seasons and lifecycle of a family will govern the design and adaptive functionality of the dwelling. The result will be an amorphous building that changes to suit real time needs of its occupants as mandated by family situation, weather, or other circumstances.

project justification: Thinking of how the environment impacts a home throughout the year and incorporating adapting properties can make a dwelling more efficient and enjoyable to live in.

proposal for adaptive dwelling

narrative

user/client description

major project elements

site information

project emphasis

plan for proceeding

previous studio experience

narrative

What does it mean to adapt? When we hear this word, 'adapt,' what is it that we think of? Perhaps it is an animal blending into its surroundings to hide itself from predators. Maybe it is a form of protection or exposure to a new environment. Or it could be as simple as putting a jacket on in the rain. According to *dictionary.com*, adapt is "to make suitable to requirements or conditions; adjust or modify fittingly." With this definition and the examples above, it is safe to conclude that to adapt is to change some state of being to better adjust to a given environment or condition. This project will demonstrate how we can relate adaptation to residential architecture.

It is understood that the most basic elements of survival are food, water, and shelter. Most of us are fortunate to have a roof over our heads each and every night; some however are not so fortunate. This need is potentially the most overlooked by many of us because it is something that is always present. We do not run low on shelter like we do eggs and milk because the shelter, the protection from the elements, is there. We live, we cook, we eat, we rest, and we play in our home. The home must be able to provide for a wide range of activities than most buildings. A dwelling is a place or residence that should be designed to provide comfort for all who inhabit it and should change with the environment.

We know that to adapt, one has to change in some way, or better relate to the surrounding environment. But how would a house do this? Not only that, but how does a house in the upper Midwest achieve this feat? Many of us have seen sustainable homes throughout the southwest that are made of thick, mud walls with skylights and are completely off the grid. One reason is because the climate is generally constant and ranges from 90-100 degrees throughout the year. Meanwhile, northern Wisconsin has extreme temperature shifts from 90's during the summer months all the way down to -30 degrees. Clearly there is a difference between these two regions. How can we implement passive strategies into our more local climate? Is there a way that residential architecture can better respond to the changing seasons?

The thing that must be kept in mind, like all designs, is that the design needs to be for people. Some homes, prefabricated ones for example, are designed to bring in the most revenue for the 'designer' and builder. Although a prefabricated home designer can be creative, they miss the opportunity to holistically craft the best possible solution for a home. This project will explore ways in which the dwelling can tectonically achieve sustainable solutions by shaping space, changing form, and using materials that are appropriate for the changing seasons of northern Wisconsin.

user/client description

The user/client for this project will concentrate on the population of the Duluth-Superior area. The intention of this project is to show how the dwellings can adapt to not only the environment, but to the user and his/her stages of life and various lifestyles as well.

This project will hone in on the potential living style of an average American in the Duluth-Superior area throughout most of his/her life.

major project elements

Because this thesis is directed towards a dwelling, it is necessary to have the basic elements of a unit including (and not limited to one):

- Bedroom
- Bathroom
- Kitchen Space
- Open Space
- Additional Modules

Other elements (not required) include:

- Parks
- Circulation

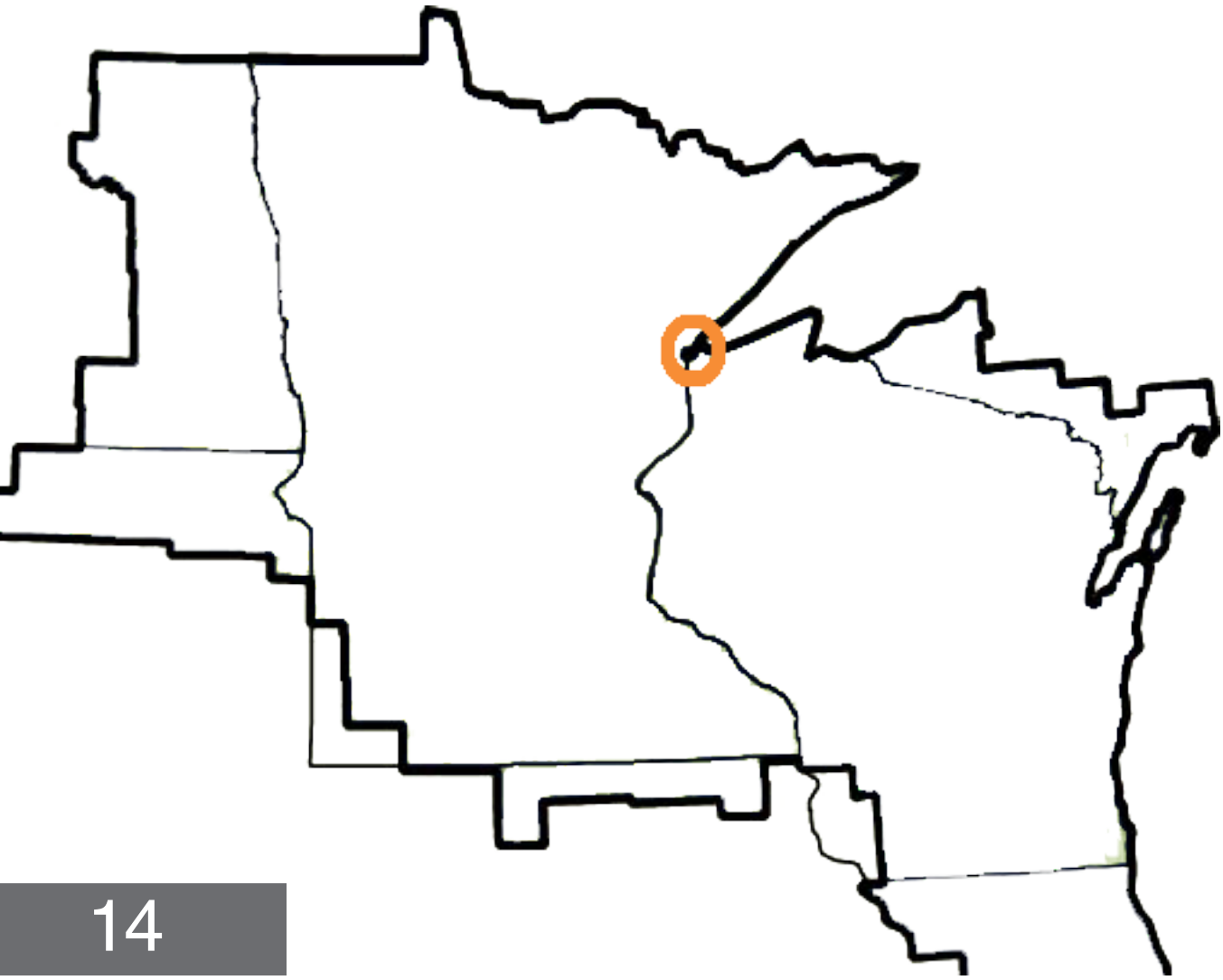
Due to the fact that this design will adapt, some spaces and planes will incorporate a level of flexibility and have the capability to convert to different space(s).

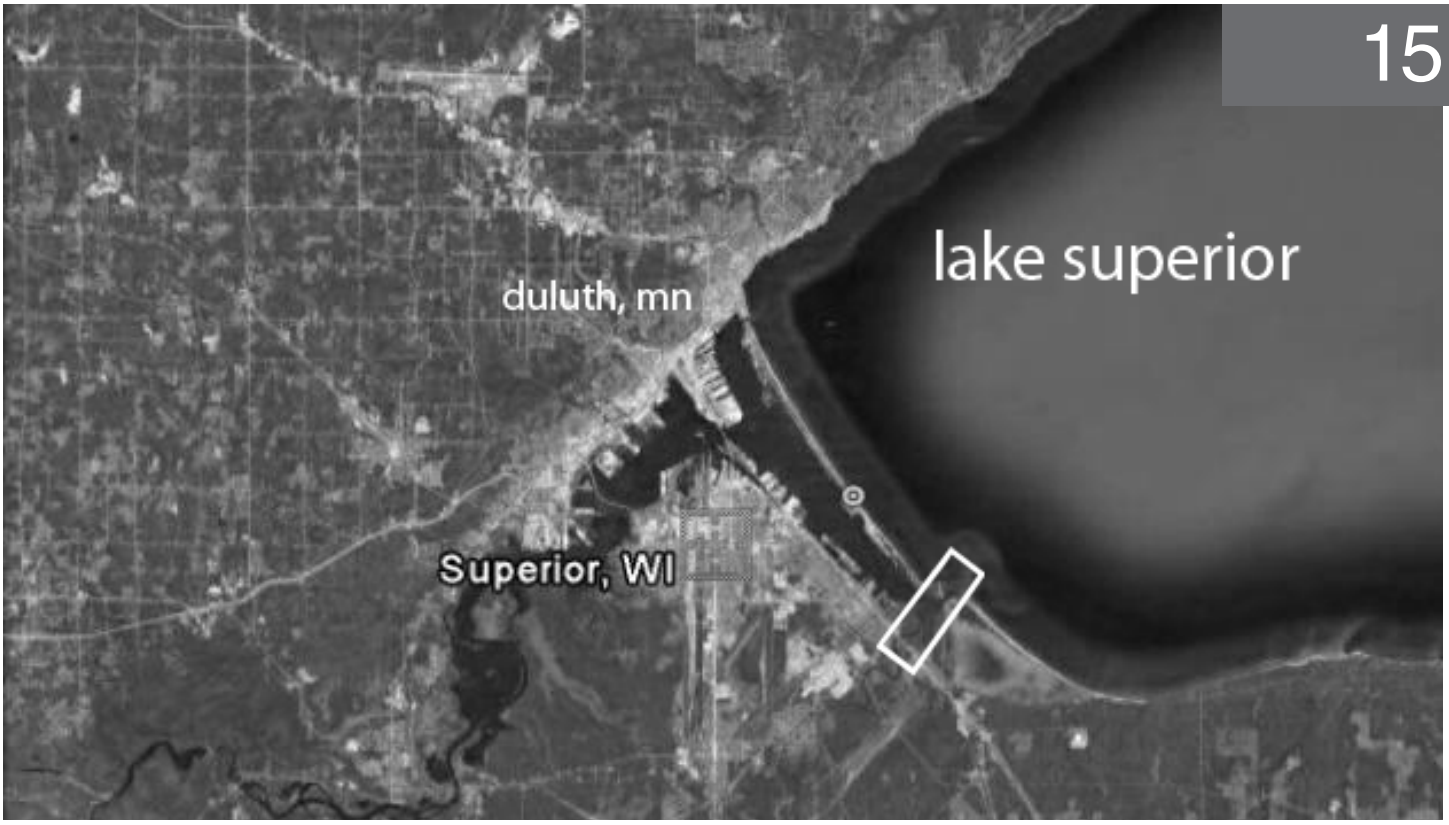
site information

The proposed site is for this thesis project is in Superior, Wisconsin within the Superior Bay overlooking Lake Superior to the northeast.

This site offers changing seasonal temperatures and conditions while still being able to accommodate a dense population on a large, abandoned ore dock.

The structure measures 1,860 feet in length, eighty feet high, and sixty-one feet in width. Three additional docks of Burlington Northern are directly southeast of the proposed dock, separated by the mouth of the Nemadji River that curves its way through the city's edge.

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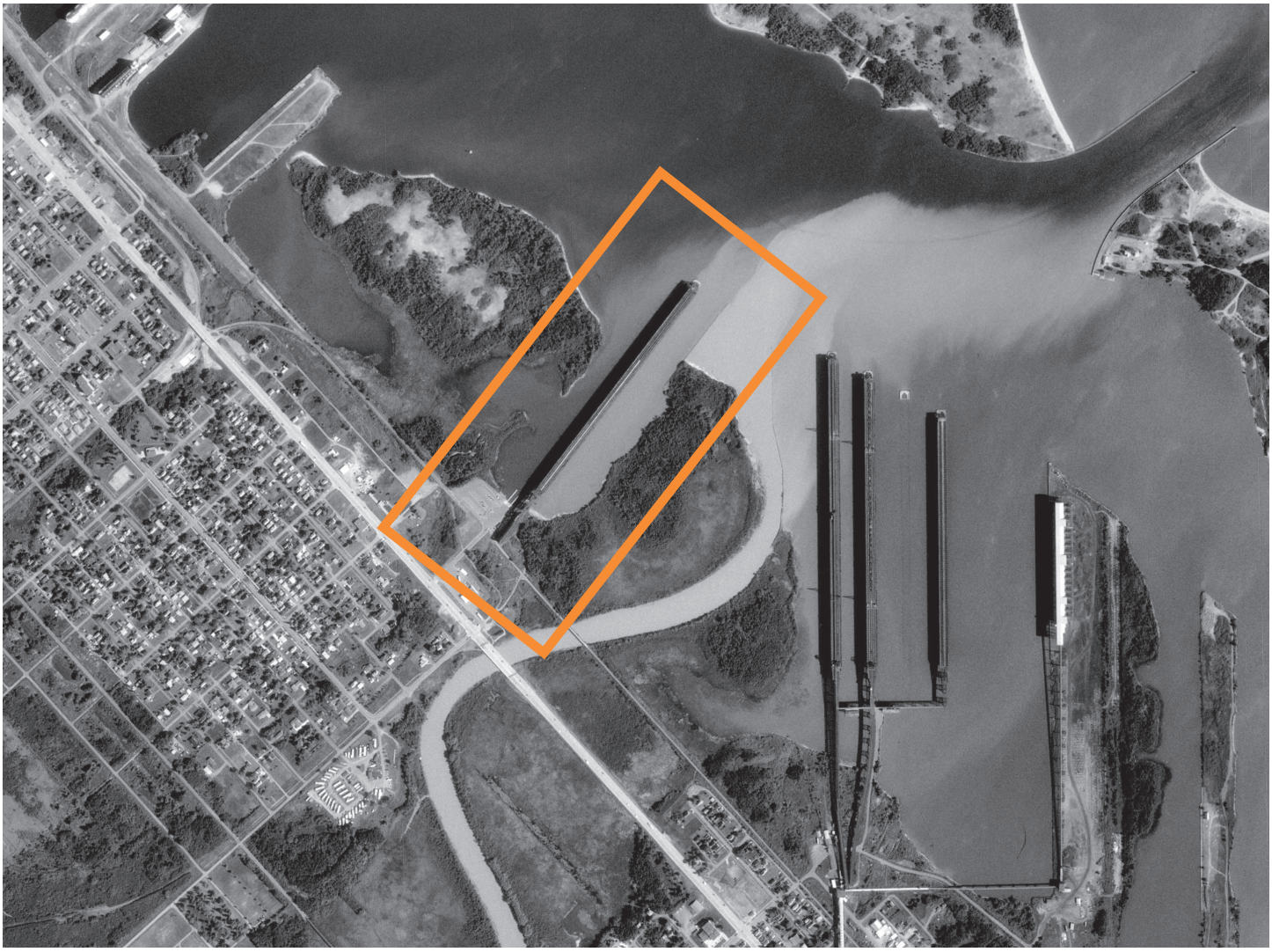
Superior, WI



project emphasis

The emphasis of this project will be to create a multi-family dwelling environment that is responsive to the user and regional climate through physical adaptations.

plan for proceeding

Research will be conducted in the following areas: theoretical premise/ unifying idea, project typology, historical context, site analysis, and programmatic requirements.

The design methodology followed will be a mixed method, quantitative/ qualitative approach. This strategy will be guided by my theoretical premise/unifying idea. Quantitative/qualitative data will be gathered concurrently to aid itself to the design.

Research will be made known throughout various points of this project book and presentation, as shown through text and graphics.

Quantitative data will include statistics and scientific data analyzed or gathered directly.

Qualitative data will be gathered through direct observations, local surveys, archival searches, and direct interviews.

Documentation will be compiled digitally and presented through this book. Copies can be found digitally in the North Dakota State University digital commons and a hard copy will be provided for the library for future use.

The presentation will be comprised of an introduction stating why I chose to examine this particular topic in architectural design with additional questions and avenues that fueled my research and design. Following the introductory questions, I will describe the chosen site and begin presenting the overall design through a graphic presentation with drawings and models.

Data collection and documentation will be done in certain intervals of time.

studio experience

second year

Arch 271
Steven Wischer
- Tea House
- Boat House
- Twin House

Arch 272
Mike Christensen
- Solid/Void
- Plaster Castings
- One, Few, Many

third year

Arch 371
Ron Ramsay
- Agincourt Golf Club
- Moorhead Library

Arch 372
Steve Martens
- Far North Museum

fourth year

Arch 471
Darryl Booker
- Bioclimatic High-Rise

Arch 472
Darryl Booker
Paul Gleye
Frank Kratky
- Urban Re-Design
- Earth Dwelling

fifth year

Arch 771
Mark Barnhouse
- Water Resource Experiment Station

program document

research results & goals

site analysis

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theoretical premise

typology

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results from theoretical premise research

a deeper understanding of the cycles of both the seasons and lifecycle of a family will govern the design and adaptive functionality of the dwelling. The result will be an amorphous building that changes to suit real time needs of its occupants as mandated by weather, family situation, or other circumstances.

The results from the theoretical premise research reflect the studies and investigations of environmental, human, and building conditions. The satisfaction and comfort of the human body determine acceptance or success of the built environment in response to external environmental factors. Understanding human tendencies, needs, and desires in relation to self and others within the created environment help establish a foundation for designing and offering human comfort within a space. This is made possible by flexibility in the dwelling which helps to anticipate changing ways of life or cyclical users through the duration of the building's existence. Creating a dynamic, flexible living environment that has the ability to adjust to humans and environmental stresses can produce an enlivened or renewed sense of place within the dwelling.

Throughout the course of human history, our existence lies in our ability to adapt to various situations including the surrounding environment. The level of human comfort is determined by external forces and the body's ability to respond to those forces. As Givoni (1999) states, "the body temperature is a passive response to heat stress that is determined by heat production within the body and heat transfer from the body's core to the skin to the environment" (p 41).

Similarly, internal temperatures of dwellings and buildings are determined by external environmental factors. During the winter months, additional wood is added to the fireplace to increase the radiated temperatures that spread to floors surfaces, walls, doors, windows, and ceilings. It will take a longer duration of time to heat objects and surfaces that are located some distance away. The temperature range at which thermal comfort is experienced is called the comfort zone (Givoni, 1999, p 54).

There are several factors that influence the comfort level for all species; air temperature and movement, presence of sun, to clothing material. Additional factors may be clothing temperature, air movement beneath clothes, skin temperature, or the body's ability to cool itself.

Givoni goes on to say that maintaining a thermal level of comfort does not translate to maintaining a precise temperature within an environment. This can elicit a monotonous experience whereas slight fluctuations in temperature and air velocity over time can constitute an invigorating experience within that space.

This is further evidence that the human body was made to adapt to the external environmental factors. The human body cannot deliberately change these factors, but it will naturally increase or decrease blood flow and activity to attain the desired level of comfort.

Adaptive environments, like the human body, react to the external factors being (human and temperature) to create a suitable environment

for comfort. The result is not a similar environment, but a change that invigorates the users who experience that space and have the opportunity to see and feel in the environment in a new way.

Adaptive architectural practices allow for the users to control and make adjustments to the external factors influenced by temperature or a simple need for change in surroundings to create a heightened experience of that space through a simple reaction driven by too much light or too little heat within the space.

Marcel Breuer (1955) states that uniting contrasting elements is a more pleasant notion of seeing and experiencing the real impact contradicting parts as opposed to compromising and using parts of each to arrive at a solution (p 32). When a man and woman marry one another, they still differ because of individual traits and characteristics that define themselves; but they are able to coexist as one.

Breuer goes on to say that buildings will last multiple generations, change will happen and those dynamic changes are just as important as the static structure (p 34). The revival of this abandoned ore dock for a multi-family dwelling had previously established itself as an iconic figure in the past decades. Despite a new function integrating itself with the existing structure does not take away from the importance to past generations and functionality of the dock, it merely serves a new purpose to contribute to this and future generations.

Using Breuer's concept of contrasting elements, it is important to not make a half-hearted solution to satisfy both entities. These natural forces and environments will impact strategies of design and how the human needs are satisfied. Angles of the sun determine position of the sun shade, but the sun shade is an architectural element incorporated with the holistic design that is a response to the environment. The design is a unified response to the environment that must understand how the environment will respond to it. Two differing entities create impact on user, building, and environment.

sociological

Before exploring the social implications of architecture, the idea of culture and how it influences daily life needs to be understood. According to James Henslin (2006), culture is the lens through which we perceive and evaluate what is going on around us (p 33). The actions and beliefs of a society create a norm for people to 'follow' and in doing so becomes a way of life. Henslin goes on to say that looking at society through a lens of culture is ethnocentrism; a tendency to use our own group's ways of doing things as a baseline for measuring others. It is easy to see the differences when making comparisons between two distinct cultures, however, to judge our own culture can be difficult because everyday occurrences that would seem unthinkable in some cultures are "normal" for us. The same can be applied in architectural terms, our understanding of what a house is and does provides us with a baseline of testing innovation and new technologies.

Satisfying the social aspect of life is critical in maintaining a healthy emotional state. Architecture is a field in which buildings, urban and community spaces are created for people (society) and their activities. It has the ability to impact people in a way that creates a distinct feeling or experience, establishing an unspoken connection (or disconnect) between person and building. Architecture can shape experience and, by shaping experience, can shape life. New lifestyle trends are presenting unique opportunities for advancement toward a new way of living. Fox and Kemp (2009) say that today's style of life is dynamic, flexible, and activities are constantly changing (p 138). Architecture, for the most part, remains static.

Fox et al. (2009) say technological advancements have given people the freedom to do work at home during the hours they choose, thus giving them more time to devote to personal or family interests (p 140). Although more action is occurring in the home, it does not necessarily mean that more space must be provided. For example, the cellular phone has become more of a miniature, mobile computer that is capable of making phone calls. Advancing technologies will happen

and change will follow. Fox et al. (2009) believe that architects needs to explore, think about, and design architecture that responds to new lifestyles with new spatial dynamics; similarly they believe that homes can be designed to efficiently handle greater amounts of flexibility in terms of number of people using them and the times they are used (p 140).

Architecture can affect behavior and how people interact with not only others but the building they inhabit as well. A conversation between two individuals a continuous dialogue that arouses interest and creates relationship and understanding in each person. Now imagine that one of those individuals is replaced by a home and a new dialogue begins to take place between person and building because the house has the ability to respond to the person. The architecture can possess the capability to adapt to the person and learn from his/her actions and adjust itself accordingly (Fox and Kemp, 2009). Whether it is verbal or non-verbal communication that takes place, there is a continuous "conversation" and engagement between the two entities. Suddenly a house or building becomes a participant in the activities, an a person who is isolated and living on their own is no longer socially alone, and the spatial atmosphere of their house becomes more lively.

psychological

It is important to know and understand the factors that contribute to the reasons a family moves from one home to another. According to a study by Peter Rossi (1955), families move "in response to change in household size, age, and gender mixes, as housing appropriate for one life-cycle stage became inappropriate at a later stage" (p 220). The primary reason involved in this thesis is the change in household size, or number of occupants inhabiting the building. When two people decide to get married, they are making a lifelong commitment to one another and may choose to have children. The spatial needs of that young couple is different than the needs of the couple with three children or

even three teens. With that, the activities and functions of rooms will be in flux throughout the lifecycle of the family. Parents will purchase a larger home, expecting to start a family in the coming years and barring any major events, the children will grow up and go to college and begin their own life, thus leaving their parents and home behind. But what of that house with the large living and dining spaces and four bedrooms, three of which are vacated? The logical option for the parents is to move to a different home with smaller spaces and fewer bedrooms. Moving can be one of the most stressful times in a person's life, even if it is well-planned.

Nomadic tribes move with the seasons and to follow their food. There are factors and circumstances in today's society a family cannot control that will force them to move; economic, social, and even age. Even when we began to settle in townships and growing cities, some merchants were forced to travel and sail so that we could maintain a static living environment. Travel, movement, and adaptability have been key to our survival as a human race and although we no longer move due to seasonal changes or buffalo migrations, there is still a level of adaptability that we possess that meets our needs for survival. The success and longevity of our race is attributed to our ability to adapt.

cyclical life

Modern society is living at a fast-paced rate with up-to-the-minute news and more efficient modes of transportation and communication. Meanwhile, the traditional way of life: graduating from high school and college, starting your career, working to age sixty-five and retiring, is no longer the style of life society tells us to live. A cyclical life gives people the opportunity to be more than one person in their life and change careers more fluidly (Dychtwald, 2003, p 140). After starting a career following college, an individual is no longer expected to feel "tied down" to a particular job and they now have an option to quit, go back

to school, and embark on a different career path. People age, but the ways of life for those people will change.

The society of today is built with change in mind because it is impossible to predict what the future holds, but having that ability to react and properly respond to a situation can determine the success of any event.

Even the concept of family has become less rigid and the Cleavers of the 1950's are no longer the model for most families. The makeup of a family has drastically changed over the last century because of the opportunities to live-out multiple lives and careers. More women are choosing to have children later to pursue personal goals before settling down and starting a family. Since 1970, the National Center of Health Statistics says the average age of first-time mothers in the United States went from 21.4 to 25 in (NCHS, 2006). Furthermore, the United States Census as of 2009 shows the average number of housing units is increasing while the population per household is decreasing.

The structural make-up of a family is becoming concurrently more complex and intimate. The age-old concept of "one size fits all" is proving quite the opposite (Dychtwald, 2003, p 111) and the composition of the family dwelling needs to resolve these changing circumstances.

flexibility

Buildings have a long and complicated life, during which their parameters of use can change widely. Even if its basic purpose remains unchanged, the way that purpose is carried out can develop beyond recognition. Predicting the future use of each building and knowing exactly what its purpose is one-hundred, fifty, even twenty years from now is a guessing game. There are many factors that facilitate building use, much of it economic, that we cannot even begin to imagine the possibilities of such a thing. However, a building that is flexible would allow dramatically different activities to occur within the same, but

"Flexible buildings are intended to respond to changing situations in their use, operation, or location. This is architecture that adapts, rather than stagnates; transforms, rather than restricts; is motive, rather than static; interacts with its users, rather than inhibits" (Kronenburg, 2007, p 10).

changing, space (Kronenburg, 2007, p 14).

There are several projects, some of which will be covered later in this thesis, that employ this concept of flexibility in with the architecture: Dymaxion House, Ove Glas House in Sweden, Rietveld-Schröder House in the Netherlands, Fukuoka Housing in Japan, the Robie House in Chicago. Even designs that are simple in nature but relate strongly to the idea of flexibility include a Native American tipi, an Airstream trailer home, or the Suitaloon. The Suitaloon was an experimental project done by Archigram in 1968 that was essentially a suit worn by an individual that can blow up to a small enclosed space (Kronenburg, 2007, p 42). Flexible design is not a new endeavor of architecture, instead it has been an applied concept in more recent designs.

Some architects will set out to design a flexible design but the finished product may be more complicated than flexible. The ways in which a building is flexible can relate and reflect the user(s) in ways that a static building cannot. For example, if a dwelling has operable walls the user can take the space they have and rearrange the surroundings based on spatial need or a simple desire for a change of spatial environment. This act of engaging with one's home can develop the 'relationship' between user and house to create a far more meaningful way of living. When architecture has the capability of responding to human needs,

it can lead to a greater sense of attachment to that space (Fox et al. 2009).

It is safe to assume that families will always exist, but the lifestyles, the ways in which families grow, live, and die can change. The same can be said for the home in which they are family because it will accommodate the needs or requirements for the family to a certain extent until they no longer need all the space or it has lost its luster. With the technology of today it is not uncommon for a building to last more than one hundred years, and over the course of time it will house many occupants and activities. These occupants generally have similar lifestyles or needs and the demands on the building are not often pushed to perform beyond its limit. However, some users may have very different agendas and if they are forced to live and work in this building, it should have the ability to meet their needs independently without a compromise.

As stated earlier, people age but the lifestyles through which they live change. If an individual chooses to live in the home throughout the duration of their lifetime, they will perform vastly different activities at twenty years old compared to those at the age of seventy. The home for this person cannot efficiently support the wide array of activities performed throughout their lifetime because a home is static. A flexible home, on the other hand, would have a greater chance of being able to provide for this lifelong resident because of the design quality.

Robert Kronenburg can best summarize the intentions of this thesis and flexible architecture

"Homes require flexibility to allow for adaptation by the resident over time. Even if they have been designed specifically for someone, people and their circumstances change...

Enabling people to use their homes in their own individual way and to alter their environment to their own requirements not only allows them to transform a building from anonymous space into a specific 'place', but it also provides flexibility to change with circumstances" (2003, p 55).

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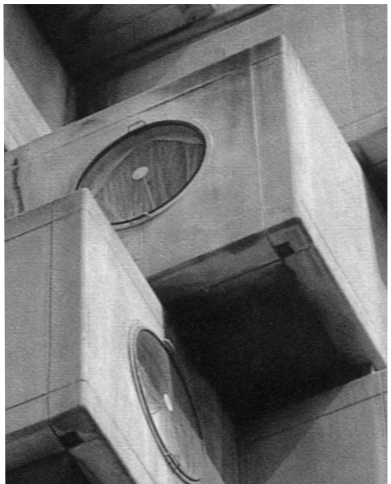


images of Schröder House courtesy of MIT Press

rietveld-schröder house

architect: gerrit rietveld
client: truus schröder-schräder
location: utrech, netherlands
date: 1925

In 1924, a 35 year-old widow, Truus Schröder-Schräder commissioned De Stijl architect Gerrit Rietveld to design a home that would not contain any excessive elements to help distance herself from meaningless routines in life (Mulder & Zijl, 1999, p 6). As defined by Charlotte Jirousek (1995) De Stijl is Dutch for 'The Style' and is an art form that relies on functionalism, rectilinear planes, and using primary colors supported with black and white (para. 2). This house defined the aesthetic quality of De Stijl most completely.

Prior to investing in her new home, Schröder had been inspired by watching her friend's child in a large empty attic and tried imagining what it would be like to live in such a way. Rietveld set out to design a home that would fulfill Schröder's needs and expectations. The design he proposed to Truus featured a straight-forward and basic main level, slightly raised off the ground; but the upper storey was a large open plan with sliding and collapsing walls to reflect her Bohemian or free-spirited way of living (Kronenburg, 2007, p 26).

This project was one of the first

open plan

partitioned plan

"So when Rietveld had made a sketch of the rooms, I asked, 'Can those walls go too?' to which he answered, 'With pleasure, away with those walls!'"

conscious attempts at a flexible architecture that required a lack of details to be submitted for building permission. Rietvelt failed to mention to the committee that the walls in the 'attic' (upper) floor contained sliding walls (Mulder et al., 1999, p 8). Rietveld labeled the upper floor as an attic because the lower level contain all the necessary functions of a house at the time and there was no reason to have another floor other than attic space.

Fortunately, the design was built and put to the test by Truus and her family and later Rietveld himself. This house, that a family lived and was raised in, had been designed to respond organically to their changing needs (Büller, Mulder, Oudsten, Overy, 1988, p 93). One of the most intriguing facts about the house is that it was Rietveld's first *entire* housing project. His previous experience involved a few rooms and additions but nothing of the magnitude of creating a complete house.

The initial phases of the project challenged Rietveld because he would bring Truus a design and she would continuously ask if walls could be removed to give the floor plan an open feel. To add further complication to the process, Truus showed her concern for still having the possibility of dividing up that large space.

Gerrit went back to work and developed the concept of sliding partition walls, although he was against this notion. Truus, however, was inspired. The sliding walls allow her to control what spaces are present and when she wants them to be. Because light was an influential component of the design, the open plan and skylight allows light to spill in on three sides of the home and further into the core without fixed walls hindering the light. The beauty of the open plan is the visual linkage between the diverse spaces that connect the house as a whole. Even the small spaces, such as the study, are "opened" up by the concept of a black ceiling to create a "hole effect", giving the space an overall larger feel.

An unfortunate consequence to this famous house is that Rietveld was not pleased with his solution. During the last few years of his life, he lived in the home with Truus and would comment that the house was quite nice, however, it was much too complicated (Büller et al., 1988, p 93). Despite his distaste for the design, it was an ingenious solution that satisfied the client from initial sketch of the project to her death.

" 'Hinged space' is generated by moving walls that 'participate' with their inhabitants in the creation of interactive environments" (Kronenburg, 2007, p52).

Woningbouw, courtesy of Robert Kronenburg

fukuoka housing

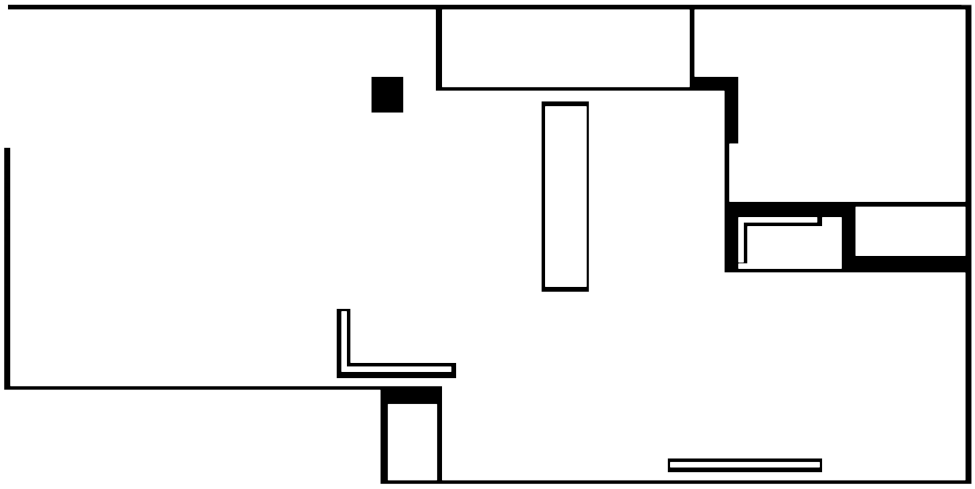
architect: steven holl
client: city of fukuoka
location: fukuoka, japan
date: 1989

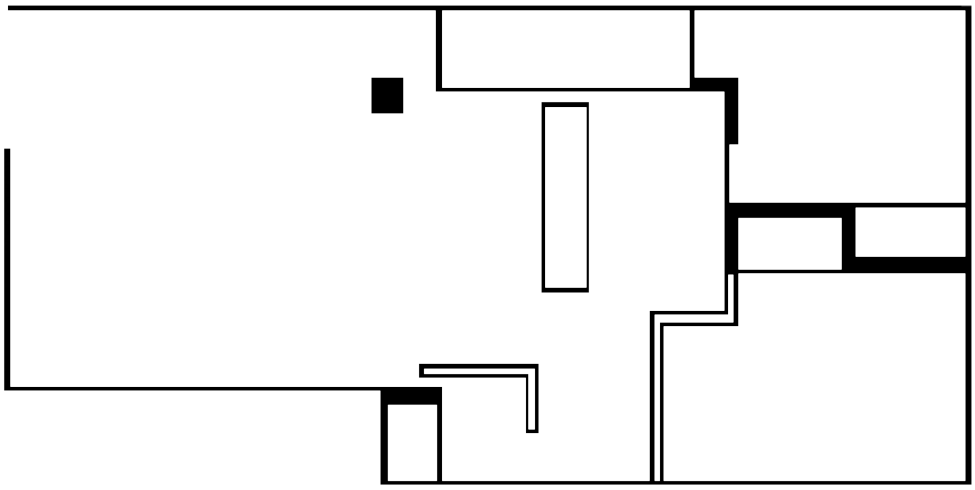
In the early 1980's, New York architect Steven Holl began experimenting with a new concept called "hinged" space. This idea is similar to that of Gerrit Rietveld and his sliding partitions because design solutions incorporate sliding walls governed by spatial demand.

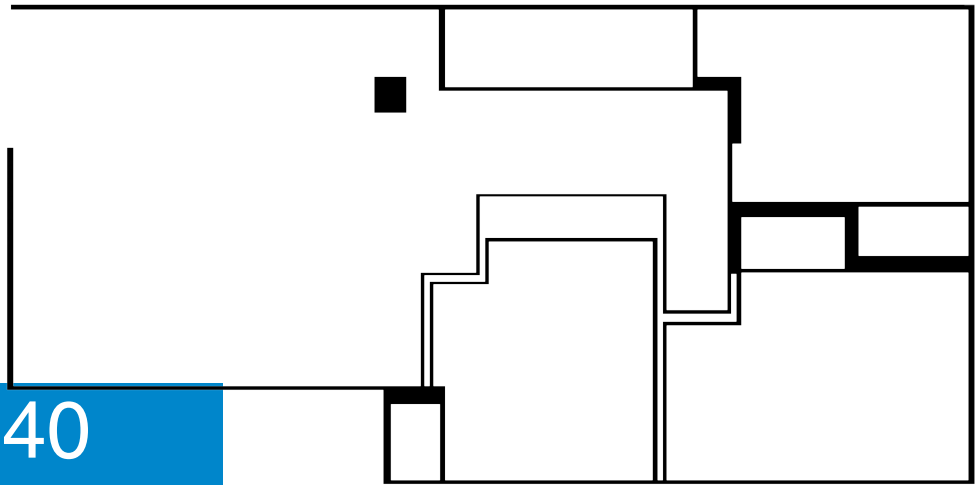
This principle inspired the users to create the space they need with the space and planes they have. By simply pushing, pulling, and physically manipulating these walls and surfaces, people can rearrange their home to their liking (Kronenburg, 2007, p 52).

Many projects that involve flexibility require the participation of the user. Psychologically, this will give the user a sense of ownership and satisfaction when tailoring their habitat.

In total, there are twenty-eight apartments within the five individual buildings that border ponds, creating a sense the buildings are "interlocking" with the ponds. Despite the fact that each building contains twenty-eight units, each unit is different with each resident







(Kronenburg, 2007, 52). The fusing and blending of spaces offer each inhabitant the chance to explore new configurations based on mood, need, or lifestyle.

"They can also react to seasonal needs, creating a feeling of enclosure and protection in a winter storm and letting light flood the entire space on a spring day." (Kronenburg, 2007, p 53)

Holl's Fukuoka apartments were not his first attempt at hinged space. His initial projects were in Manhattan, New York: the Cohen, X-Y-Z, and Theo-logical. Despite the creative thinking and ingenuity, the cost to live in these buildings was incredibly high because space is at a premium in Manhattan. However, the client in Fukuoka wanted Holl to incorporate the hinged concept because it reflected the Japanese culture and would allow for more flexibility of space.

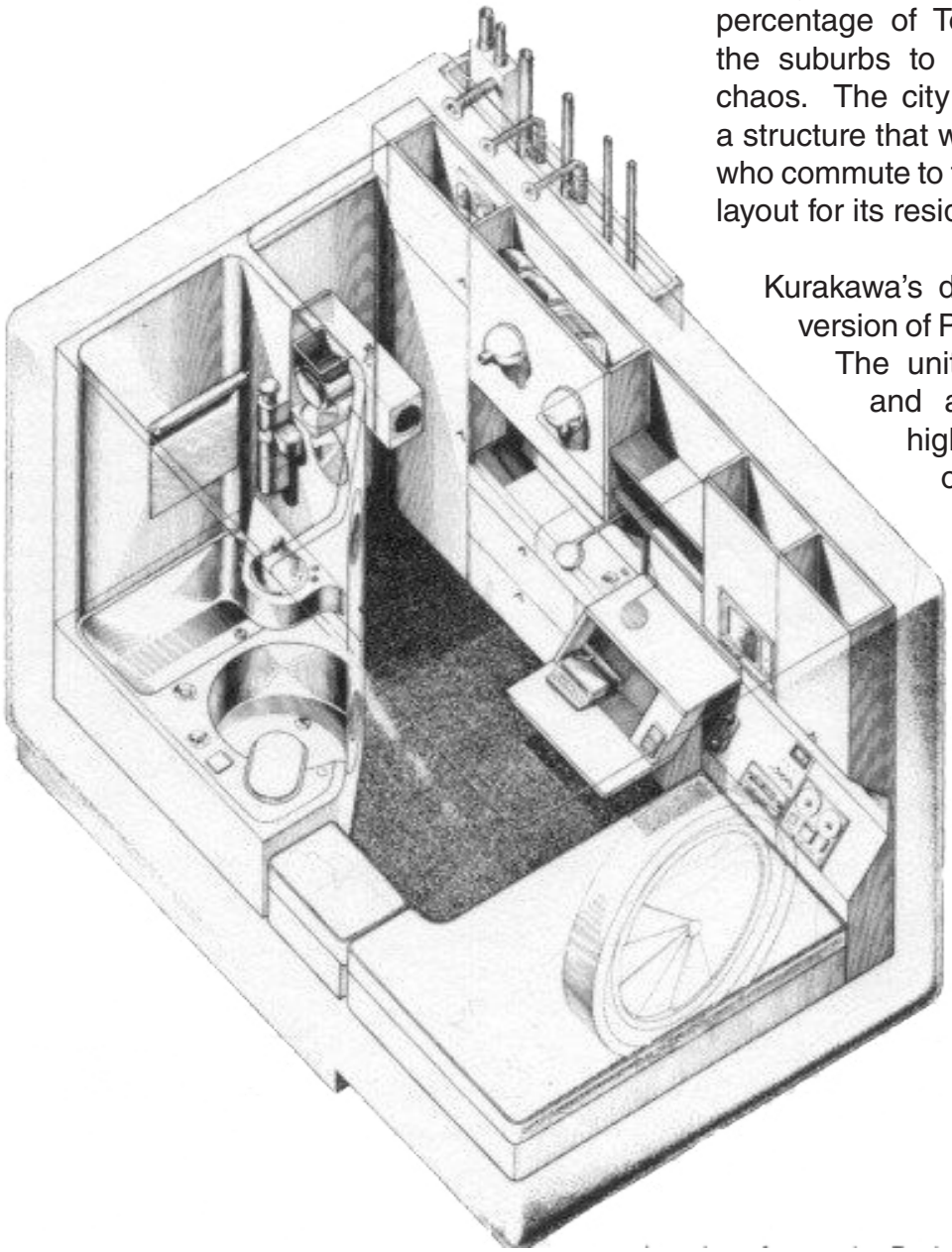
Much of what Holl did was create spaces with an open plan and designed walls similar to those by Rietveld but that were freestanding. These walls allow users to directly control the spaces within by moving the walls throughout the apartment.

The floor plans (left) show the same unit with the movable walls placed in different locations. Holl knew that it was important to create an atmosphere through which the users would feel connection to their apartment and view it as a home, a source of inspiration.


中銀
中銀

nakagin capsule tower

architect: kisho kurokawa
client: city of tokyo
location: tokyo, japan
date: 1970



During the mid-to-late sixties, a significant percentage of Tokyo citizens began moving into the suburbs to relieve themselves of the urban chaos. The city requested that Kurokawa design a structure that would attract people in the suburbs who commute to the city by incorporating a versatile layout for its residents.

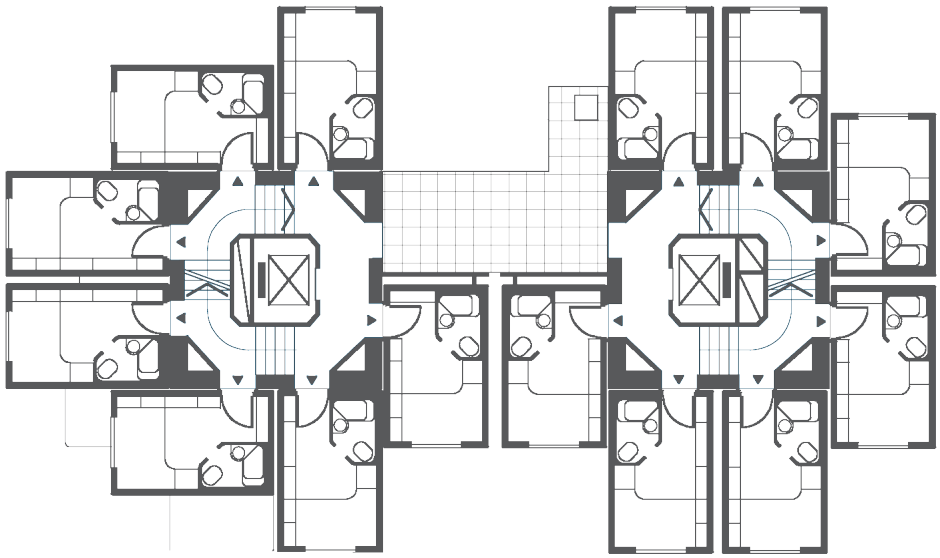
Kurakawa's design brought to life Archigram's version of Plug-in City from a few years before. The units can be easily mass-produced and assembled on site by fastening high-tension bolts to the central core of the tower (Kurokawa).

Each room offers a simple, compact layout of 8.25' x 13' x 8.25' (Kurokawa) that provides similar amenities to a hotel. A fascinating feature with the design is the ability to add or remove units based on the need. Kurokawa did this to show that architecture does not always need to be static, instead it has the potential to change form over time. These units could be used as apartment or studio spaces and if a family of increasing size lived here they could simply buy a nearby unit for more space (Kronenburg, 2007, p 42).

This form of architecture that

changes and evolves according to needs of the occupant incorporates a level of participation that many architects experimented with during this era. Although it is mass-produced, the spaces of autonomy and individuality provide a new level of human existence woven into the fabric of the urban scene.

"..prototypical house designs have influenced the development of architectural form through the issues they have explored... Experimental design also influences the mainstream and eventually many ideas and concepts, once considered stimulating and exciting though impractical, suddenly appear realizable" (Kronenburg, 2007, p 41).



additional influences

These three case studies also played a significant role in the development of this thesis project.

Moshe Safdie's creation of an organic flow to the design and layout of Habitat 67 brought a new sense of life to Montreal during the Expo in 1967.

The renovated High Line in New York by Diller Scofidio + Renfro in 2009 utilized a 1.5 mile stretch of abandoned rail transport and turned it into an elevated park and walkway for citizens of the area. As seen in the picture, some tracks were left as a way to mark what was previously there.

The Kraanspoor in Amsterdam used an old concrete dock to support a three-story office building. Although the new structure was placed on top of the existing structure, it was a critical study because it gave inspiration to this forward-thinking thesis proposal and design.

habitat 67

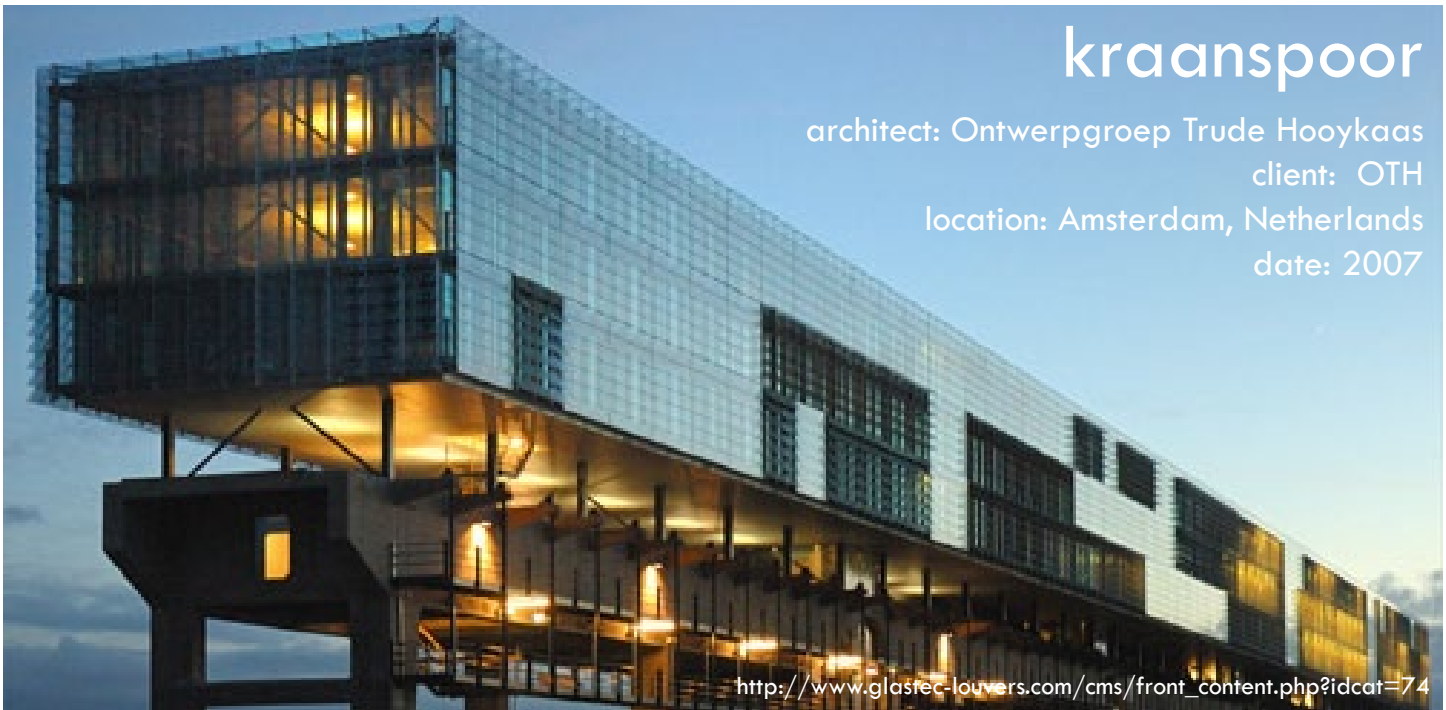
architect: moshe safdie
client: canadian corporation
location: montreal, canada
date: 1967

http://artla.tumblr.com/post/152787320/moshe-safdie-habitat-67

the high line

architect: diller scofidio + renfro
client: friends of the high line
location: new york, new york
date: 2009

http://archleague.org/site/wp-content/uploads/2009/12/Corner-High-Line_Washington-Grasslands.jpg



kraanspoor

architect: Ontwerpgroep Trude Hooykaas
client: OTH
location: Amsterdam, Netherlands
date: 2007

http://www.glastec-louvers.com/cms/front_content.php?idcat=74

summary of case studies

The results from this typological research will serve as forms of inspiration and concept that have been connected through exploration of flexible architecture. As the dates of the case studies indicate, this topic has faded to the background of architectural design over the last twenty years as a result of many clients' desire to build for a minimal cost and no complications. However, architecture is beginning to move towards an increasing level of complexity without the complications which is why flexibility has the opportunity to surface again during this period of green architecture.

This thesis will explore concepts of past architectural design and technology of today within a region of the United States that is fully immersed in the four seasons. Above all, a multi-family dwelling will be the first priority of design throughout this thesis, meaning the primary focus is on the people who will live in this dwelling. Like the Schroder House and Fukuoka Housing projects, this design will attempt to create a "sense of place" for the inhabitants through engagement with the building and allowing that engagement to lead to a relationship between the dwelling and user.

Gerrit Rietveld delivered more than a house to Truus Schroder. He gave her a home that allowed her to live the way she wanted. Home is a place to eat, cook, rest, sleep, and spend time with family and friends. The house, on the other hand, is a deliverable product or object. A successful dwelling design will have a "character" that is significant to its users in ways that allow the users to define themselves through the expression of the home. Truus Schroder wanted two very different things in her home: an open floor plan and the control to segment that open floor plan when she desired. For the next fifty-eight years, she lived in that home because she knew no other place in the world would satisfy her needs in the ways that this house could.

As previously mentioned with Rietveld, the principles of the De Stijl movement will drive this thesis to use a color palette of materials that is familiar area that will define this project.

Steven Holl's development of hinged space from the early 1980's led to several projects that incorporated the concept. Like Rietveld's sliding partitions in the Schröder House, Holl allowed users to take the space they have and turn it into the space they need through movable walls. Similar to Rietveld, Holl knew that the success of this project, like all projects, is dependant on satisfying the client by delivering spaces that bring joy and delight to the users.

Kisho Kurokawa's Nakagin Capsule Tower in Tokyo was a slightly different project than the two projects previously stated. The idea of flexibility was incorporated with Kurokawa's design, however, it was used on a larger scale. At the time of construction, it was a solution that would bring residents back to the heart of the city and deliver a long-term solution for change with removable units. Unfortunately the time and effort it required to remove a single unit, though planned for, was never a logical option. Kurokawa had visions of the tower changing its vertical form over the years as an organic reflection that would visually display the status of the city. This mass-produced form of housing was able to adapt for the total occupancy of residents but too overwhelming to personally engage the occupants themselves in the design.

Throughout the course of human history, adaptations to external forces and the ability to be flexible have supported the human race into the 21st century. Exploration of new ways of living have been an ongoing investigation within the last century alone and although new styles or patterns emerge from this ,they still need to provide our basic human needs: eat, sleep, and interact with others. The dwelling is the primary means of architectural exploration because most people know and understand the functions of a house and look or desire spatial qualities that will make their experience of living delightful beyond the successes or failures of today.

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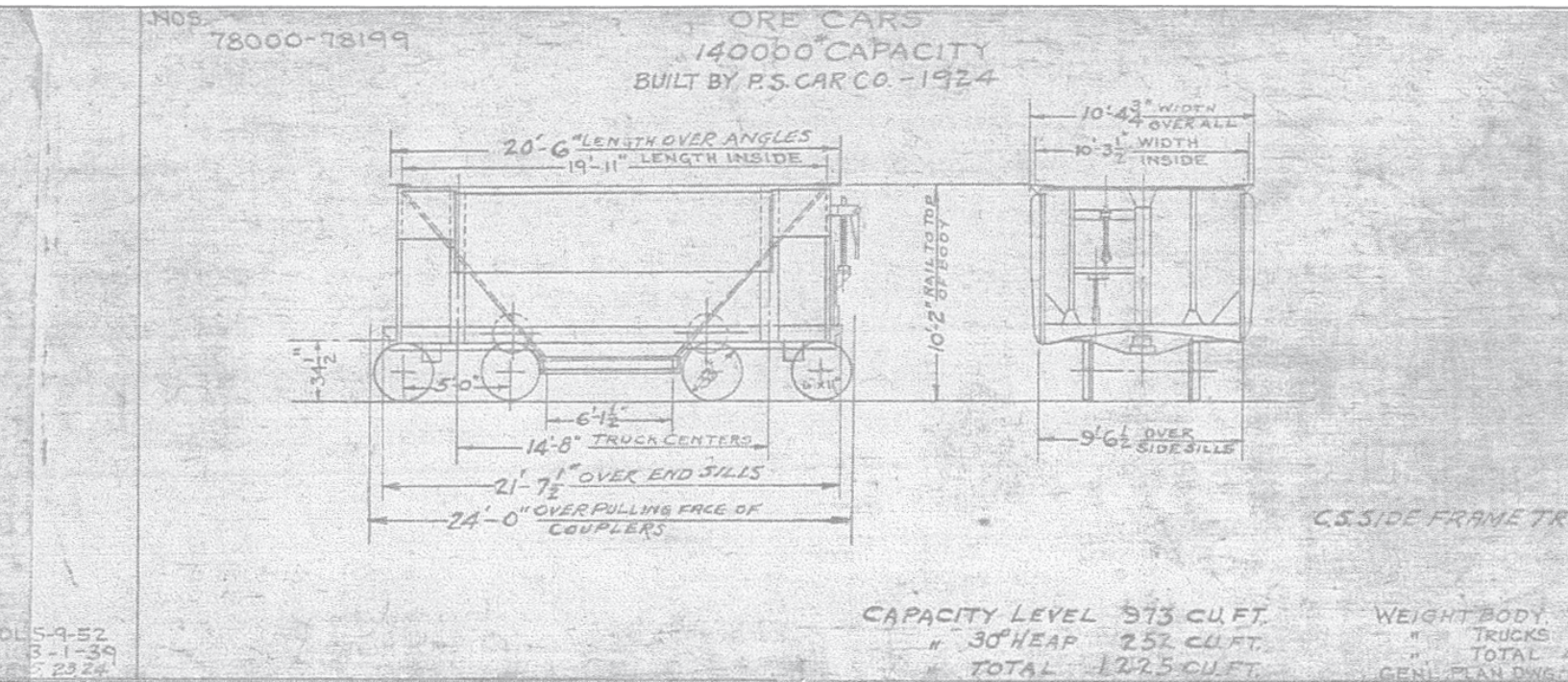


superior, wi

The earliest European visitors to the area arrived in 1618 and were greeted by the native Ojibwa. Settlers befriended and exchanged cultures and lifestyles with one another to establish a relationship. Trading posts were set in place for members of both cultures; some traded items of the Ojibwa were pieces of mined copper used for weapons or jewelry. When early settlers would depart and return to the area, they brought with them many more settlers who were eager to become part of the fur trading and copper mining industries.

The "Twin Port" cities (Superior and Duluth, Minnesota) quickly developed into cities of the largest harbor to connect the Great Lakes to the Midwestern territories of the United States. As quoted by an early resident "Lake Superior appears as a giant hand of destiny, pointing its finger towards the iron ore mines, pine forests and farming possibilities." All of these things, along with an unparalleled location, are the solid foundation from which the city built on.

By the late 1800's, the new town slogan became "Where sail meets rail" because of the booming shipping and railroad industries thanks in large part to the iron ore mines and rich forests.

Population: 27,224 within forty-five square miles

Demographics: 2.35 persons/household
(2.91 average family size)

Households: 27.9% have children under 18
41.3% married couples
12.3% mother with no husband
42.3% non-families
34.2% made up of individuals
13.5% individuals 65 or older

Climate: Humid Continental with contributing factors of Lake Superior and surrounding topography. Summer temperatures are around 65.1 degrees, compared to 14.4 degrees in the winter. Average annual precipitation is 32.1 inches.

The City of Superior
"Where Sail Meets Rail"

"Zenith of the unsalted seas."
-Dr. Thomas Foster

duluth, mn

As the early French explorers made their way to the tip of Lake Superior, one settler's attempts to make peace with the native Ojibwa tribes stood out from others. Daniel Greysolon, Sieur du Lhut made continuous efforts to attain friendships with these local tribes, and the city is named; du Lhut, after him.

As the Twin Ports began establishing themselves in the later part of the 19th century, they could boast having the only passageway connecting the Atlantic and Pacific Oceans. Because of this, it became an instant and easy point of access to the areas supply of seemingly endless ore mining opportunities and rich lumber. However, it was the arrival of the railroad that brought out the full potential of Duluth as another means of transporting people and goods more efficiently throughout the region. In 1869, Duluth was the fastest growing city in the United States.

Tragedy struck in 1873 when a stock market crash nearly wiped out the city. Fortunately, the strong infrastructure that helped build the city was the rejuvenating breath the city needed. By the end of the 19th century, Duluth had the most millionaires per capita.

The Duluth Commercial Historic District is comprised of 107 downtown buildings that have been preserved to display the commercial adaptations of architectural styles that were popular during the city's greatest times of prosperity (late 19th-early 20th centuries). Continuous efforts to rehabilitate these structures are carried out to preserve the rich history of this port city.

Households: 26.6% have children under 18
41.4% married couples
11.4% mother with no husband
43.9% non-families
34.5% made up of individuals
13.3% individuals 65 or older

Population: 84,419 within sixty-eight square miles

Demographics: 2.26 persons/household
(2.90 average family size)

taconite

The discovery of iron ore ranges in the upper Midwest paved the way for growth and development in this region of the United States that helped to create jobs in other Great Lakes cities. Many iron-ore ranges near Lakes Superior, Michigan, and Huron ship the iron-ore to steel-making cities along Lake Erie such as Cleveland, Ohio and Erie, Pennsylvania.

The Mesabe, Ogibwe for “giant” (“The Mesabi--Kemosabi,” 2000), Iron Range in northeastern Minnesota was discovered in 1887 Leonidas Merritt and his brothers and mining began in 1892 (“Mesabi Range,” 2005). The Vermillion and Cuyuna ranges are also near the Mesabe Range but they are not as large. Nearly two-thirds of the iron-ore used in the United States is from Minnesota alone (“Iron-Ore Shipping,” 2005). Unfortunately, as quickly as the mining begun it was also diminishing.

The development of taconite is a response to the depleting red ore in the United States has been. Taconite is a low grade iron comprised of 15-30% iron, compared to 50-60% in red ore and was known as a waste product of the mining process. Dr. E.W. Davis, a geology professor at the University of Minnesota, invented the taconite “pellet” (taconite.org). Through the extraction process, the taconite is ground into a fine powder then passed through magnets that collect the iron to separate it from the excess or waste material. Water is mixed with the pure iron and tumbled into pellets measuring one centimeter in diameter for a simplified means of transportation. The development of taconite has saved Minnesota’s iron-mining industry.

raw taconite

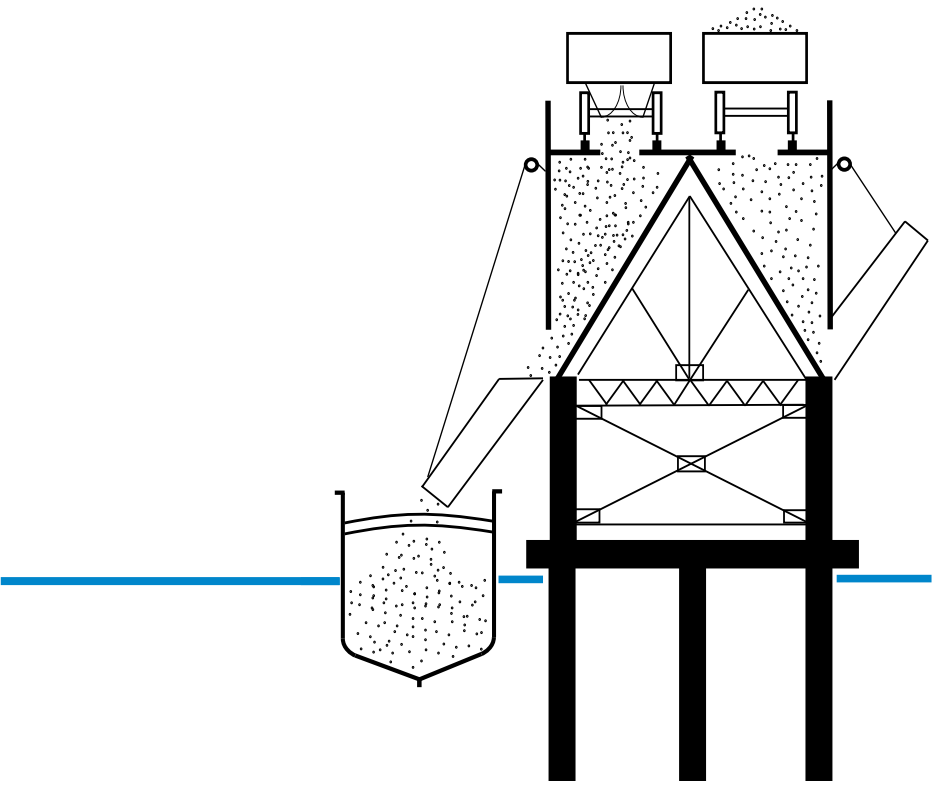
taconite pellets

taconite being loaded

taconite, ore docks, & freighters

Once the taconite pellets are hardened for transport, they are loaded into railway cars and taken to the docks. The first ore dock was made of wood in Marquette, Michigan in 1857. These ore docks measure 60 feet wide, 80 feet high, and 900-2,400 feet in length (Cooleybeck, 2005). The train carrying the taconite pellets will travel along the top of the dock and drop the pellets into holders.

When the freighter, or bulk carrier vessel, arrives, it will position itself near the dock. Once the freighter is secured to the dock, the cargo hatches are opened and the chutes are lowered to the opened hatch. The cargo hatch and chutes are spaced twelve or 24 feet apart depending on the dock. Original models used gravity as the means of transferring the pellets from dock to freighter. Newer models use belts that save time and are more efficient during transfers.



These large carrier vessels have been an effective means of shipping iron-ore, limestone, grain, coal, salt, and cement throughout the Great Lakes. Some of the largest freighters measure over 1,000 feet in length and can carry as much as 78,850 tons of bulk cargo ("Welcome to Great Lakes Shipping," 2010).

Several docks that have been out of use for decades are being removed. One of the most recent is the dock in Ashland, Wisconsin. Many members of the city have expressed wishes to see the dock remain, however, it is a decaying structure that has not been used since the mid 1960's. The city plans to remove most of the structure but create a dock that can be used for fishing and tourism and will serve as a historic landmark to the city.

flexible dwellings

"Our understanding of what a house is meant to do provides a baseline beside which innovation can be tested - it enables us to explore everything from new constructional and structural systems to experimental social grouping."

The success of the human race, and all other species, is dependent on having the ability to adapt. Over the last century, architects and designers have been searching for new ways to enhance ways of living through experimental architectural ideas and solutions, some of which have not been realized.

Frank Lloyd Wright, one of the earliest architectural pioneers in America made his mark with the Prairie House. This style of house had a relatively open plan with a living space surrounding the fireplace in the center of the house. The central location of the fireplace served well during the cold winter months of the Midwest region. Along the exterior of the house he placed permeable walls with a row of windows to allow for an even distribution of breezes and natural lighting.

Despite Wright's success in the United States, Europe was the main scene for architectural innovation and design. Le Corbusier's earliest attempt for a flexible design was a retirement home for his parents on the shores of Lake Geneva in Switzerland (Kronenburg, 2007, p 24). He approached it with a mind set of minimal design that could allow for more users than just his parents. Le Corbusier designed a folding screen that could create space for a guest and a table that could extend out for extra diners if needed.

Although he had never designed an entire house, Gerrit Rietveld, a De Stijl architect with a background in furniture and cabinet making, designed the Schroder House for Truus Schröder. The lower level has a conventional layout that was preferred by Rietveld, while the upper floor is based on the open plan that responds to the practical needs of Truus (Mulder et al, 1999, p 8). In order to achieve this, Rietveld created a series of partitionable, segmented spaces within the larger space. Rietveld believed the success of the house was not in the changeable interior but in the exploration of a new aesthetic that made it innovative. But as much as the De Stijl movement influenced the house, the moveable walls and flexibility are complimentary to the popularity and success of the house.

The concept of flexibility did not resurface until the middle twentieth century when Buckminster Fuller proposed the Dymaxion House. The house could be mass-produced and shipped out in a cylindrical shipping container measuring 15.8 feet by 4.3 feet (Kronenburg, 2007, p 35). Once the house arrived on site, it could be constructed in 200 working hours, approximately sixteen trained individual could erect the house in two days. Despite 37,000 pre-orders for the product, the production never occurred because Fuller would repeatedly change details and the Beech Aircraft Company shelved the project. Fuller stated that it would not be honest to sell something he knew he could not deliver (Krausse and Lichtenstein, 1999).

This project will strive to incorporate a degree of flexibility that is not under/over-designed as a means of satisfying the users. Appropriate technologies and design strategies will be considered to achieve a proper level of technology that does not require daily maintenance by the users. If the design becomes too complex, it will affect the users in a negative and unwanted manner.

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goals for thesis project include:

The final result for this thesis project is to bring more than a creative solution to this unique situation in Superior. By studying and applying flexible architecture, there are endless possibilities to accommodate for change related to both inhabitants and environment.

Inhabitants and every day users will be the utmost priority throughout the duration of this project. Architectural design is not about creating elaborate buildings, but creating spaces that arouse feeling and emotion. Beyond the feeling and emotion comes longevity of use and the ability to consistently engage users in new ways to build a relationship over time.

As mentioned earlier in case studies, dwellings that create a dynamic and engaging living environment are more personable to users compared to those that remain static. A dwelling that adapts and has the ability to respond to the needs and style of living has potential to respond to any user throughout the lifetime of the building. It must be stressed that the goal for this project is to create homes, not housing.

Coincidentally with flexibility for the inhabitants, the dwelling units themselves will be allowed to adapt to the seasonal changes that occur throughout the year. The site exists in a climate that ranges between 70° in the summer to 10° in the winter months. The advantage of Lake Superior's proximity will cool the dwellings during the summer months to allow for a fair amount of passive design strategies.

Over the course of time, the site could possibly be exposed to many environmental changes. The area's population is steadily rising for the first time in decades, and it will undoubtedly continue to be a tourist attraction in the region.

Following the concept of adaptability, the site for this multi-family dwelling is located on an abandoned taconite ore dock. These massive structures propelled the Twin Ports economy at the turn of the twentieth century as a critical stage in the transportation of iron-ore near the cities. Over time, these figures have become iconic to the residents and visitors of these port cities along the coast of Superior and although some have been torn down, others such as the dock in Ashland, Wisconsin has been converted to a fishing pier as a tribute to the mining industry's impact on the city. Similarly, this thesis will attempt to re-use the remaining structure and convert it into an multi-family dwelling that adapts on the micro (resident) and macro (city) scales.

"Architects need to learn to explore, think about, and design for applications particularly suited to such new lifestyle trends, ranging from programmatic and site-context response to spatial dynamics"
(Fox & Kemp, 2009, p 140).

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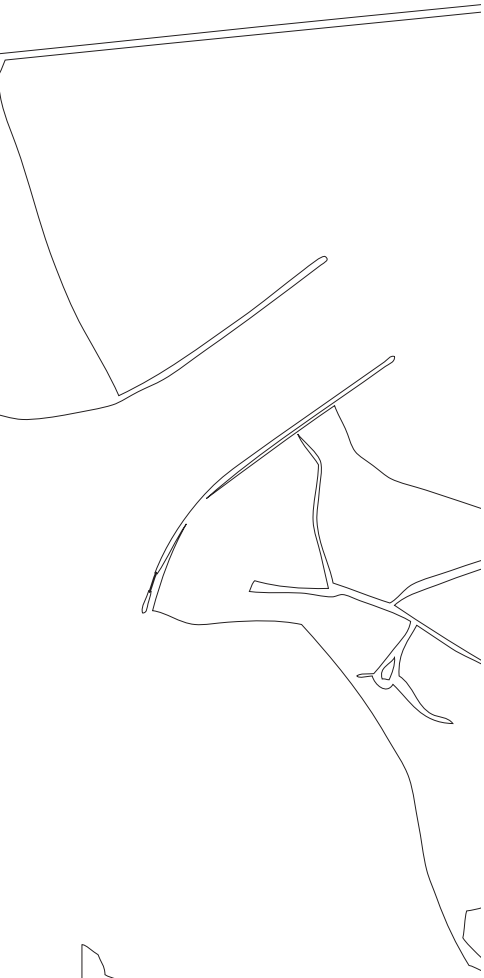
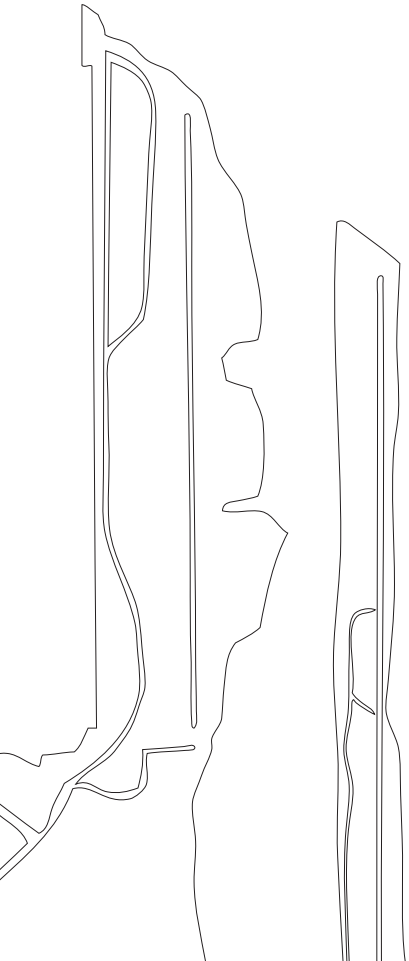


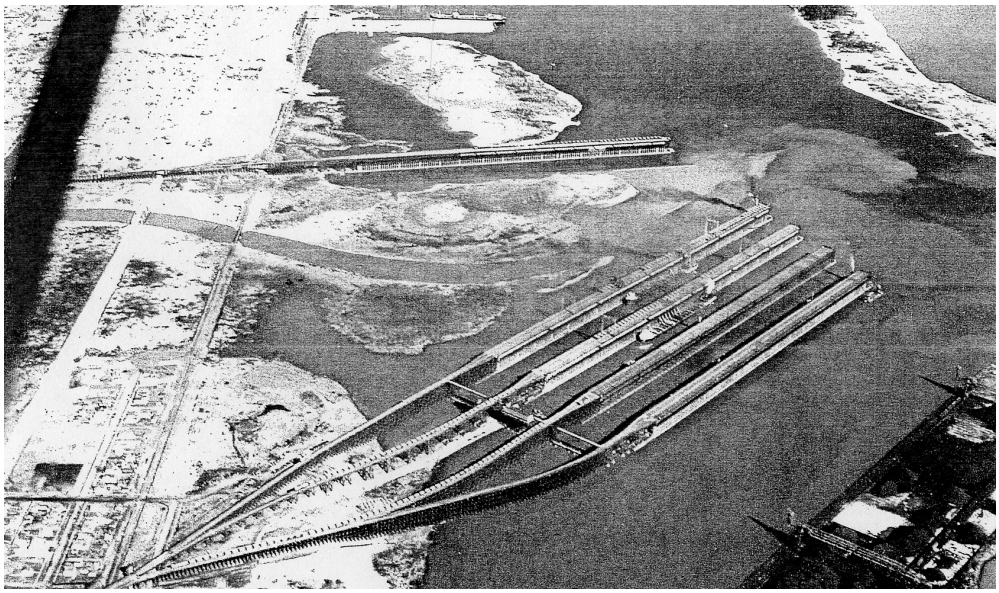
site analysis

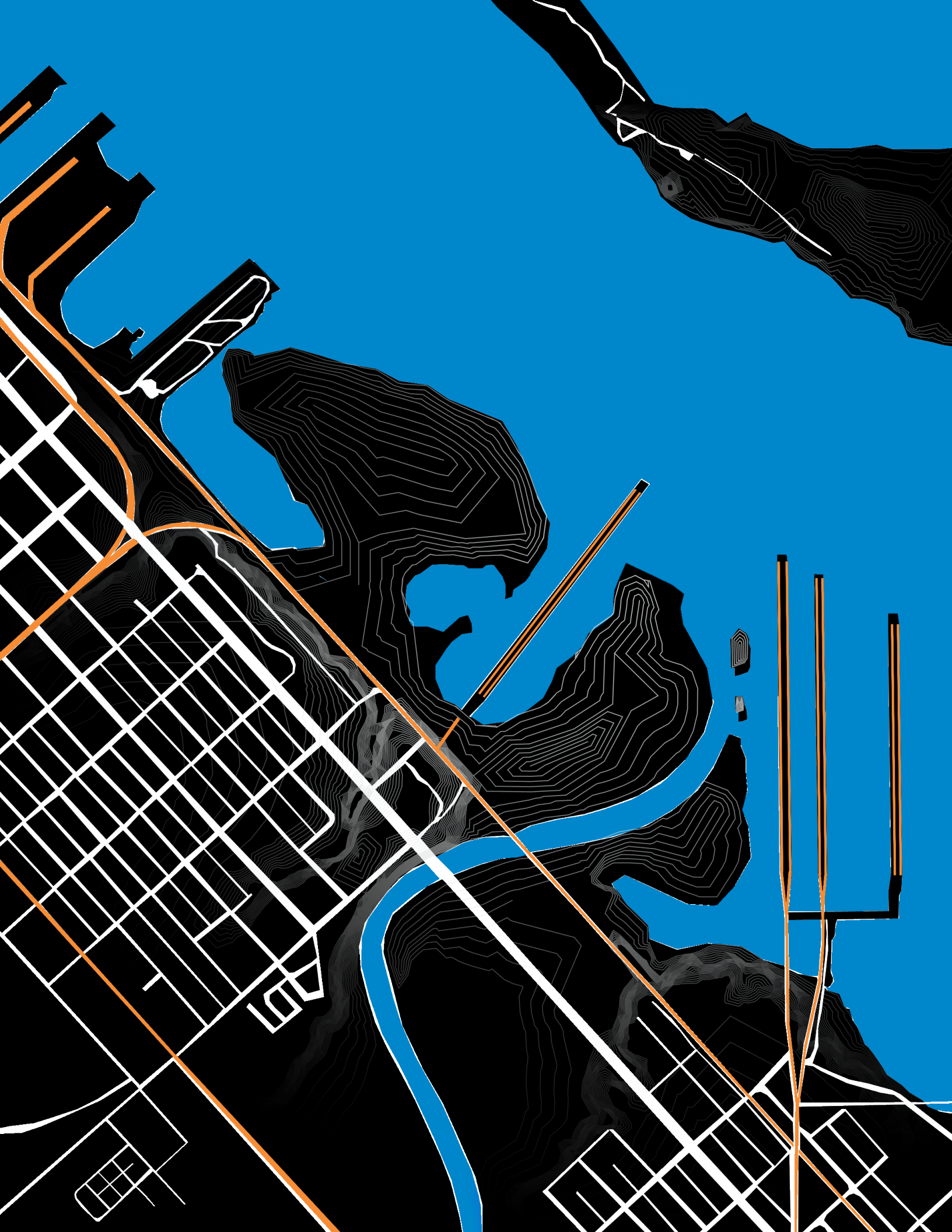
The site for this thesis design is located in Superior, Wisconsin on an abandoned ore dock measuring over two-thousand feet in length in the Superior Bay. Currently, there is a thirty-five car parking lot directly southwest of the dock. Residential houses are within one-half mile of the dock, followed by 1.5 miles of industrial park. A small channel of water runs south of the dock. Duluth's Canal Park is six miles away by way of water, which is primarily where boats will enter or exit Lake Superior.

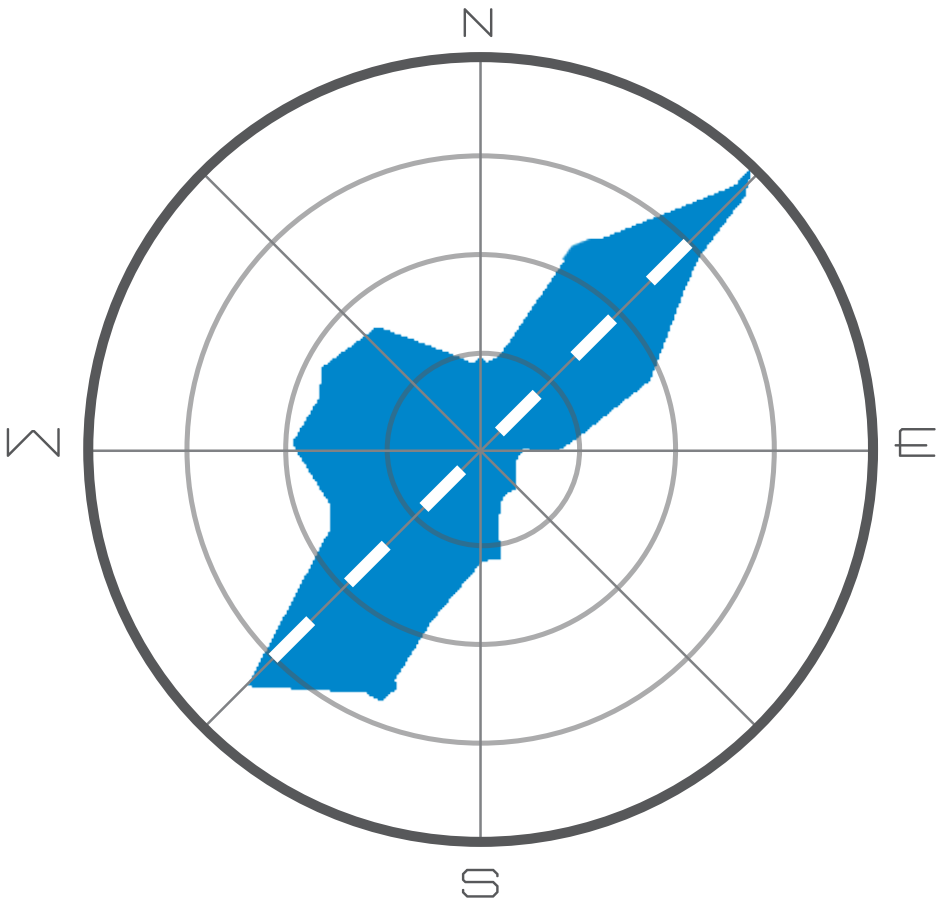
Three additional docks are nearby and still in use to date. As stated earlier in the Programmatic Requirements section, those docks may present a sound issue for residents on the abandoned dock when the boats and docks in service are being loading.

Prevailing winds come from the wnw direction in the winter months and east during summer months. Because of the proximity to Lake Superior, the winter months are warmer and summer months are cooler than average because of "lake effect."





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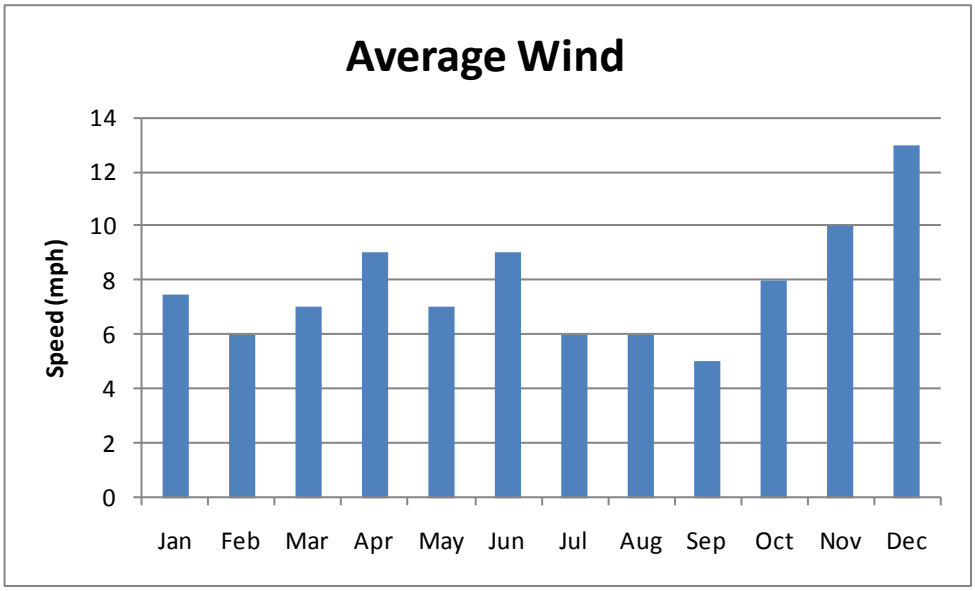
Average Wind
Speed (mph)
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6
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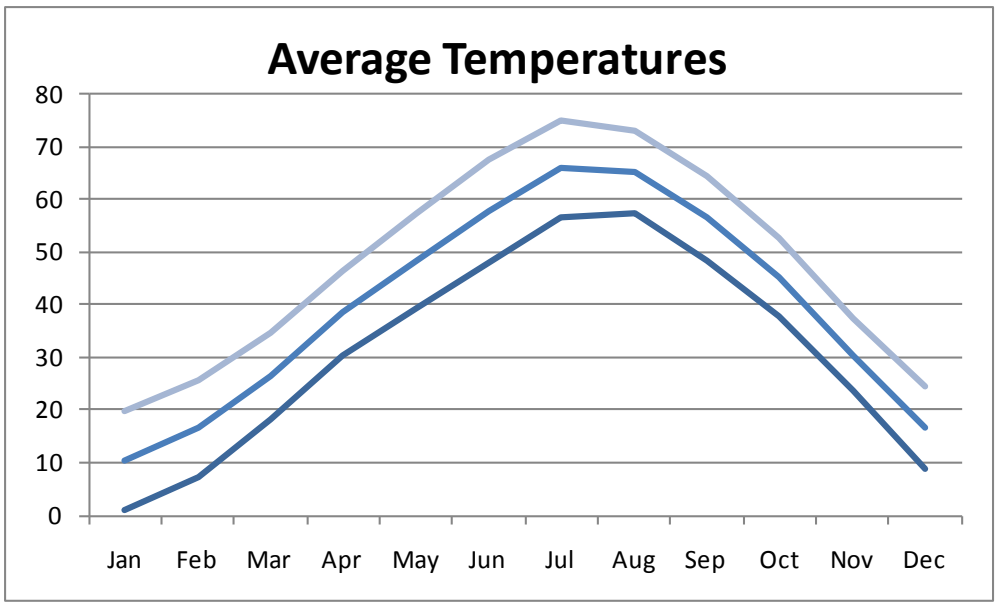
Average Temperatures
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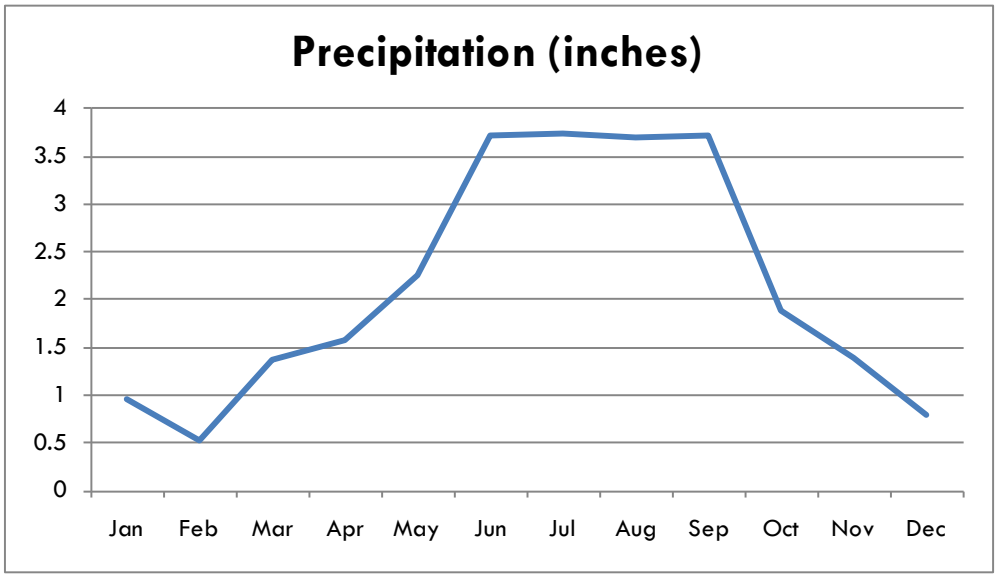
Precipitation (inches)
4
3.5
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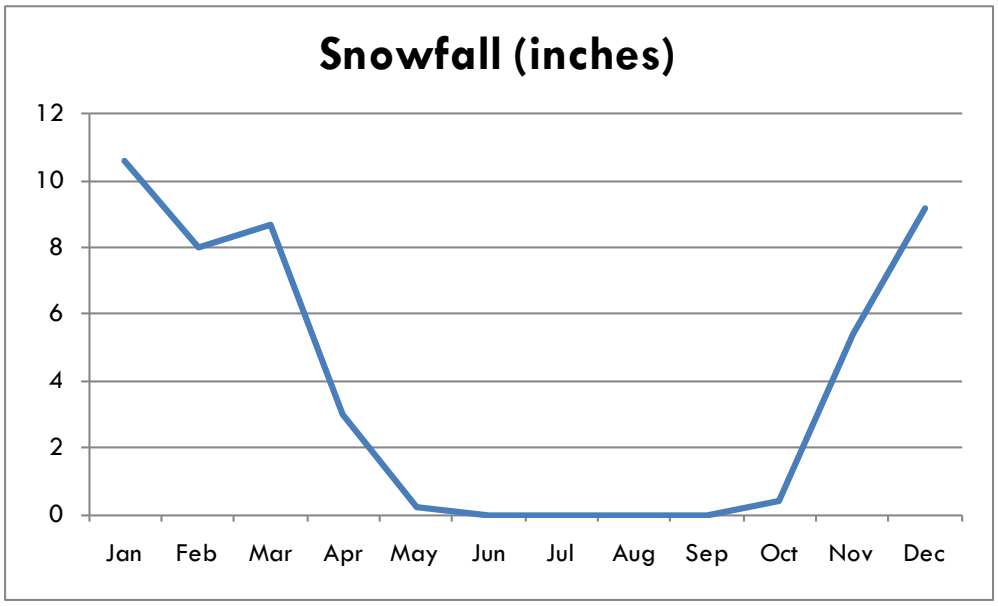
Snowfall (inches)
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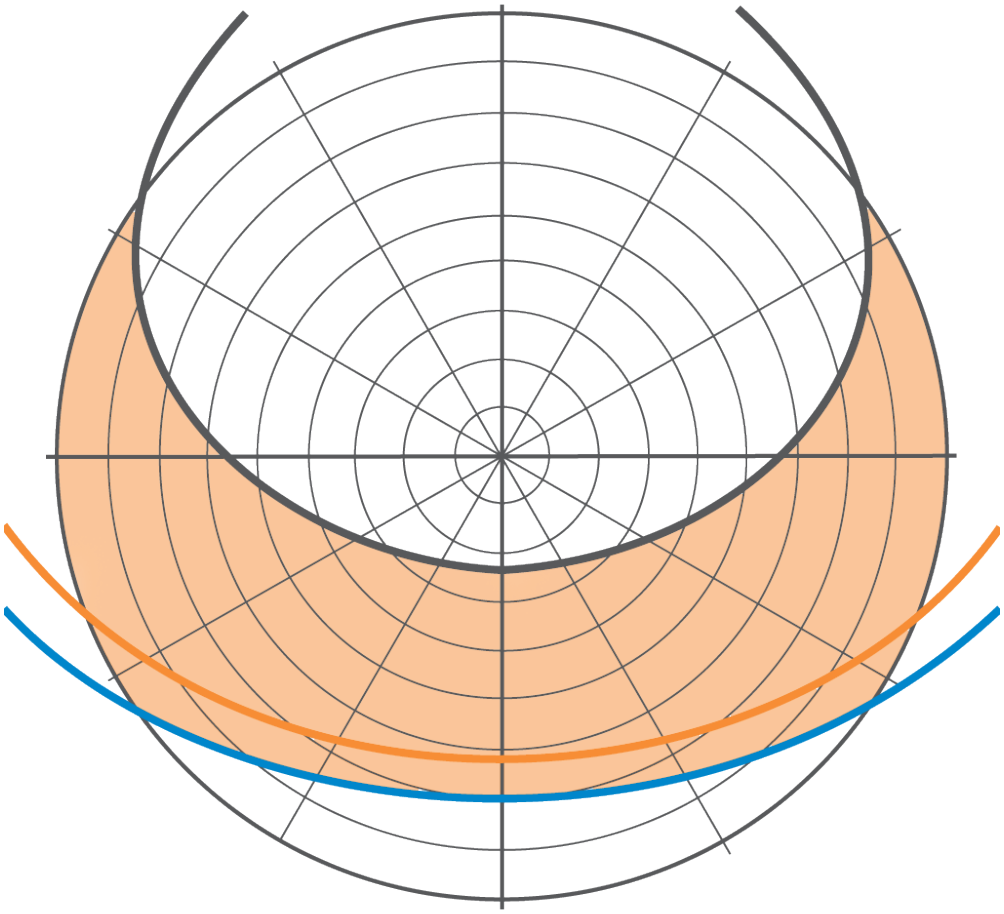

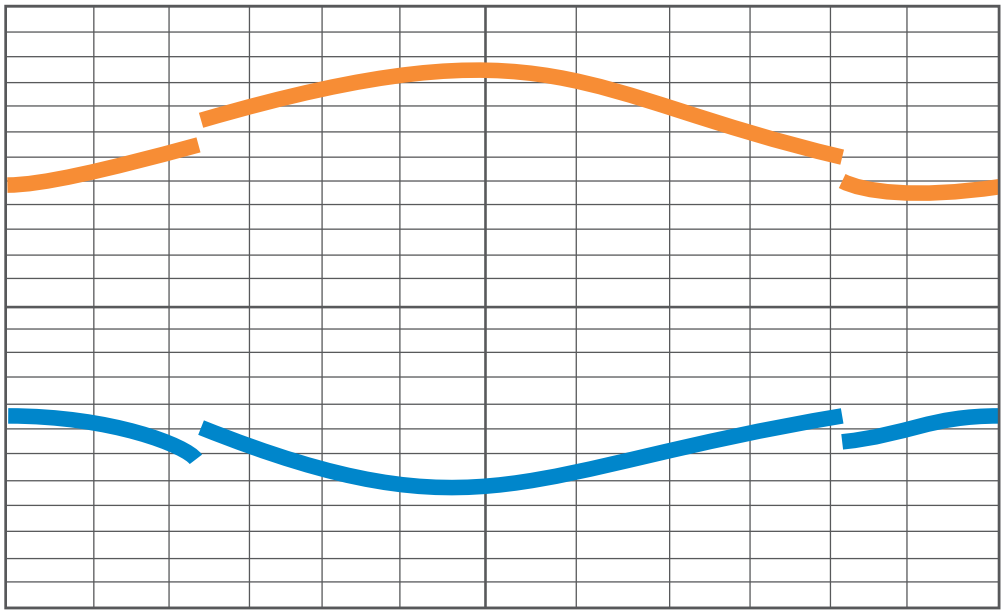

gestalt

This colossal figure in the Superior Bay has been a valuable player in the mining industry of the area. Through the development of transportation and lake freighters, these ore docks are a significant piece in efficient shipment of ore.

On the visit to this relinquished dock, it was difficult to imagine such a dominant figure of the two cities was no longer needed for the area. This thesis will attempt to not only salvage a magnificent structure, but also a meaningful piece of history to Duluth-Superior.

Pedestrian and vehicular traffic activity to date is not allowed on the dock. However, with dwellings integrated into the dock there is a beckoning for public use on the lower and upper-most portions which will provide sufficient distance so that public activity does not disturb residents. The setting on the dock is fairly tranquil with the exception of boats and freighters passing and loading on nearby docks.

The views from these dwellings will provide breath-taking views of the surrounding cityscape and lake that are unattainable anywhere within the city.


HIAWATHA

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The typology of this project is a multi-family dwelling located on an abandoned taconite ore dock in Superior, Wisconsin. The typology will be similar to others but will incorporate adaptive and interactive strategies like those mentioned previously in the case studies. A repeating question throughout this process is “How much is needed?” This question will not prohibit the design to be smaller in terms of square footage, but it will influence the design to feel larger while still relating to the occupants on a personable level.

Most homes entail a place to cook, a place to interact, and a place to rest. These spaces provide for the main functions and activities that satisfy the needs of a human on a daily basis. Any additional spaces may be superfluous to the design but will not be entirely disposed of to offer additional alternatives to the project.

The functional spaces stated above will fluctuate in size as governed by the occupant(s) and their way of living. The overall concept is to have a design strategy that can be applied to varying styles of life. A way of interconnecting and segmenting these functional spaces is going to play a key role in spatial relationships that will demonstrate the flexibility of form and space throughout the dwellings.

Recurring dimensions will reflect the distance between the chutes of the taconite loader. These chutes are spaced twelve feet apart on center. Thus, spacings will be driven by increments of four, eight, and twelve feet to maintain the concept of three’s throughout the design.

The dock runs along a northeast-southwest axis with southwest towards the city of Superior and northeast towards Lake Superior. Sunlight may be pulled from above to accommodate the angle of the dock and to allow for more filtered light into the spaces of each dwelling. Because of the spatial reduction and it may be feasible to split up groupings into

pairings and create clusters acting as small neighborhoods within the larger “dock community” within the larger Duluth-Superior community. The number of inhabitants, like most neighborhoods, is an unknown factor but this thesis provides a plan for the total number of units with limitless possibilities and configurations.

The overall size of the dock will potentially allow for engagement of members from the surrounding community who do not live in this multi-family dwelling to have the opportunity to experience this historic figure during the day while giving 24-hour access to residents only.

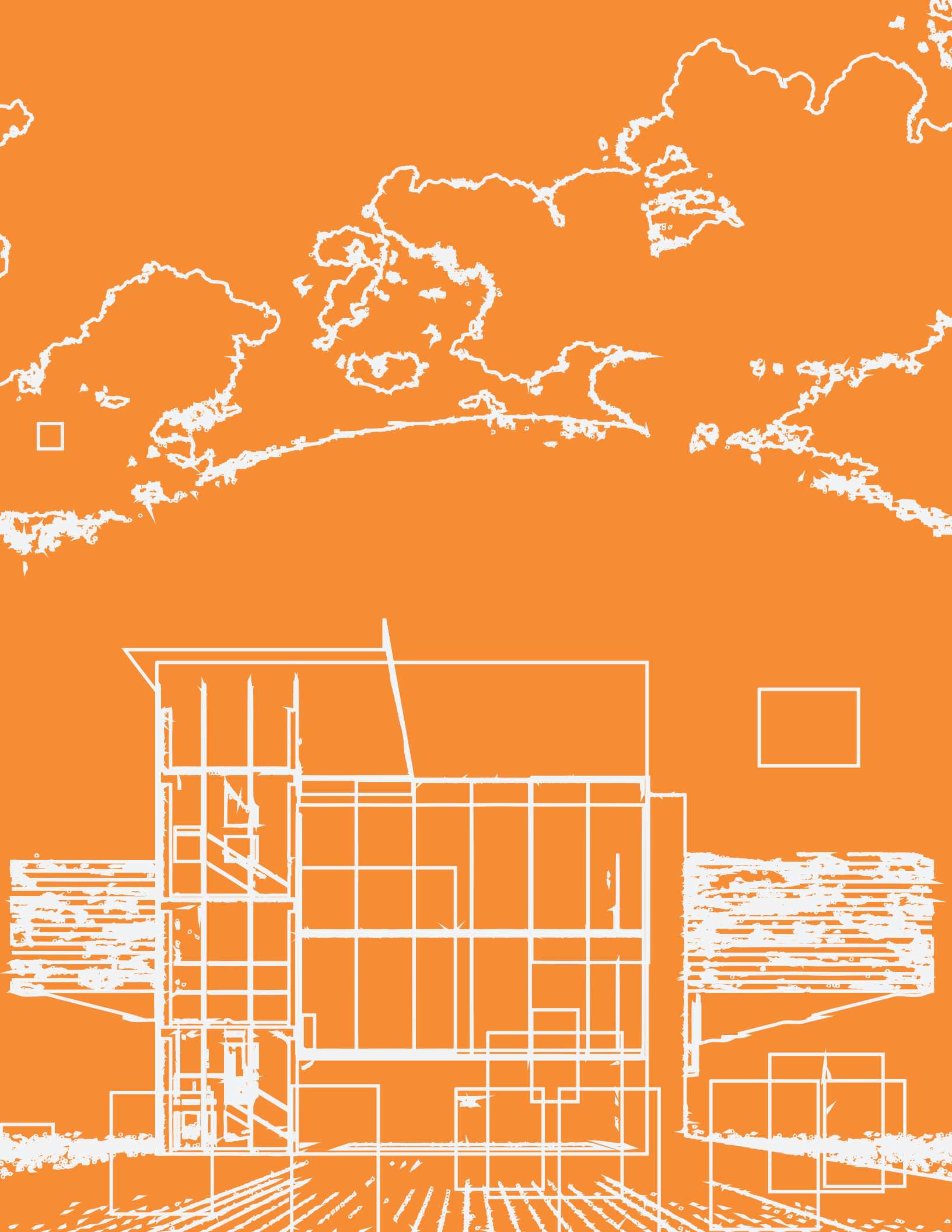
Individual dwellings will strive to bring a sense of place to residents and provide them with a space they can shape into *their* home. This form of engaged living will create healthy living styles for users who inhabit the abandoned dock. On the micro scale, adaptability of the homes will focus on the user’s comfort and style of living. The macro scale will aim at site and environmental adaptability.

The color and material palette of the site will follow closely to the De Stijl movement in that there will be a minimal (preferably 3) usage of varying materials that express their distinct texture and color. No materials have been determined to date, but the red-orange of iron is the first choice that will compliment the blue of Lake Superior.

Nearby ore docks that are in continued use should not cause sound issues, however the large freighters that will load on these docks will need to be accounted for. Also, the proximity of units will determine the partitioning thicknesses between units.

Resident’s style of living will be a driving force behind this design. The design process must be one of forward-thinking quality to accommodate for the needs of future users or new ways of living for existing users.

Total square footage of each initial dwelling is be 24’ x 36’ for a gross total of 864 square feet. Additional space provided measures 12’ x 24’ (288 square feet) and each dwelling can add three to the initial configuration if desire.



design documentation

process

project solution

goals prior to start of design:

flexibility - to people

adaptive - to people and environment

“lightness” on site

materials - lasting, highly recyclable

natural light

green space

blending indoors and outdoors....
....does that make the space *feel* larger?

how much space do we need to live?
....is our comfort infringed?

can a dwelling adapt to suit human needs?
....instead of us adapting to a dwelling.

what does it mean to adapt?

1 - to make suitable to requirements or conditions; adjust or modify fittingly

2 - to adjust oneself to different conditions, environment

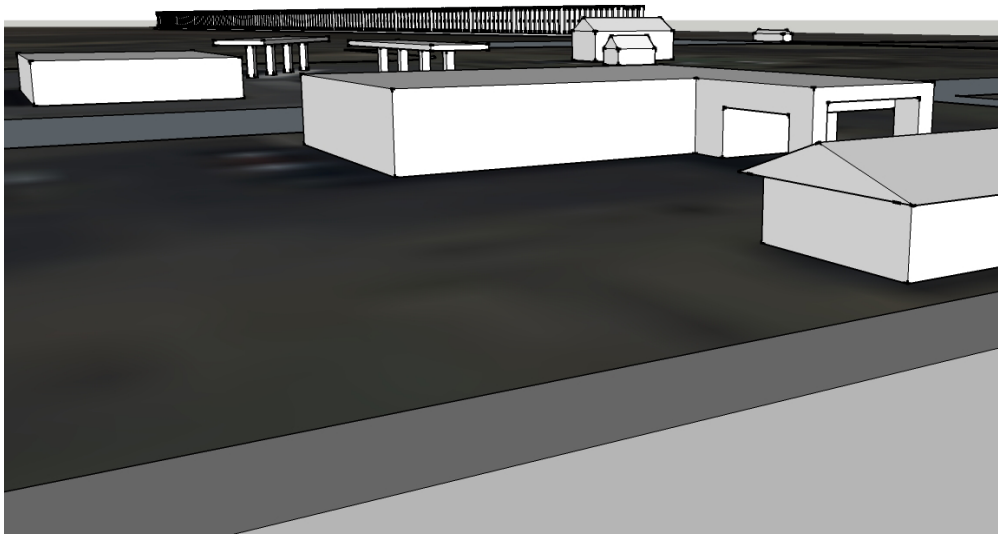
syn - accommodate, alter, change, suit, tailor

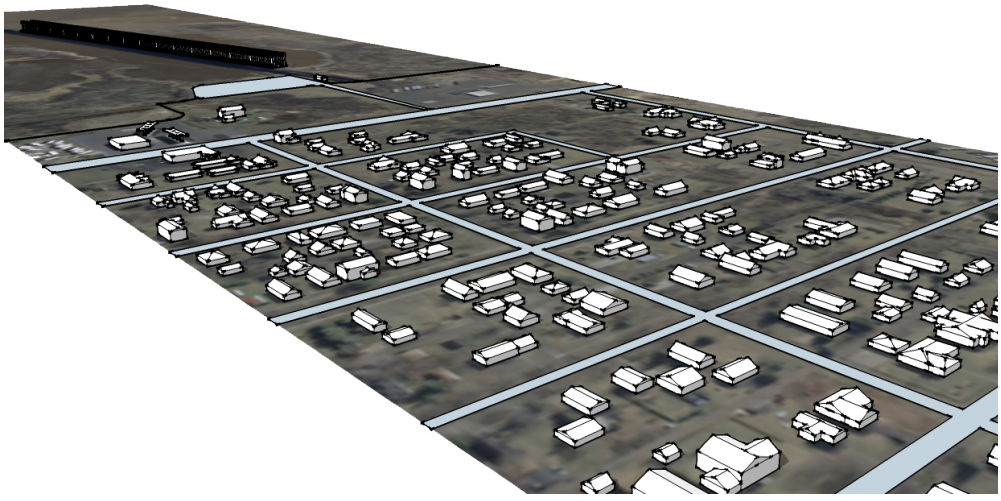
definition courtesy of www.dictionary.com

context

Early stages of the semester involved modeling the site using SketchUp to help understand and illustrate the context of the area surrounding the dock. The dock is encompassed by water on three of the four sides and the overall length provides a strong axis both on and off the water. With the exception of the waterfront properties along the bay, many of the lots shown in the image below are residential properties.

Through this study, it was critical to see the relationship between many of the residential units, property layout, and height of each house. The downtown area is two miles northwest of the site on Highway 2-52.





dock dimensions

The next phase of the project was to learn the dimensions and repetition of the dock structure. This information was then translated into determining the size of each unit.

Length: **1860’**

- 1- 612’
- 2- 600’
- 3- 648’

Width: **60’**

Height: **80’**

- Concrete: 40’
- Recycled Steel: 40’

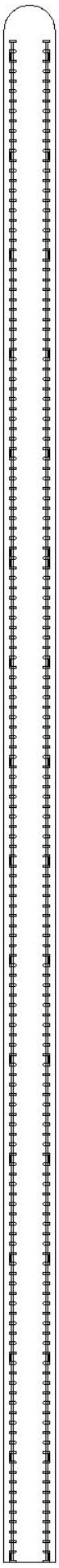
Another aspect was the closed “bays” that appeared every tenth bay.

> Initial intentions for these bays were to use them for vertical circulation or hvac systems

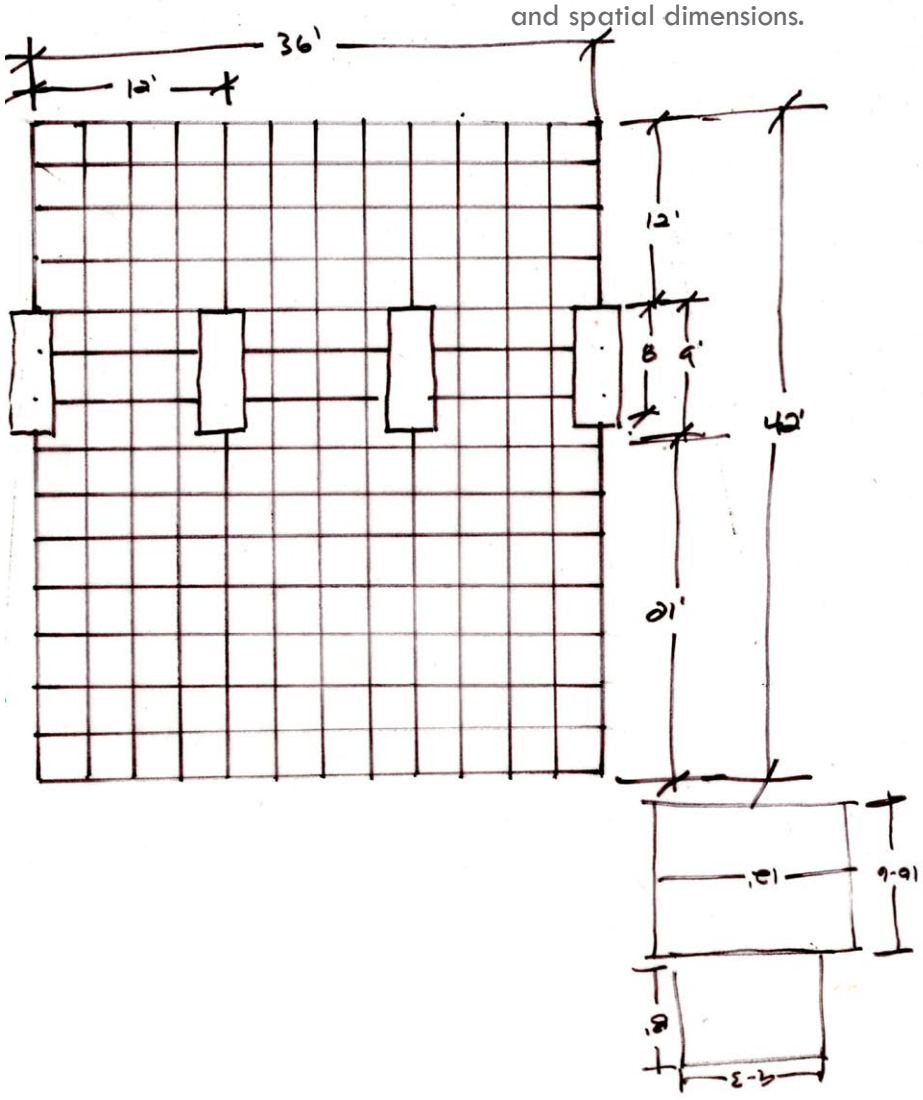
Concrete column dimensions: **8’** (96”) x **2’9”** (33”)

Dimensions between concrete columns: 12’ on-center

Interior dimensions between concrete columns: **33’**



designing on a grid to mimic the repetition of the given structure. This choice was made to allow the dock structure to influence any future decisions in relation to size and spatial dimensions.



structure

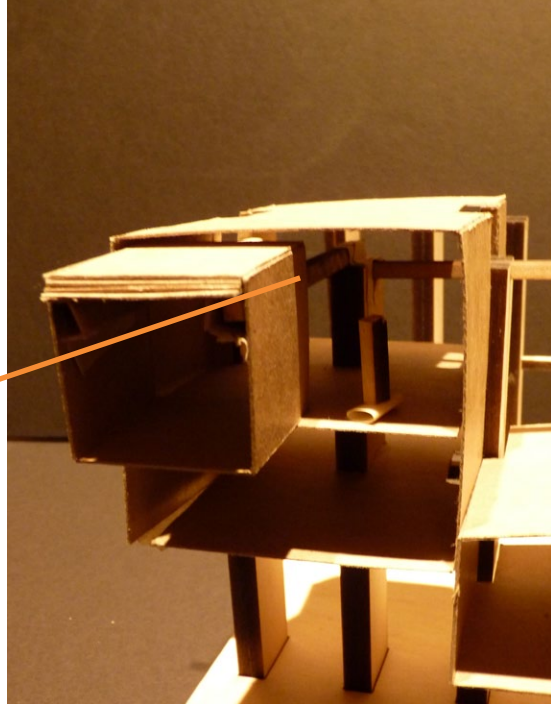
The structural elements changed several times throughout the design process. It was important to use a structure that would allow for the dwelling units to cantilever from the dock and over the water as much as possible.

1 Early stages used an I-beam that would be bolted to the smaller concrete column face. One flaw with this design was that it would stress the column in a way that it was not designed for. An early study model was a strong indicator of this flaw.

2 The next structural system used channel beams bolted to the *sides* of the concrete columns. This would transfer stress loads in a manner that was more fitting to the design of the column. Although this structural system would allow for "placing" units on top of these beams, it did not speak of adaptive re-use. The new structural system should seamlessly integrate the dwellings with the dock and the channel beams did not do that.

3 The final structural design that would evenly hold loads, be easy to construct, and most importantly would seamlessly integrate the dwelling units with the dock was a vierendeel truss system. These vierendeels are 12 feet tall with vertical webs spaced every 12 feet as well. Three trusses comprise one large truss totalling 120 feet, creating a horizontal system that bisects the concrete structure.

1



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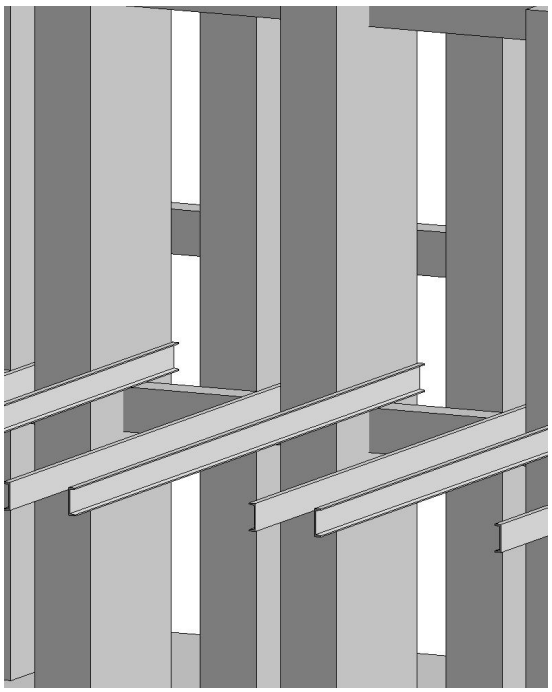

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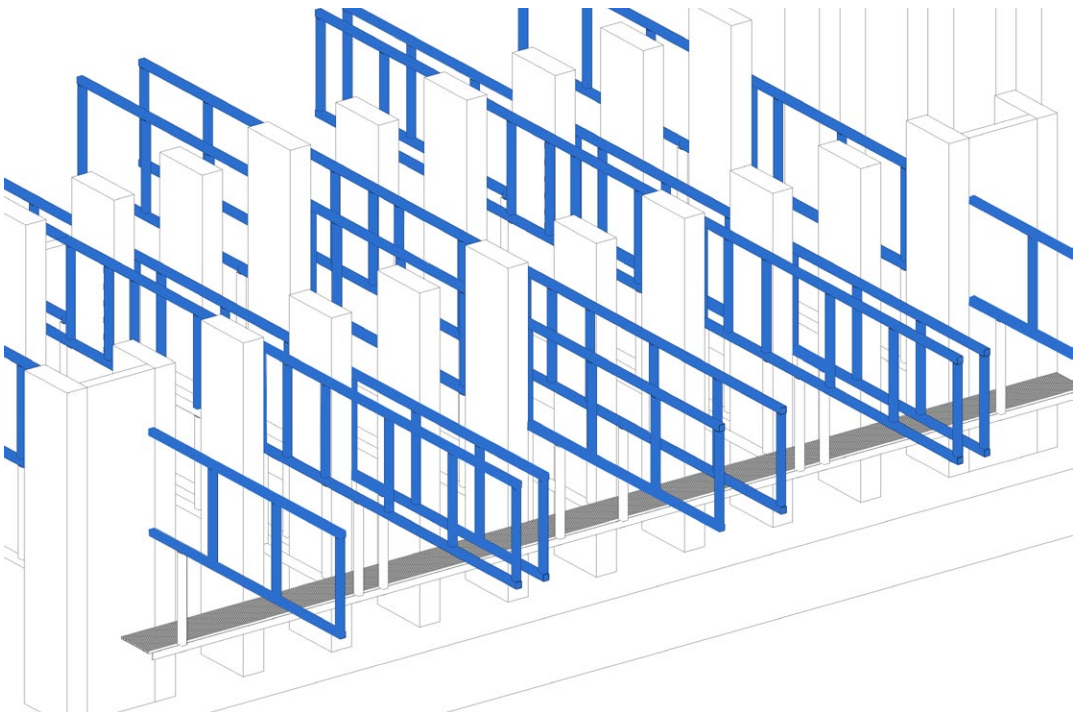
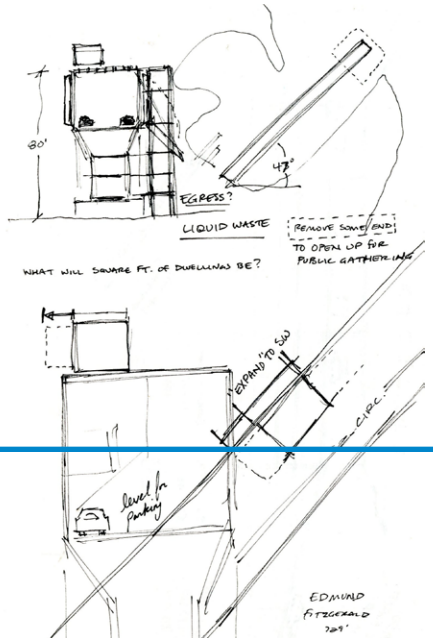


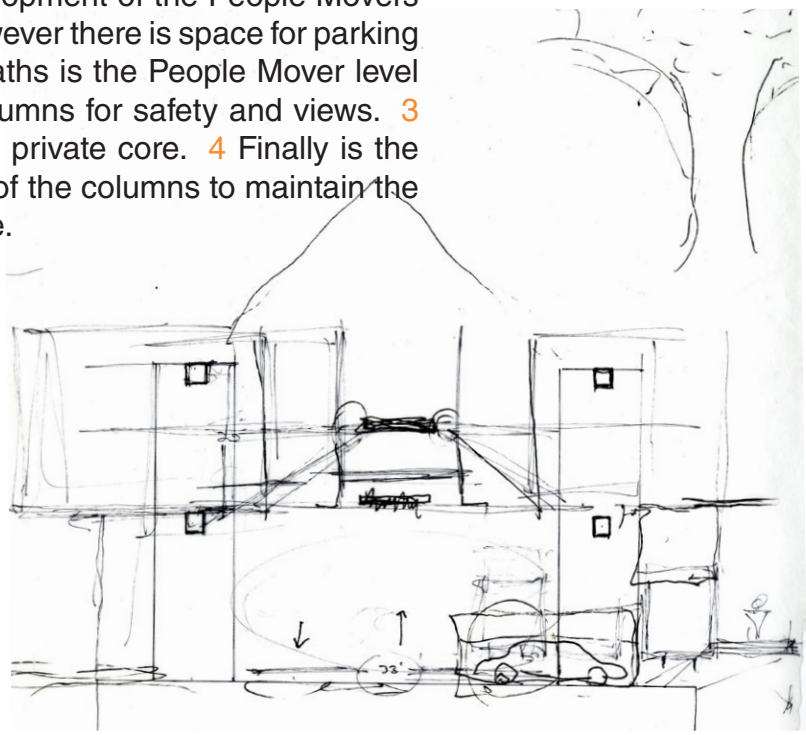
circulation

One of the more challenging parts of this design was implementing a circulation system that was simple and true to the dock. Because the dock is as long as the Willis (Sears) Tower, it was necessary to have a system that was efficient and could be expanded.

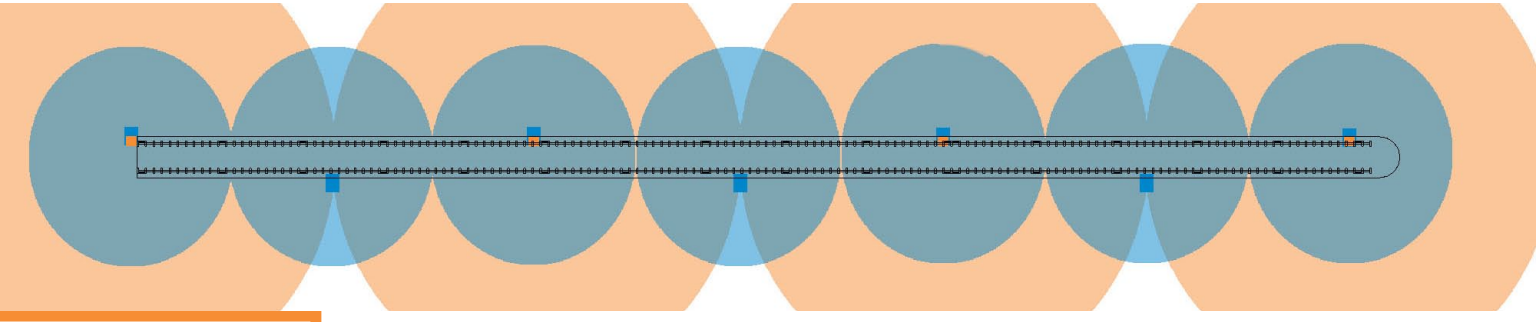


After speaking with the City Planner and Port Division Director of Superior, Jason Serck, one topic that was researched and discussed was Superior's Directions 2035 proposal to have a more efficient system of transportation throughout the city. This thesis incorporates a transportation case study for the city using Parry People Movers. The thesis proposes that by 2035, Superior will implement these modes of efficient transportation that use flywheel technology after studying and improving the system within the dock.

The main circulation cores (cars, People Movers, private and public walkways) are located within the concrete columns and divided into several layers. 1 The lowest level on the dock is intended for cars, although it is the goal that with the development of the People Movers that cars would no longer be needed, however there is space for parking between columns. 2 Above vehicular paths is the People Mover level with foot traffic on the *outside* of the columns for safety and views. 3 The next level is residential with a more private core. 4 Finally is the "High Line" level slightly below the caps of the columns to maintain the view of looking inside the dock to outside.



The circulation study (below) illustrates the points where stairs and elevator cores are located. The maximum walk to a unit from a stairwell is 150 feet while the maximum walk to a unit from an elevator core is 300 feet. Elevator cores are designated at the locations for parks where the dock expanded in 1917 and 1925.



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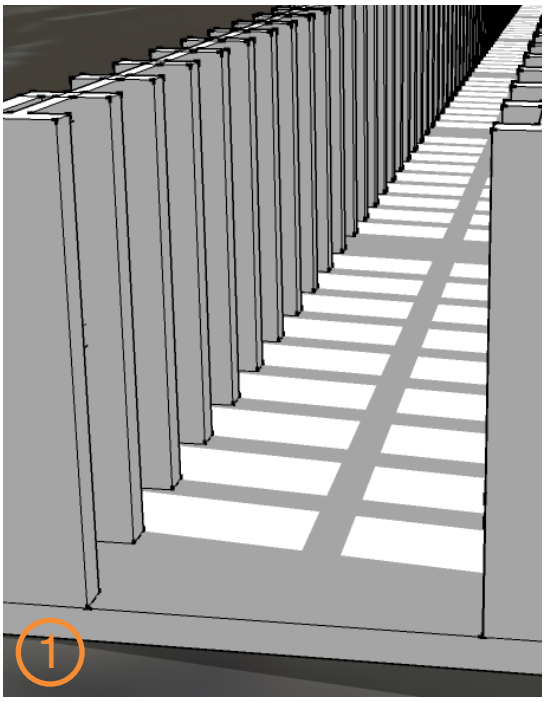
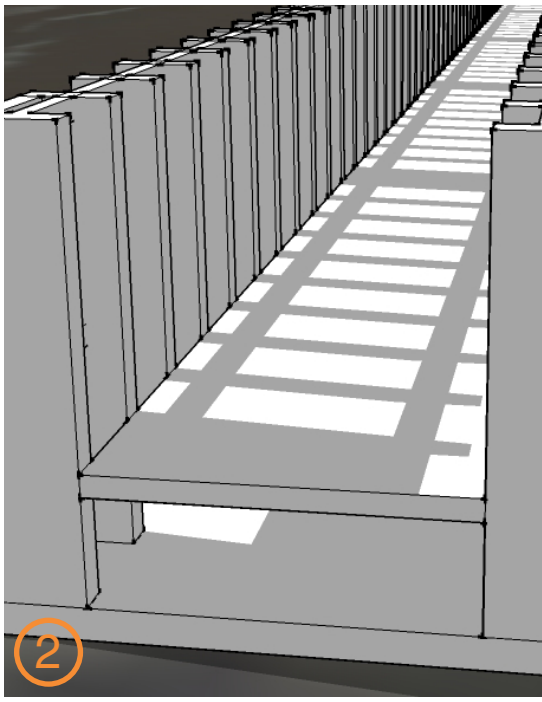
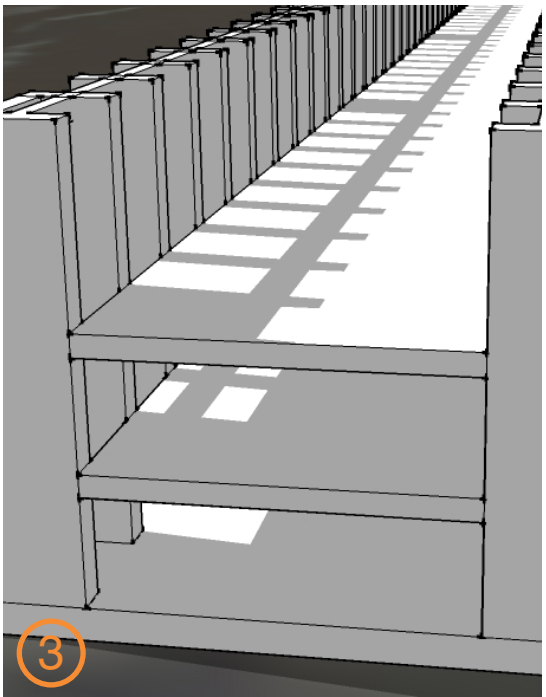
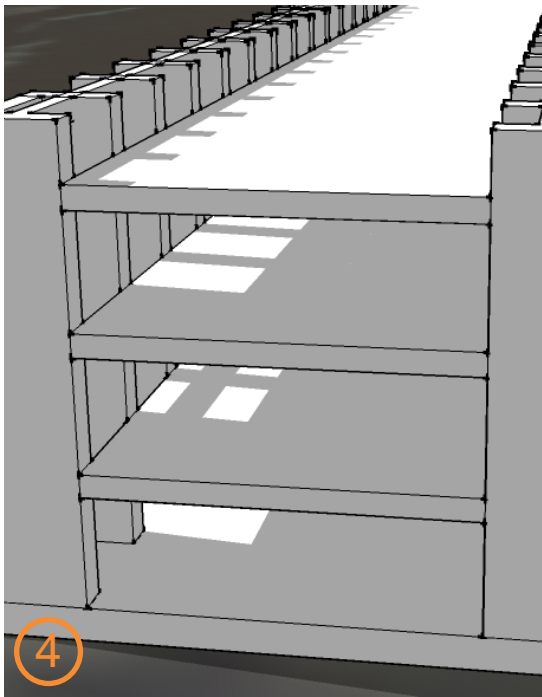




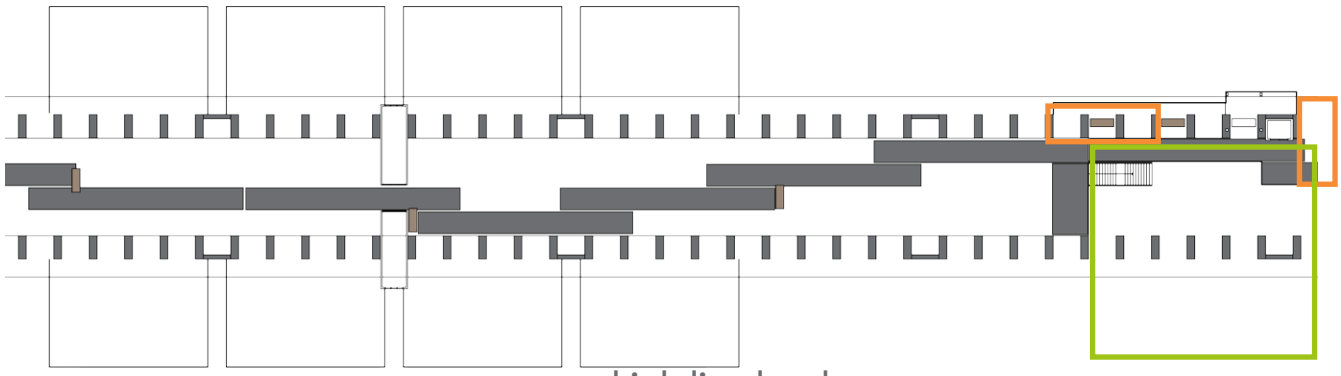




circulation

This longitudinal section shows the layers of the dock including the levels and circulation cores and corridors. This level gives both residents of the dock and visitors a chance to experience this dock in a completely new way. There are four parallel segments where walking paths made of local granite are places. Next to these pathways are a combination of many perennial plants and native grasses.

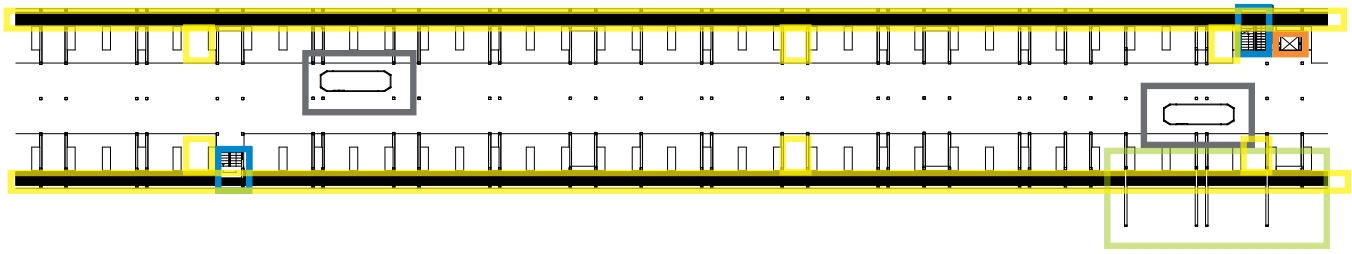
The people mover level functions for both residents and visitors as a mode of horizontal transportation along the dock with walkways along the outside of the concrete columns.



high line level

shops

park



people mover level

park

paths

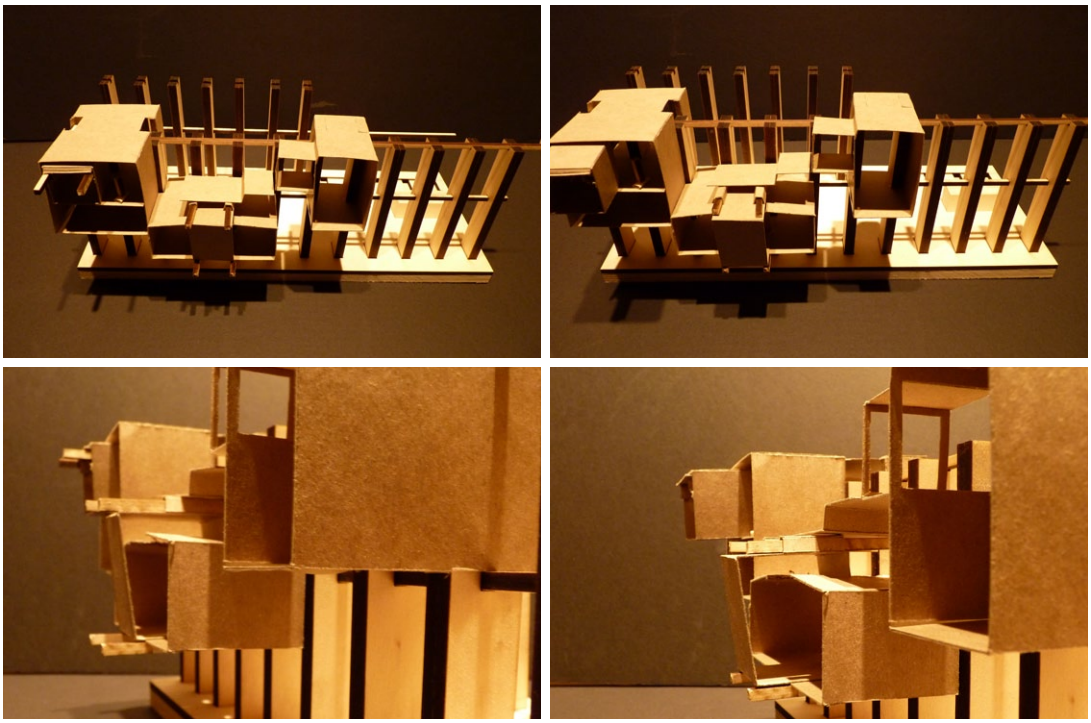
people movers

stairs

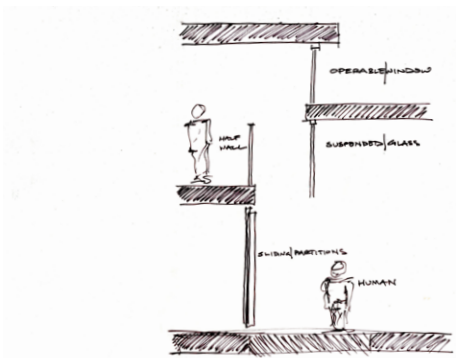
elevator

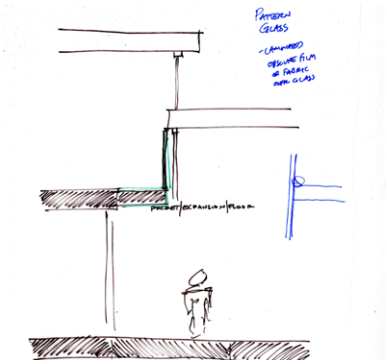
dwellings

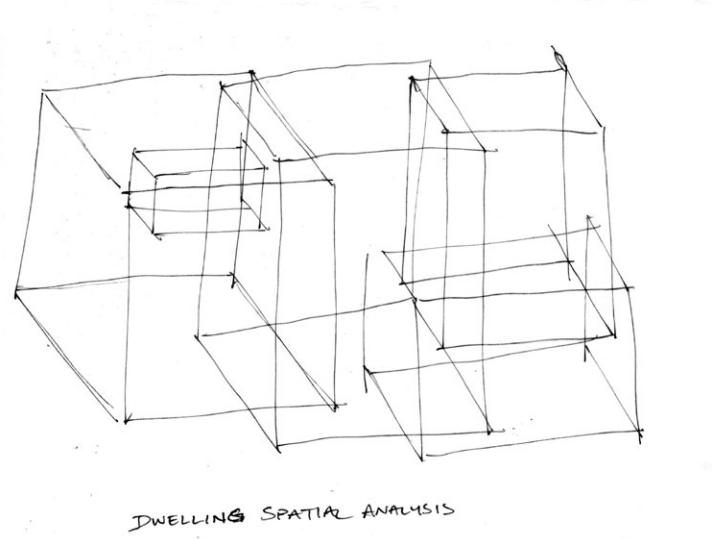
The primary focus of this project was to deliver dwellings that would be able to adapt to both user and environment. An early strategy was incorporating space that would expand and contract based on needs and demands of the user. A model was constructed to illustrate potential units with contracted then expanded space. These expansions would be pushed out away from the dock, increasing the cantilever. However, after a careful study of structure and thermal bridging it was determined that it was not feasible for this climate (yet).



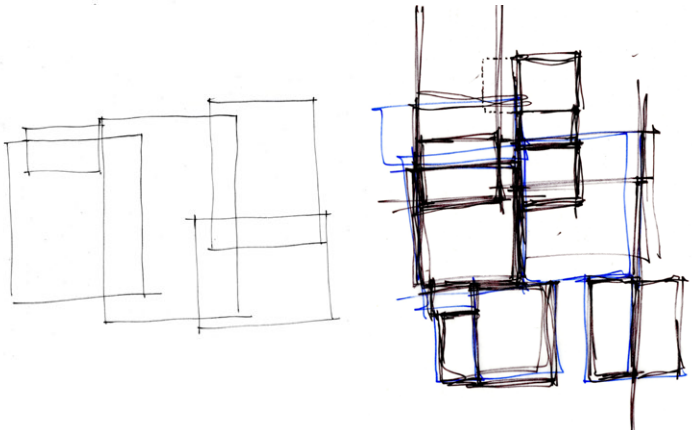
These then led to the expansion and contraction of interior space alone. This would allow each user to move partitions and floors based on what they need, when they need it. The major drawback to this concept was a system that was planned and that loses sight of adaptiveness. It allowed users to change space but to the way it was designed, not freely.





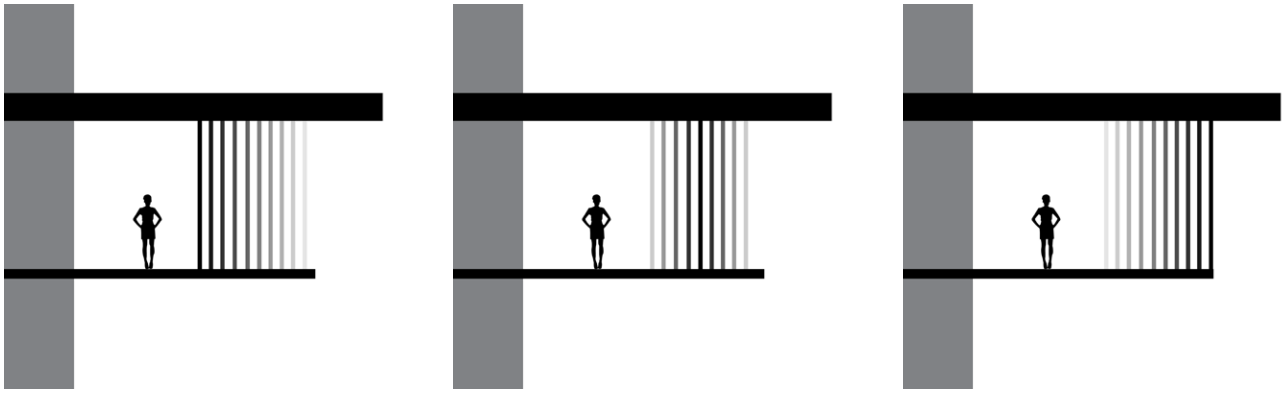


concept of pushing/pulling space to accommodate for expanding and contracting needs of space for each person and family.



translating push/pull concept into floor plans to get a sense of how the adaptive space can be arranged.

this progression demonstrates the concept of pushing/pulling space without being literal and pre-determined like previous models.

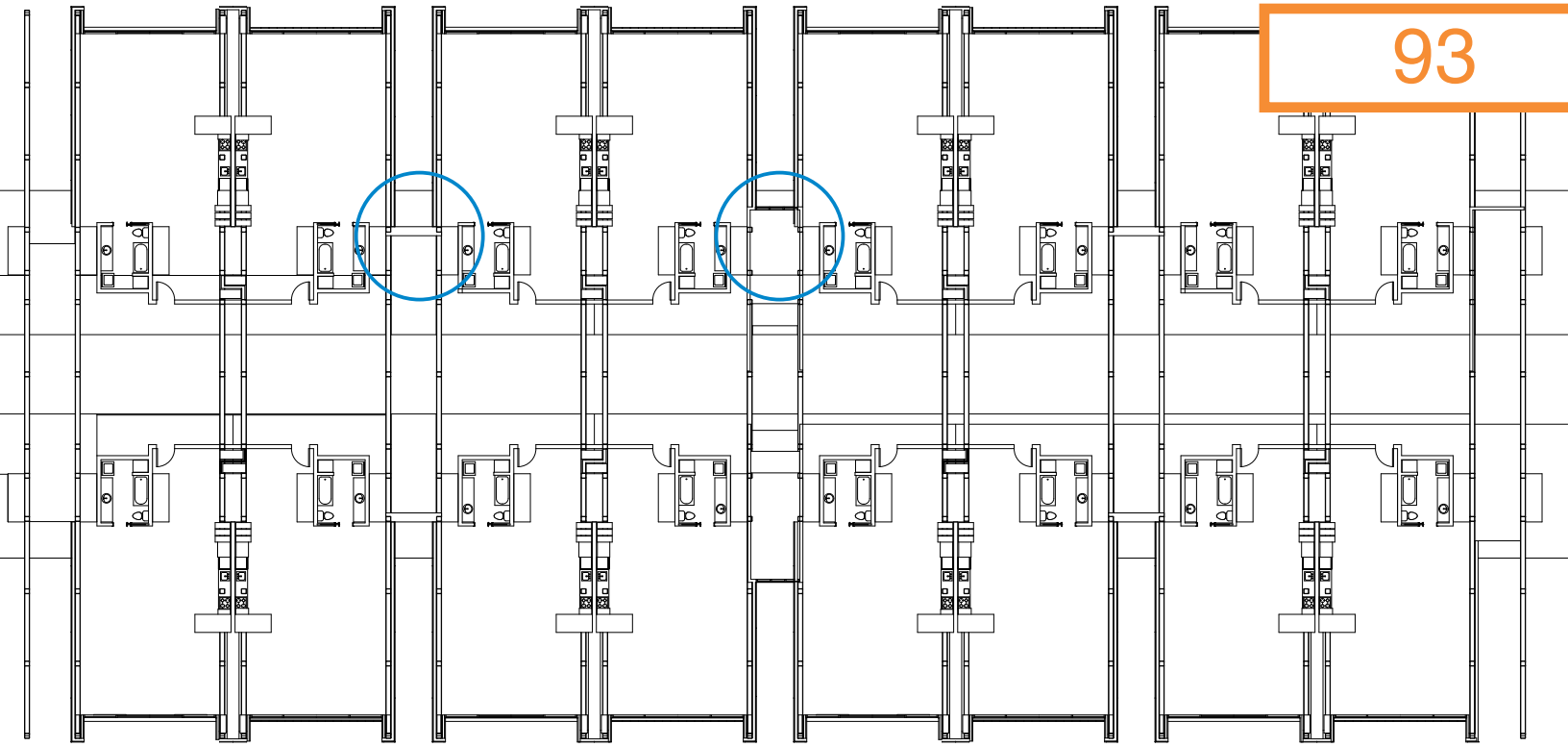


dwellings

As the floor plans progressed, it was critical that the design needed to follow a concept similar to Holl's in that space would be provided and users could transform the given space into space they need. This required an open plan that was beneficial for construction and users throughout the lifetime of the building. The basic elements of a dwelling were determined as a place to live, eat, and sleep.

The design developed into one that would ship components for initial construction followed by shipment of space as a family grows.

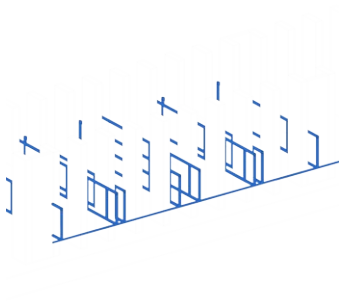
One of the biggest challenges in this project was designing for a single individual but keeping in mind the flexibility to provide for a family. For economic purposes, two units share a wet wall with kitchen necessities and a modular bathroom unit can be "slid" into place on the other side of the entry. The entry of the unit is intimate with a lowered overhang where mechanical and hvac is housed.



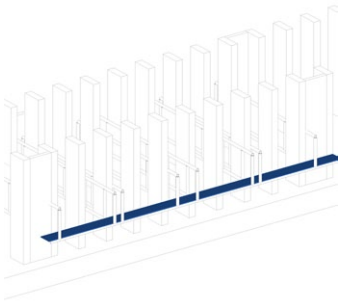
Instead of having all units side-by-side the design utilizes the gap to bring light into the circulation corridor for residents between bays of columns. These moments gave residents peeks out from the interior of the dock.

construction

The images below show the process of components and how each is assembled and constructed on the dock to create an individual unit.

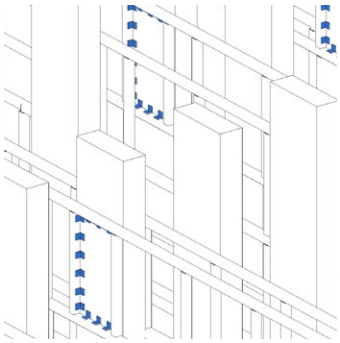


The People Mover vierendeel trusses are put in place. Interior webs create pathways for the movers.

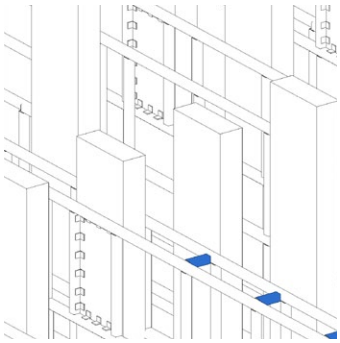


A small six foot extension of the trusses on the outside provides a pathway for pedestrians.

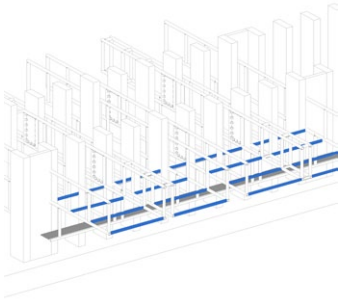
Vierendeels are added above, providing a frame for dwelling units.

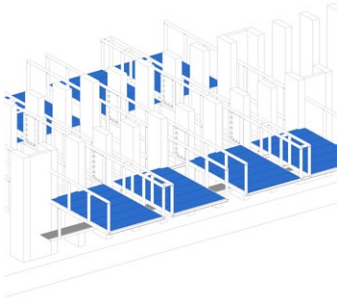


Angled plates are used to bolt the vierendeels to the existing concrete structure.

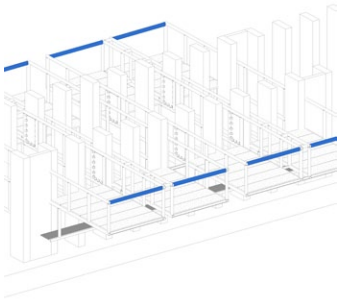


Stiffeners are used to hold neighboring units together and make the structure more rigid.

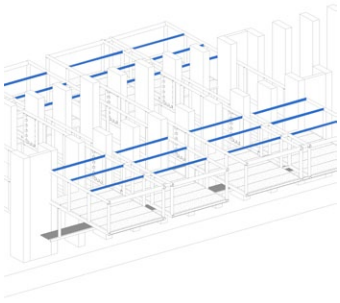


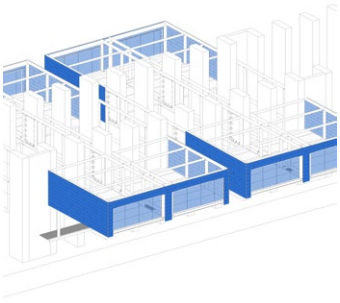


Concrete decks are placed on the beams.

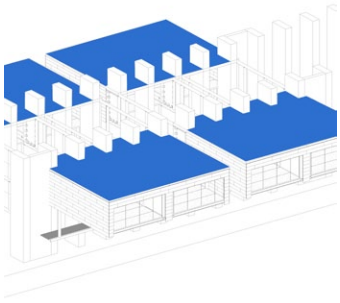


The outside roof beam is larger to increase stiffness to allow for the cantilevered length.





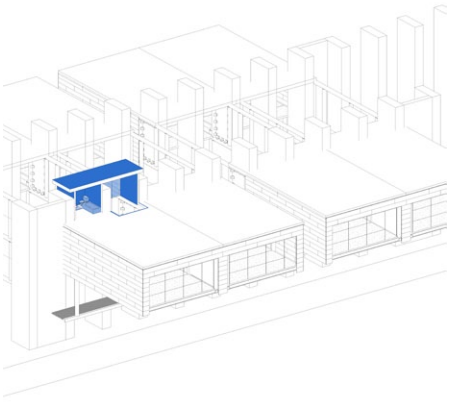
The units are wrapped with zinc panels.



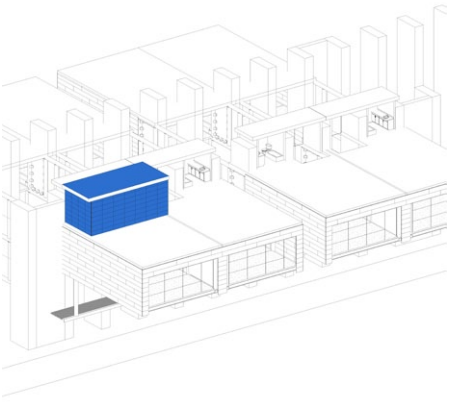
As an individual enters their front door, they are pushed through the entry and immersed into a view from their unit. The exterior glass facade provides a feeling of open and lightness as one is drawn to the edge furthest from the dock. These glass walls are divided into four large sections, the middle two are sliding glass panes. When opened these give users a sense of outdoors flowing in.

construction

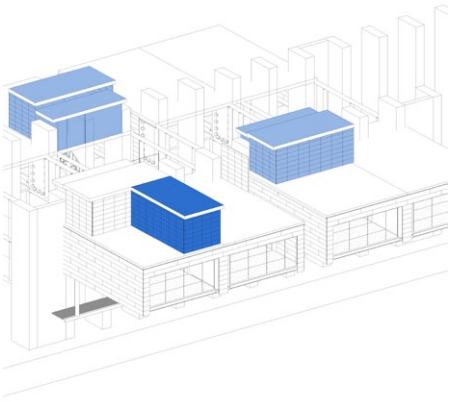
These images illustrate the process of construction for units when an individual or family chooses to expand and contract. Each dwelling will be able to accommodate for the expansion of a family with added modules placed above the starting unit.



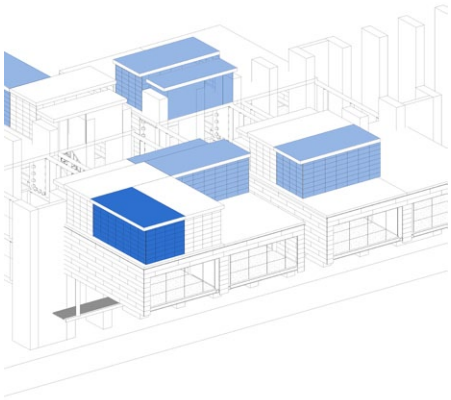
The bathroom module and vertical circulation space are added.



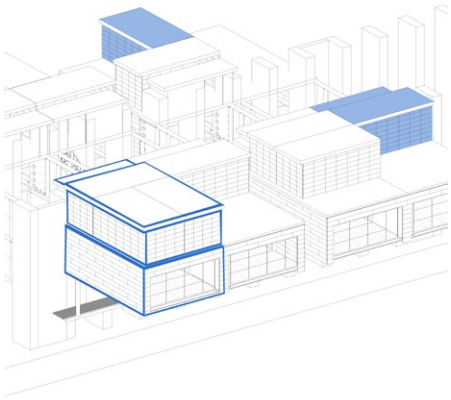
An additional space module is placed near the bathroom.



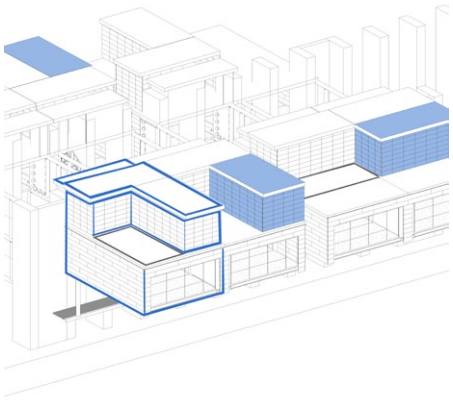
Another module is added.



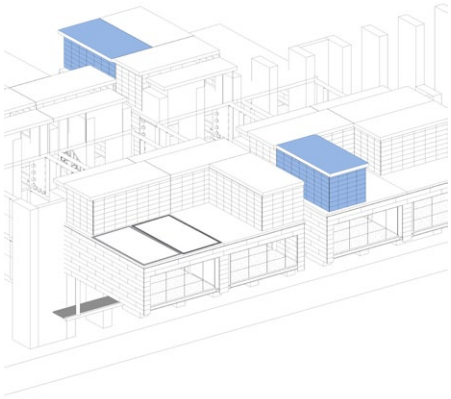
The final module is added on.

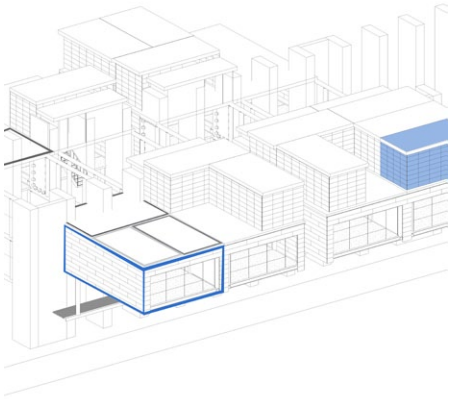


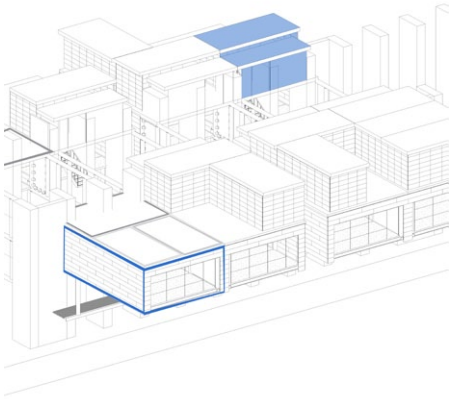
This unit is now fully expanded.

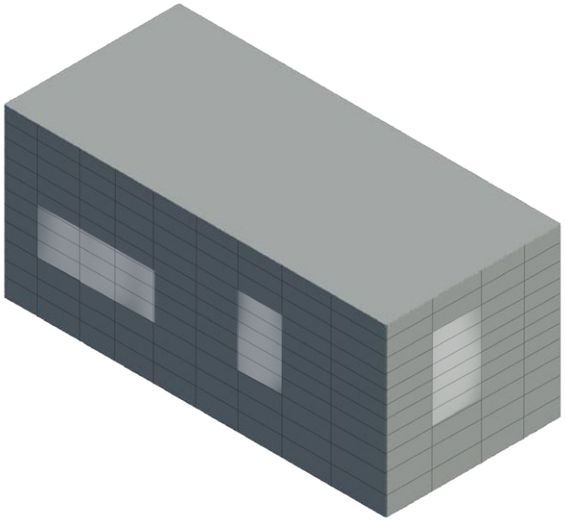


This image shows the unit begin its decline.









additional module

This module is dimensioned to fit on a double-step flatbed trailer that can easily be shipped to the site and set in place by a barge crane. The bathroom and vertical circulation modules are sized to fit within the first additional module for easy transport.

This expansion and contraction of space happens all along the dock making it organic, never having the same appearance...

...all of which is possible based on the users.

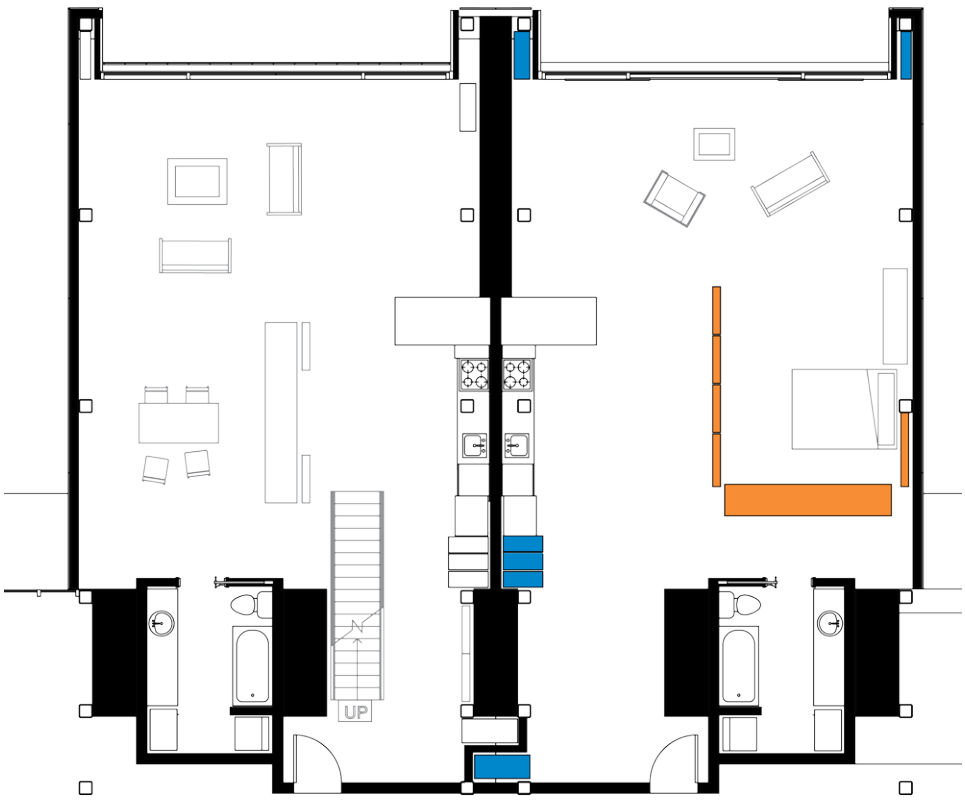
movable partitions

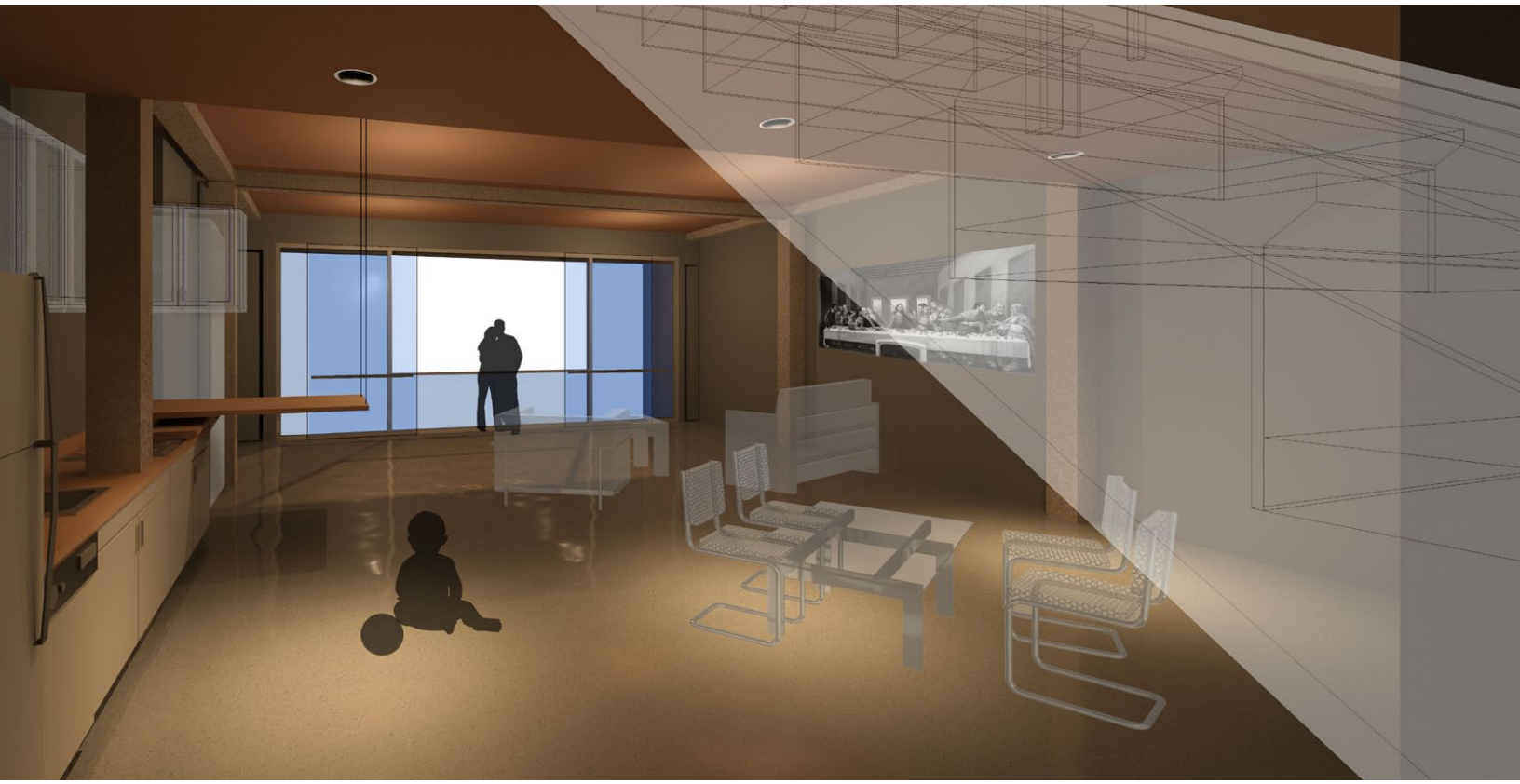
By using lightweight movable partition walls, users are allowed to transform the given space and make it space(s) that they need. This gives inhabitants the freedom to live in space that better suits their needs.

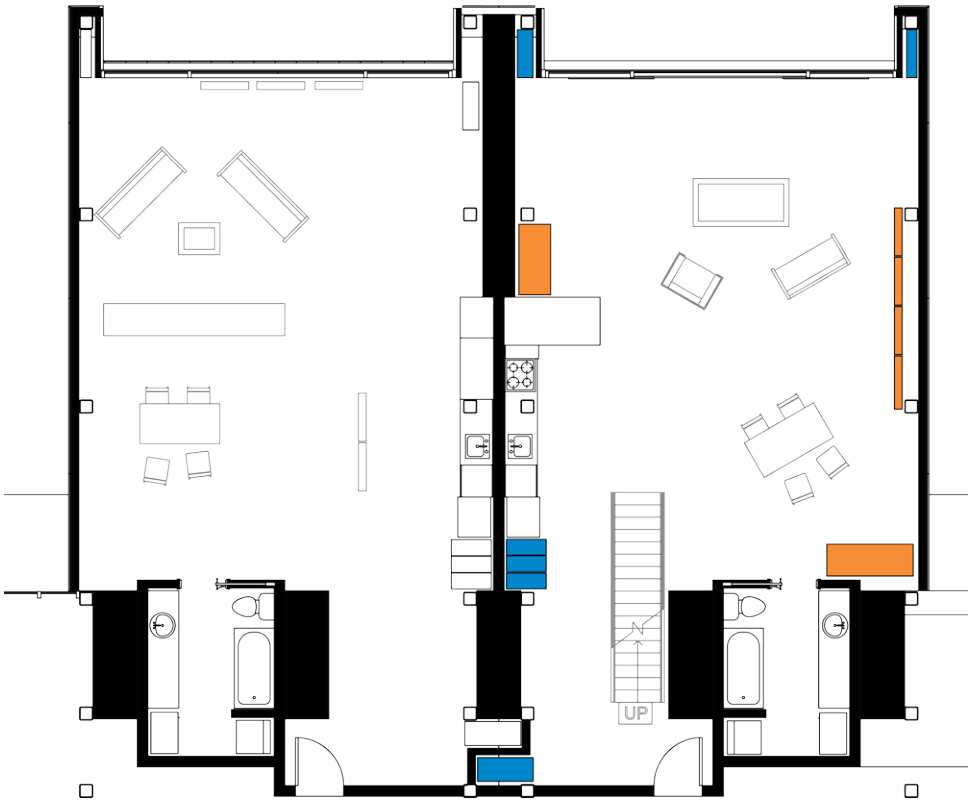
The season, weather and time of day can also influence a user's configuration and arrangement of walls and space. These walls are key components to the unit that promote user interaction and long-term use, but more importantly are adaptive to new occupants as well.

dwelling evolution

These images show the difference living style of a single individual and a small family. The floor plans and units are the same, the adaptability of the unit allows for both instances to occur. A planned expansion accommodates the potential need for each user in vastly different living situations. Each unit is designated with movable partition walls that give users the opportunity to create space they need and want with hidden storage and cupboard space.






UP

materials and sustainability

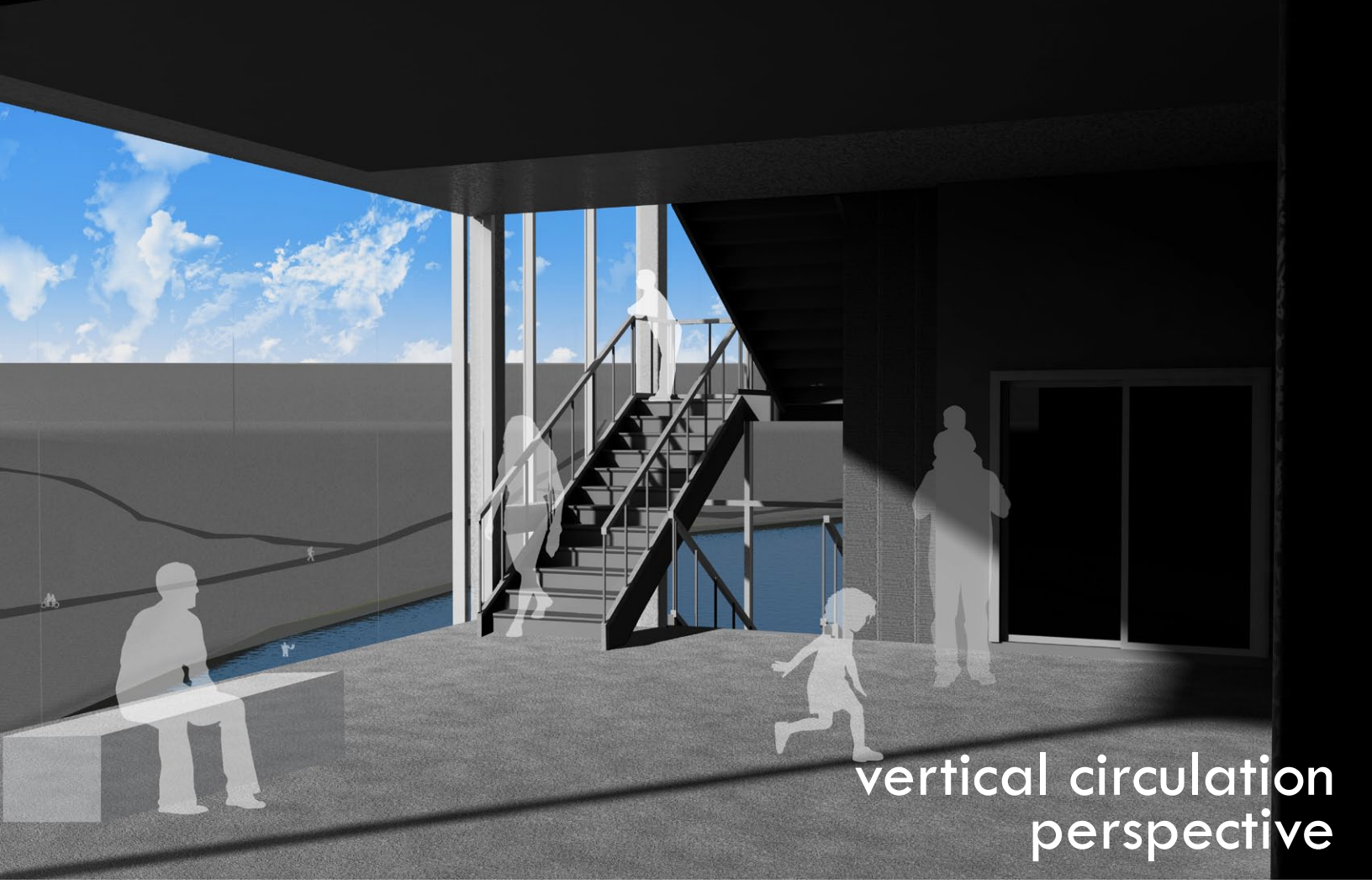
Many materials and functions of this project are implemented and designed to last far beyond the average lifespan of a building. Below are a few key points that demonstrate sustainability within this project:

1- people movers used to quickly transport people horizontally throughout the dock. These are integrated into the site as a case study for Superior's Directions 2035 proposal for an improved traffic management.
2- perennials (per|through, annus|year)the high line level features several layers of vegetation and color, including switchgrass. Switchgrass can grow to be several feet tall and capture carbon dioxide. They are low maintenance and have the ability to outcompete weeds.
3- local granite is used to create the paths that weave between the perennials and switchgrass on the high line level. Over the course of time, the granite and vegetation will begin to overlap and merge with one another similar to the surrounding area.

4- flyash is used as an aggregate in the concrete decking. This flyash will be captured during the steel-making process for the vierendeel trusses and shipped together.
5- zinc is the material used on the skin because it is long-lasting (200-300 years), it is able to resist corrosion in this environment, and is nearly 100% recyclable.
6- recycled wood from a local abandoned mill is reused throughout the units to cover hvac and plumbing components above the entries.
7- existing dock is 1860 feet in length, made entirely of concrete. The reuse of this structurally sound dock helps bring interest this iconic city figure despite its forty years of inactivity.

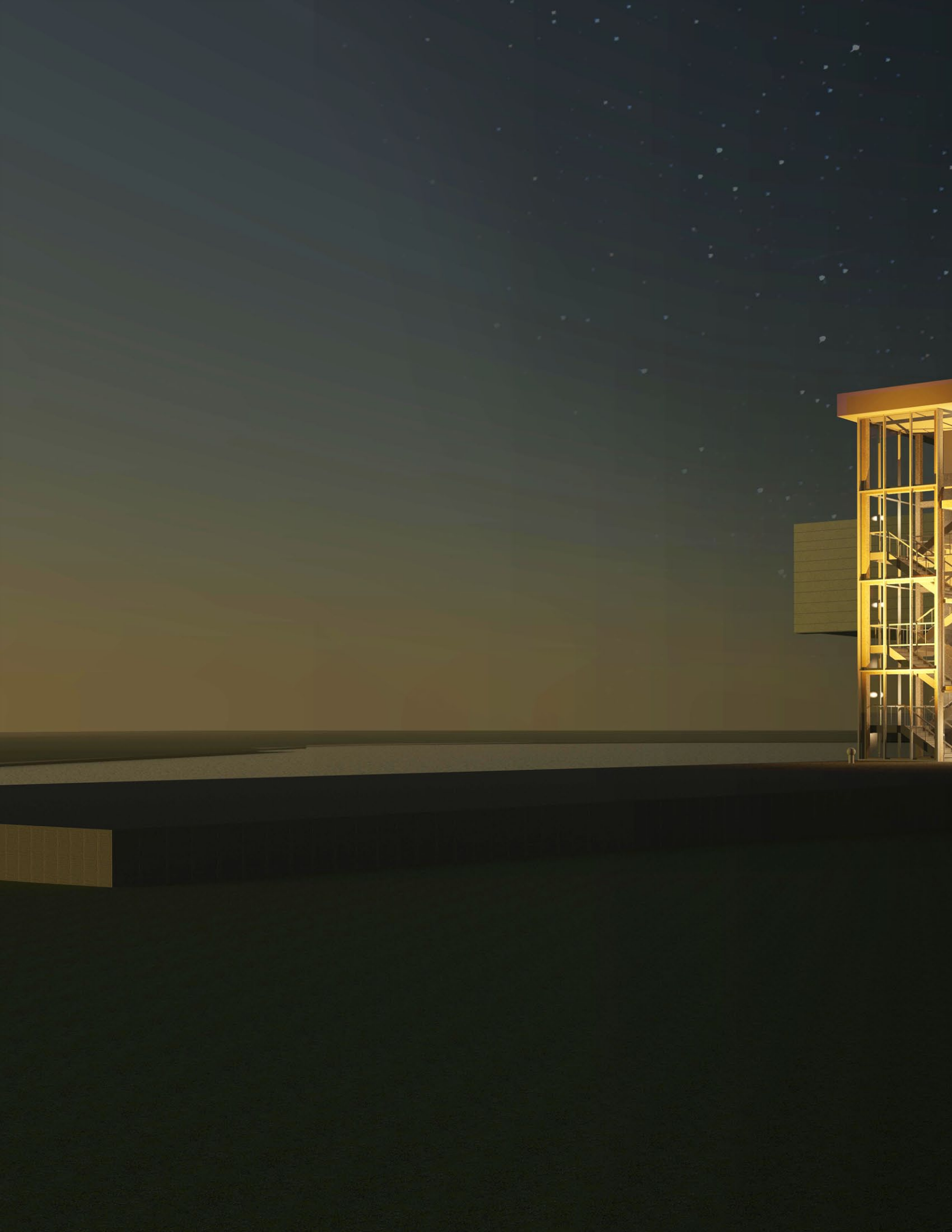

2
6
7

entry perspective



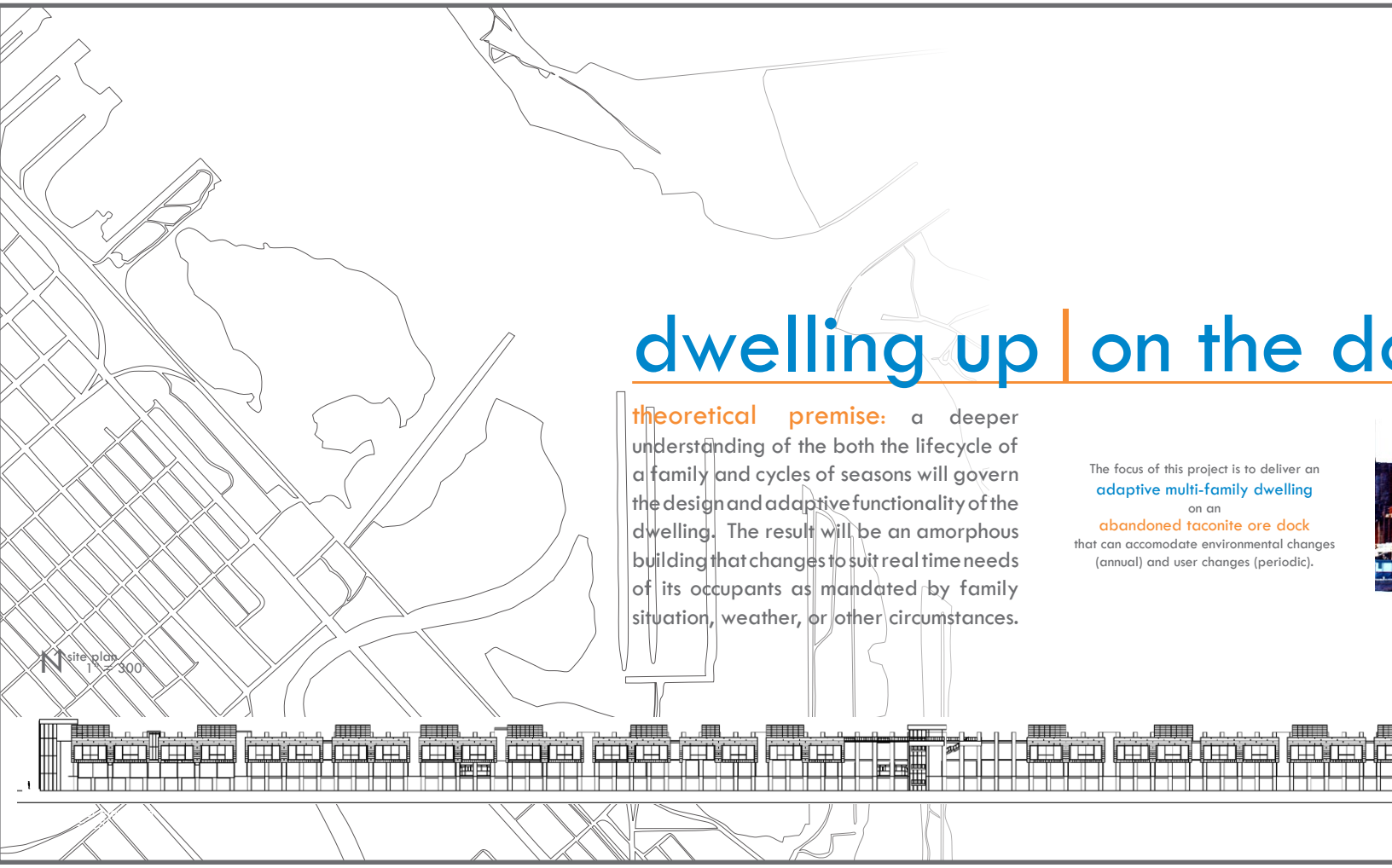
vertical circulation perspective

stair core



evening perspective

end of dock perspective



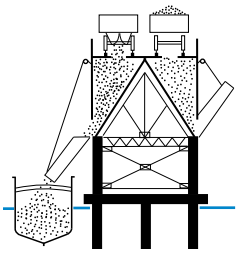
dwelling up | on the d

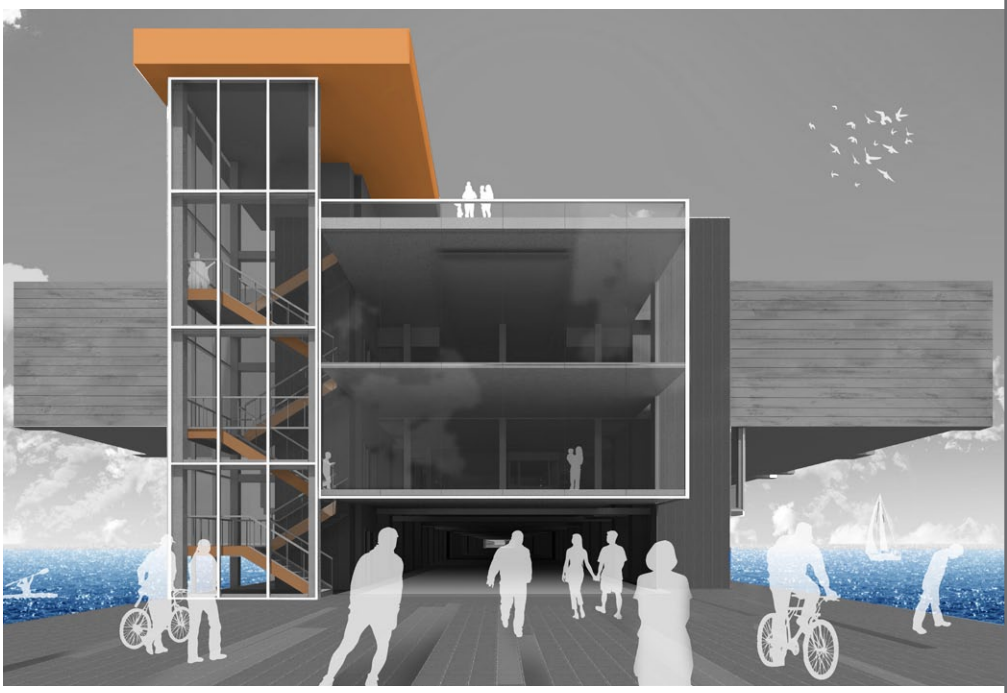
theoretical premise: a deeper understanding of the both the lifecycle of a family and cycles of seasons will govern the design and adaptive functionality of the dwelling. The result will be an amorphous building that changes to suit real time needs of its occupants as mandated by family situation, weather, or other circumstances.

The focus of this project is to deliver an
adaptive multi-family dwelling
on an
abandoned taconite ore dock
that can accomodate environmental changes
(annual) and user changes (periodic).

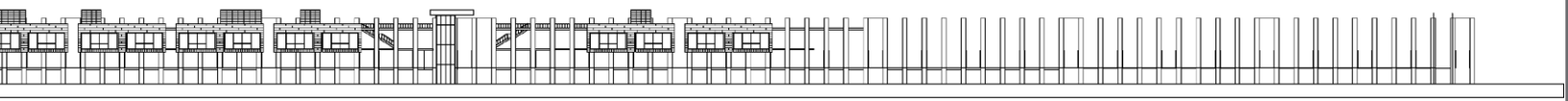
N site plan
1" = 300'

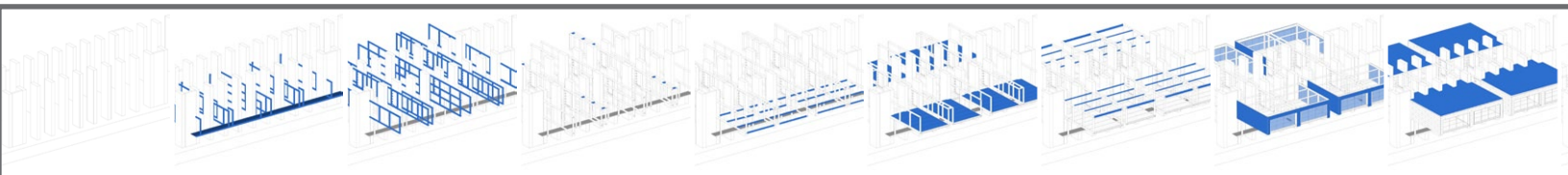
ock



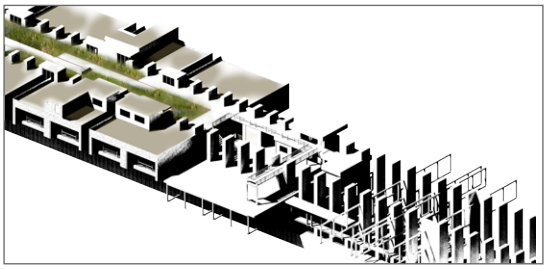


entry perspective

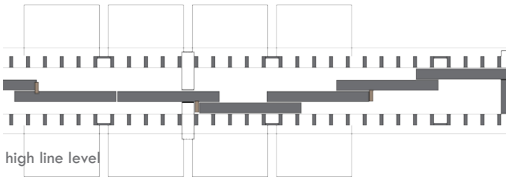




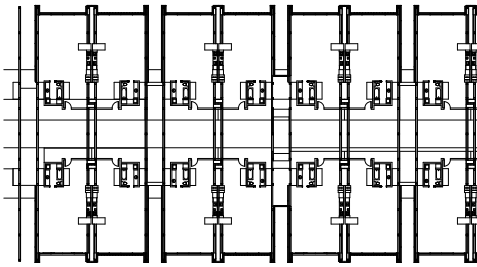
dock development process



birdseye view of high line and park

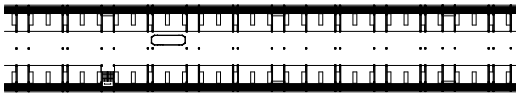


high line level

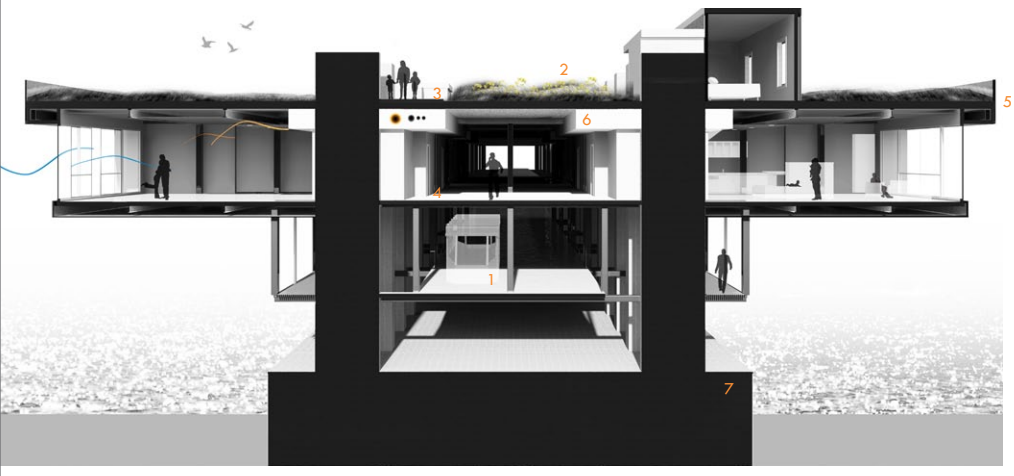


residential level

longitudinal section perspective



people mover level



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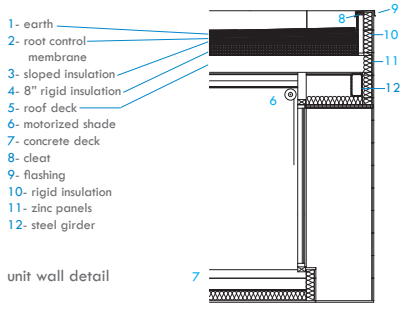
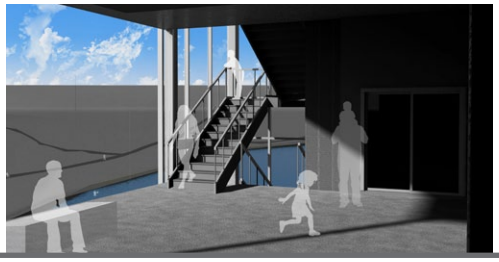
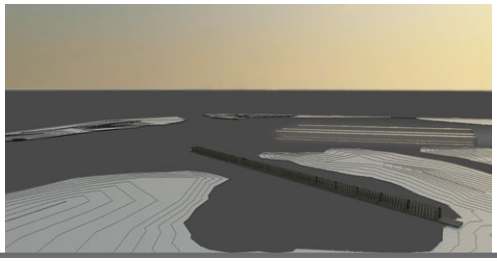


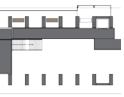
unit wall detail

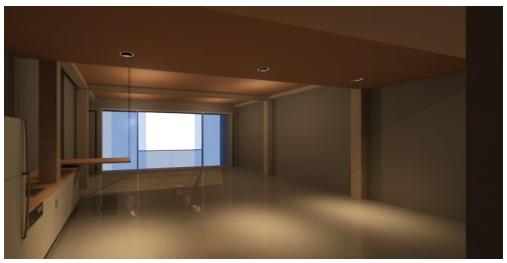
Jared Weismantel
Professor Mark Barnhouse

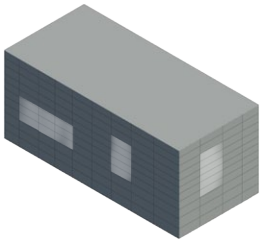
Revit Architecture 2011
AutoCAD 2011
Adobe CS5
InDesign Photoshop Illustrator

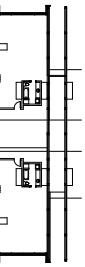




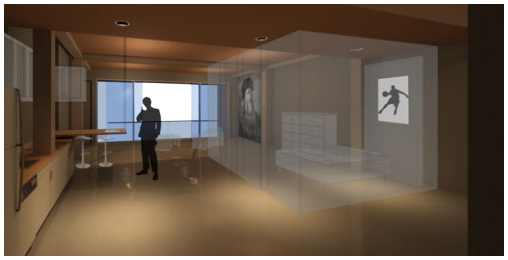


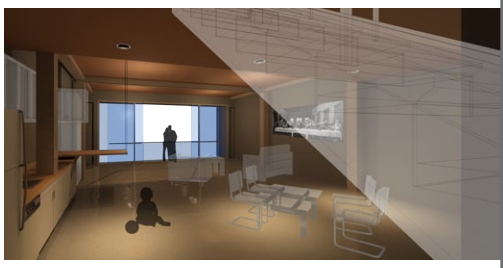


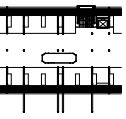




The open plan and movable partitions encourage occupants to use the components of their dwelling in a way to create space they want and need. Seasonal changes can influence the composition of a unit tailored to the desired setting. Because the square footage of each unit is lower than a traditional dwelling, storage space is enhanced with hidden or deepened closets.

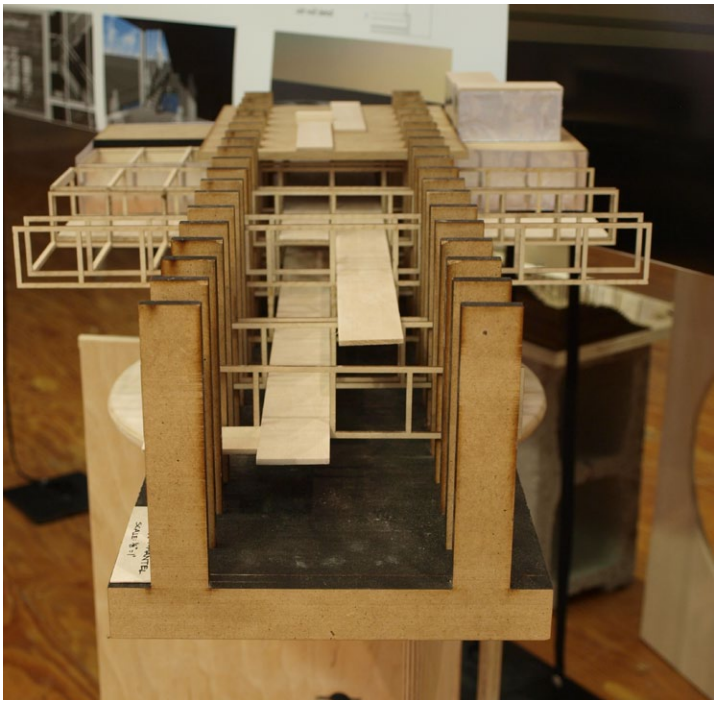


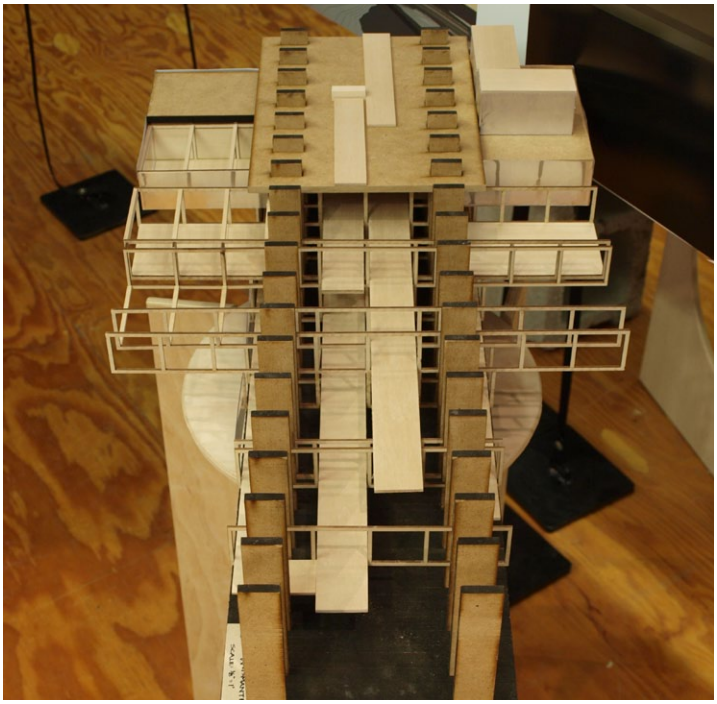


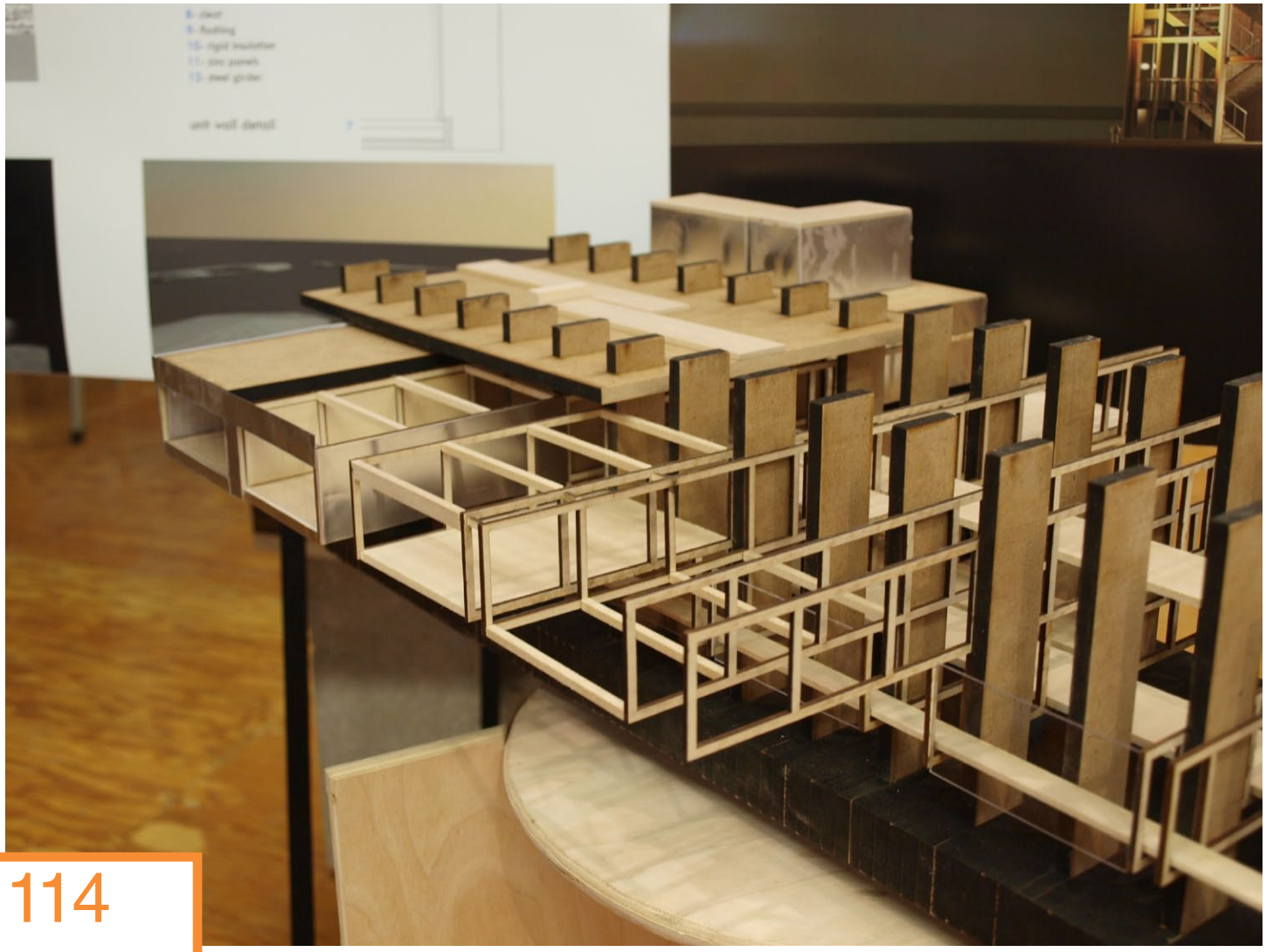


Over the course of time, a family may experience a growth or decline. This is accounted for through additional modules dimensioned similar to those of the ore cars that were once a key component on this dock. Units are able to add-on up to three additional modules, the first of which includes the stairwell and bathroom shipped within the module itself.

installation







115

dwelling up | on the dock

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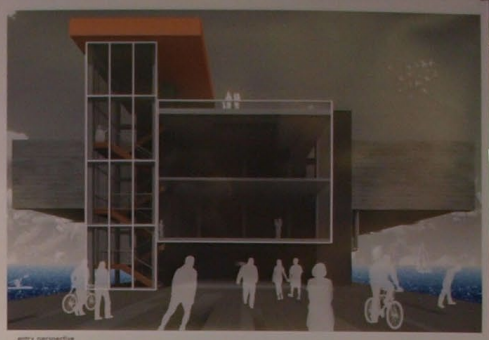
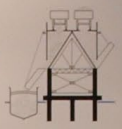
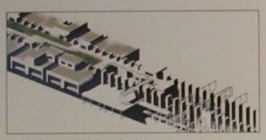


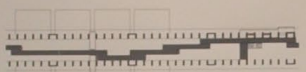
entry perspective



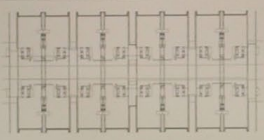
dock development process



birdseye view of high line and park

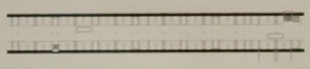


high line level



residential level

longitudinal section perspective



people mover level

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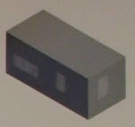
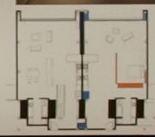
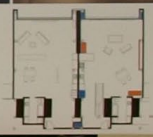
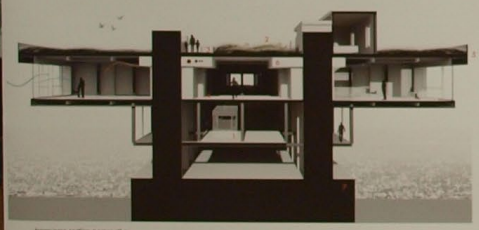
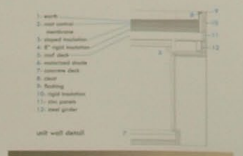








transverse section perspective



unit wall detail

reference list

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Temperature statistics courtesy of:
http://www.climate-charts.com/USA-Stations/WI?WI478349.php

Precipitation and Snowfall statistics courtesy of:
http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?wi8349

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hometown: Watertown, SD

My goal as an architect is to show the ability to bring creative and innovative solutions to the built environment.