

2015

# Building for the Future: Revitalization through Architecture

Rebecca N. Perry

University of Massachusetts - Amherst, rnperry@art.umass.edu

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BUILDING FOR THE FUTURE:  
REVITALIZATION THROUGH ARCHITECTURE

A Thesis Presented

By

REBECCA NICOLE PERRY

Submitted to the Graduate School of the University of  
Massachusetts Amherst in partial fulfillment of the  
requirements for the degree of

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May 2015

Department of Architecture

BUILDING FOR THE FUTURE:  
REVITALIZATION THROUGH ARCHITECTURE

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Approved as to style and content by:

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Kathleen Lugosch, Chair

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Ray Mann, Member

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Stephen Schreiber  
Chair, Department of Architecture

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## ABSTRACT

### BUILDING FOR THE FUTURE: REVITALIZATION THROUGH ARCHITECTURE

MAY 2015

REBECCA NICOLE PERRY, B.S. KEENE STATE COLLEGE  
M.ARCH UNIVERSITY OF MASSACHUSETTS AMHERST

This thesis focuses on the revitalization of a once thriving manufacturing city, Gardner, Massachusetts. In the past the city of Gardner was rich with furniture manufacturers. Over the years the manufacture of furniture has left Gardner. The goal of this thesis is to reinvigorate the furniture making and craft back into Gardner. The proposed revitalization of the town was furthered through teaching and the design and production of a new product line. The renovation and retrofit of an existing now abandoned, building. Designing to meet the strategies, methods, and processes of furniture production; merged with an architecture meant to signal both respect for the history of Gardner and a new revitalization; designing from the inside – out.

Thoughts about sustainability and environmental design are incorporated into the design. There are a multitude of new building practices and strategies that are explored and will be used to try and form a design that could unite usability, function, aesthetics, and comfort as well as meeting current code and ADA requirements, through retrofitting an existing building. Teaching the former craft of furniture making will ignite revitalization in the downtown area. A new form of universally designed furniture making will be taught and practiced in the facility.

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# CHAPTER I

## INTRODUCTION

### 1.1 Intent

The intent of this thesis is to revitalize a once thriving manufacturing city through teaching and sustainable practices. I plan to retrofit an existing building in Gardner, Massachusetts for a furniture school and a work/live complex. I wish to invigorate the craft of furniture making into the surroundings and to bring back what was once the source of Gardner's booming economy.

### 1.2 Objectives and Goals

The thesis topic has been emerging over the course of the research. The articles and books that have been read so far have intrigued and interested the progression of the research towards the final thesis topic. The main objectives are to have a facility to teach the furniture making craft and also to produce furniture in Gardner. At one time that sense of handcrafting was instilled into the residents of the city as a sense of pride and accomplishment. It meant a lot to the city that they were recognized as a furniture manufacturing leader in Massachusetts. The values that are associated with making things by hand is something that gets lost in the present because of societies new dependence with technology. The digital world has emerged with a great overbearing reach that threatens aspects of the natural physical world. People can lose sight of nature and physical products. Immersion into the digital world can obscure what is right in front of them. A deep rooted necessary commodity and work force has vanished from

Gardner. It is the goal of this thesis to offer a path to bring some of that back, both through physical and emotional avenues.

Being environmentally conscious is a main goal of this thesis through the retrofit of an existing building that is in great need. The building has a lot of potential and fits within the parameters of the thesis. Those parameters will be focused on later in this document. The thesis also explores how economical and universal design can take shape in the digital world with all the new technologies out there.

The built environment accounts for a lot of the harm done to the natural environment and there are sustainable approaches in place to mediate them. The conventional approaches are not enough in terms of mediating. The need for shelter and tools to live must be addressed so as not to impede on the environment necessary for life. Economy also relies on the environment, without the environment there cannot be any economy as we know it. The goal is to connect the environmental and economic needs of the building and the people to form a functional learning and living environment in the downtown setting of Gardner, Massachusetts. Through this an implementation of fostering craft and community could take hold to form a new typology for “Live / Work / Learn” architecture.

## **CHAPTER II**

### **DESIGN PRACTICES**

#### **2.1 Review of Existing Literature**

##### **2.1.1 Environmental Design**

There have been many varying opinions and ideas about human life and what part they play in the Earth's natural environment. Some people may agree that humans are a part of the Earth's natural environment and some people may not. These thoughts have been researched and talked about for many years. A large portion of these thoughts come from the fact that many people think that humans are effecting the natural environment, and not for the better. Many environmental based organizations and movements have been created to support this concept. One of the greatest largest contributors to this deconstruction of the natural world is the man-made structures that are used for shelter. Buildings, houses, and factories are all forms of architecture and the way that they are built can either help or destroy Earth's natural environment.

Architecture is such a broad term, with so many forms with different rules, regulations, and specifications for each. Various forms of architecture are practiced all over the world and some specific forms are becoming a growing trend in modern architectural designs throughout the world. Architectural concepts and designs are very different in varying countries mainly because of the climate. They also vary because of the cultural differences in areas. (Culture plays a part in the architecture because of the traditions and customs of these cultures.) Because of this wide variety of architectural designs, there would be skepticism about an architectural concept that could be used worldwide. Although there is no one architectural design concept that is used on every

continent-in every country, there are a few architecture and design concepts that are becoming more and more popular. These concepts are mainly concerned with the well-being of the environment and nature.

These kinds of design and architectural concepts are more commonly known as environmental architecture: the process of addressing natural environment parameters when designing, building structures. Environmental design: the process of addressing natural environment parameters when devising plans, programs, policies, buildings, or products. Green architecture, Green design, Eco-design, Sustainable design, and Sustainable architecture: the art of designing physical objects, the built environment and services to comply with the principles of economic, social, and ecological sustainability. There are also many other different branches of these concepts that will be explained later in this paper. But here I will start with environmental architecture and design.

Environmental architecture and design are mainly concepts that work with the process of addressing parameters that are environmental, which means involving the environment and nature. This also means that this must be addressed in every part of the process, from devising plans, programs, policies, and buildings to the actual products and materials used for the construction of a building for house. This way of thinking is greatly related to the ideas and thoughts of the very first environmentalist movement. These thought started back with the transcendentalism movement. These ways of thinking and even political thoughts were introduced to the United States by Thomas Jefferson, Ralph Waldo Emerson, and Henry David Thoreau.

These men introduced the main points of the environmental concerns that needed to be taken into consideration many years ago. The main points were to protect the



continuity of life and quality of life through the conservation of the natural resources of the world. More of the points in environmentalism were to prevent pollution and control land use. From this there was another movement in the 1950s and 1960s that was called the “New Environmentalism” movement. This movement was more directed to the industrial development of the world and how to preserve life on the Earth.

As industry developed and became more prominent in the growing economy, the effects were not initially realized. Over time negative side effects that were noticed on the environment and nature. Some major environmental side effects were air pollution, especially in large cities with many skyscrapers and large buildings. From air pollution came the wider and more harmful global warming. Global warming is alleged to be caused from the rise in the Earth’s air temperature; Anthropogenic greenhouse gases are increasing.

Anthropogenic means the effects, processes, objects or materials that are derived from humans. The opposite of anthropogenic would be the actions that happen in the natural environment without human interactions. So in other words humans are contributing to this harmful occurrence, which has become known as global warming. Humans are contributing because it is through their actions that these green house gases are becoming more prevalent in the past century. Just in the past century the overall global surface temperature of the Earth has increased  $1.33 \pm 0.32$  °F, ending in 2005. If these green house gases keep increasing at such a steady rate this earth may not be able to stay inhabitable to all the humans that live on it. The effects would make the Earth very cold. Without the natural resources that Earth’s ecosystem provides the effects on the Earth may become irreparable. Most of these thoughts and ideas started during the

industrial movement when the effects on the environment were considered when building or furthering the industrial movement.

It was believed that the industrial development at the time of the industrial movement was not up to, or compatible with the thoughts of the environmentalism movement. Radical groups of the time set out to do just that.<sup>1</sup> In many ways this was the beginning of the first thoughts about environmental design and architecture. Now, with an ever-growing environmental movement, these thought and ideas became more explicit.

This gave way to the broader field of architecture and how it can be used in a different way to be even more than a building to work in, or a home to live in. Consumer products and other things also started to follow the guidelines of the environmental way of thinking. The green architecture and eco-friendly products are very popular and for good reason. This earth only has a limited supply of natural resources, they are not unlimited like some may choose to think or believe to be true. Judicious use and preservation of limited resources is what should be happening everywhere, and could have been more effective if it was not realized so late.

Humans have been on this earth for a long time. It has been only a couple hundred years ago that anyone really started to see the negative effects humans have on the natural environment. However there is a newer process of design that is becoming more popular that has some of the same qualities of the early environmental design and architecture movements, but with more refined requirements and processes.

This is called sustainable design and architecture. There is an abundance of factors that are being taken under closer consideration in the 21<sup>st</sup> century, like:

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<sup>1</sup> "Environmentalism." The "New Environmentalism" <http://www.infoplease.com/ce6/sci/A0858012.html>

growth of economic activity and human population, depletion of natural resources, damage to ecosystems and loss of biodiversity; factors grouped into a more common term called the “Environmental Crisis”. Designing with sustainability is a response that will hopefully address the “environmental crisis”. More simply sustainable design is the way of counteracting the fact that Earth will not be able to support rapid population growth. The Earth may reach its sustainable limits. Sustainable design can do this while also maintaining the quality of life that is present today, through “using clever design to substitute less harmful products and processes for conventional ones”.<sup>2</sup>

One can take sustainability many different ways. This is mainly because there are different forms of sustainability, because the definition of sustainable depends on the subject matter one is talking about to know for sure what sustainability really means. Sustainability means the ability to be continued indefinitely in time. But there are also different ways of interpreting sustainability and its definition. Starting with the relationship between humans and nature is where one can start to understand the complexity of sustainability. Humans need nature to survive but their dependence on nature has weakened nature as a whole. More than just the dependence on physical nature, humans are mainly becoming more and more dependent of the non-renewable energy; materials that nature only has in limited supply. This relationship does not go both ways evenly. The fact that “natural systems are sensitive to human sources of population, noise, and other disturbances”<sup>3</sup> are just the start of all that humans do to the

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<sup>2</sup> van den Bergh, Jeroen C.J.M.. Toward Sustainable Development: Concepts, Methods, and Policy. Washington, D.C.: Island Press, 1994.

<sup>3</sup> van den Bergh, Jeroen C.J.M.. Toward Sustainable Development: Concepts, Methods, and Policy. Washington, D.C.: Island Press, 1994.

environment. Although, the relationship is changing nowadays because nature is becoming more dependent of man now because of the fact that humans find happiness in the direct and indirect presence of nature.

There have been many thoughts on the idea of overpopulation. This means that the Earth would or will be overpopulated with humans and therefore unable to support such an abundance of people. Thoughts about this occurrence date all the way back to the 1700s, with Thomas Malthus. Thomas Malthus was an English economist and demographer who came up with the idea that the Earth would eventually become overpopulated and unable to sustain human life.<sup>4</sup> He was not the only person to think this way, there were many to follow that had similar thoughts on this subject. The major factor in this idea is the fact that the earth has limited resources; therefore if there is a growing population there may not be enough of these resources to maintain life on this Earth for all inhabitants forever. There are many steps we can take to ensure that humans can survive on the Earth, with the natural resources that are

As mentioned in William McDonough and Michael Braungart's book, there is an olive oil seller that must bring his oil to the market on a donkey, the only problem is that while the oil is very inexpensive to make therefore he make a large profit on the sales, the cost of feeding the donkey is greater than what he make is sales. And he needs the donkey to travel to the market with the olive oil to sell. So because of this he started feeding the donkey less and less to make more of a profit. This backfired when the donkey eventually dies.<sup>5</sup> Keeping production and materials close to where they are

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<sup>4</sup> Castree, Noel. *Nature*. New York, New York: Routledge, 2005.

<sup>5</sup> McDonough, Braungart, William, Michael. *Cradle to Cradle*. New York, New York: North Point Press, 2002.

produced and manufactured is a key factor in the sustainable and environmental ways of thinking. Thinking in this way one can reduce the travel and transport of materials.

Materials that pertain to building and architecture that are readily available closer to the construction site which is a more eco-friendly way of working with the environment.

The conditions of sustainable design and architecture are defined as: 1)

Preventing the destabilization of global environmental features, such as climate patterns or the ozone layer., 2) Protecting the importance of ecosystems and ecological features, to maintain biological diversity., 3) Renewable resources must be renewed through the maintenance of soil fertility, hydro biological cycles, and necessary vegetative and sustainable harvesting must be enforced., 4) Minimize the depletion of non-renewable resources, which implies that these resources should be used for resource – efficiency, durability, and the maximum practice of repair, reconditioning, re-use, and recycling., and 5) Not to exceed the critical load of emissions into the air, soil and water. There are more conditions involved with sustainability but for the design and architecture conditions these are of critical importance.<sup>6</sup>

By following these conditions sustainability can become a relationship between human economic systems. And if implemented completely and enforced right this can cause human life to continue indefinitely. Human individuals can flourish, human cultures can develop, but the effects of human activities must remain within bounds. This will not destroy the diversity, complexity, and function of the ecological life support system. In order for these conditions to be followed humans need to be aware of the true harm they are putting on the natural environment of the Earth in which they live.

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<sup>6</sup> van den Bergh, Jeroen C.J.M.. *Toward Sustainable Development: Concepts, Methods, and Policy*. Washington, D.C.: Island Press, 1994.

Mankind's ability to understand evolutionary processes and to evaluate to some extent the future is what is the most difficult. Many Americans cannot see that their actions are harming the environment in which they live, mainly because they cannot see the direct effects of these actions.

The concepts of sustainable design and architecture are not only practiced in North America, they are practiced throughout the world. Although this was not always true. Many environmental practices were mainly practiced in the North America region. This was because of the notion that "we tend often to oppose economic globalization because it constitutes the loss of local diversity but nevertheless support the globalization of a practice ecological restoration."<sup>7</sup> It is believed that the local diversity of many cultures will be lost or weakened in a way that would not be beneficial to the inhabitants of that land or area. However that concern does not come into play when talking about the sustainable design and sustainable architecture concepts because they are meant to help, and save the environment, all over the world. This form of globalization is exactly what is needed and can be possible with the help of the humans living on this Earth.

This is our Earth, the inhabitants of it are growing and populating at a steady rate and should be able to survive with the resources that are available on it. Although there are limited resources it is feasible to preserve most of them in order to thrive with the natural resources that this Earth still has left. Humans are native to this planet and most would say that it is their home and hope it will be for the rest of their lives. But what about the lives of their children or their grandchildren, what will happen to them? It is time to make true these hopes for the future inhabitants that reside on this great Earth. It

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<sup>7</sup> Higgs, Eric. *Nature by Design*. Cambridge, MA: MIT Press, 2003.

must be done now or it will be too late. In many ways humans should look at the animal that seems to survive in the harshest of conditions, the cockroach. They are able to withstand the harshest of circumstances and have been alive and striving for longer than humans. They have adapted to these lesser conditions and strived in them. Humans can take a hint from them if they want to continue their existence on this Earth, and sustainable architecture is one out of many ways this can be done.

### **2.1.2 Universal Design**

The intent of this facility is that it can foster innovation and growth in the universal design field. The main principle in the universal design intent is to simplify life for everyone. This is possible through making products, communications, and the built environment more usable by all people regardless of age or abilities.<sup>8</sup>

The principles of Universal Design are:

1. Equitable use
2. Flexibility in use
3. Simple and Intuitive use
4. Perceptible information
5. Tolerance for error
6. Low physical effort
7. Size and space for approach and use

Universal design addresses the design of spaces and products that are safer, easier and more convenient for the users. Universal Design evolved from Accessible Design which addresses the needs of people with disabilities. Universal Design takes that intent further

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<sup>8</sup> NC state University Center for Universal Design <http://www.ncsu.edu/ncsu/design/cud/>

by recognizing a wider spectrum of human abilities. This spectrum is the typical human progression from childhood, periods of temporary illness, injury, aging, and then elderly.<sup>9</sup>

Universal Design takes into account the range of human diversity in physical, perspective, and cognitive abilities. It also takes different body sizes and shapes into account. It benefits more people than the Americans with Disabilities Act (ADA). The ADA is legislation that protect the civil rights of people with disabilities by ensuring that they are not denied access to jobs, goods, or services because of their disability. The ADA requirements need to be followed for buildings and facilities. Most of the outlines are the bare minimum of what can be done for people with disabilities. Universal Design goes well and beyond those minimums to meet the best practices for design, and continues to evolve and improve. This term was coined by Ronald L. Mace in 1997. He was the founder of the Center for Universal Design at North Carolina State University. Ronald L. Mace collaborated with a group of architect, product designers, engineers, and environmental designers to develop the principles of Universal Design.

Universal Design is an ongoing design process which involves a choice to provide products and spaces that are designed to be flexible, adaptable, provide alternative means of use, and multiple interfaces. It is the goal that all people benefit from something that is universally designed regardless of their age, ability, sex, economic status etc.<sup>10</sup>

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<sup>9</sup> Universal Design.com

<sup>10</sup> Udeworld.com



## 2.2 Case Studies

### Study 1:

#### **Prairie House: House for a Fashion Pattern Maker and Fiber Artist**

For this case study I wanted to choose a building that demonstrates responsive design. Responsive architecture is defined as “a class of architecture or building that demonstrates an ability to alter its form, to continually reflect the environmental conditions that surround it.” These responses can be generated in many different ways and for different reasons. There are a variety of responses that are possible and the uses to which they have been put.

This is a fairly new area of architecture and there are few precedents built and un-built. The building that I found the most interesting and that I decided to focus on for my precedent is the Prairie House: House for a Fashion Pattern Maker and Fiber Artist (2011) in Northfield, Illinois. They used sensor data to transform standardized assemblies into highly contextual ones by means of responsive technologies that are embedded into the building. It uses actuated tensegrity<sup>11</sup> systems in conjunction with new cladding systems to emit less than half of the carbon of a typical house in Illinois (it is estimated to be true). Because of these structures it allows for beautiful qualities of parametric architectures to flow into the space by way of physical responses.

The interest of the designers is in using programming as a form of architectural media which can transpose new modes of very specialized operation onto standardized building assemblies. They have done mathematical simulations to indicate that general returns for skins that can change color typically provide a combined annual savings of 0

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<sup>11</sup> Noun – the property of skeleton structures that employ continuous tension members and discontinuous compression members in such a way that each member operates with the maximum efficiency and economy. Dictionary.com

.45% in the mid-west climate zone. The way in which this buildings skin can change color is via thermo or photo-chromatic inks. The savings are increases when there are permeable rain screens on the exterior to allow for natural ventilation. Levels of insulation can also be controlled for a higher annual savings. The overall savings are greatest with structural systems that incorporate all of these factors and can change shape and volume. They provide combined annual savings of 23.72% in the mid-west climate zone. Expanding to reduce the impact of internal heat loads on hot days and shrinking to reduce heating requirements on cold days. All of these systems are controlled by computers that continuously calculate the surrounding influences and make the building respond to them.

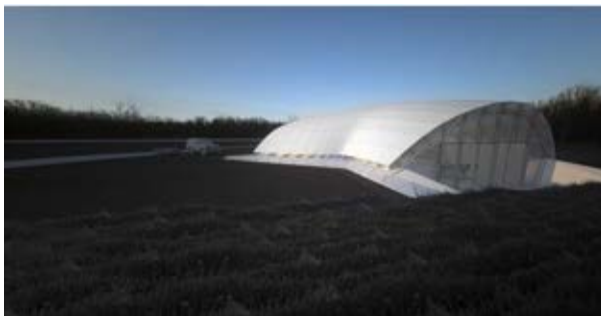
This responsive exterior looks like a very intricate curved truss system from the exterior but



**Figure 1:** Prairie House Northfield, IL Orambra

on the interior the shapes they make are quite different. It allows for shadows to fall on the floor in different patterns.

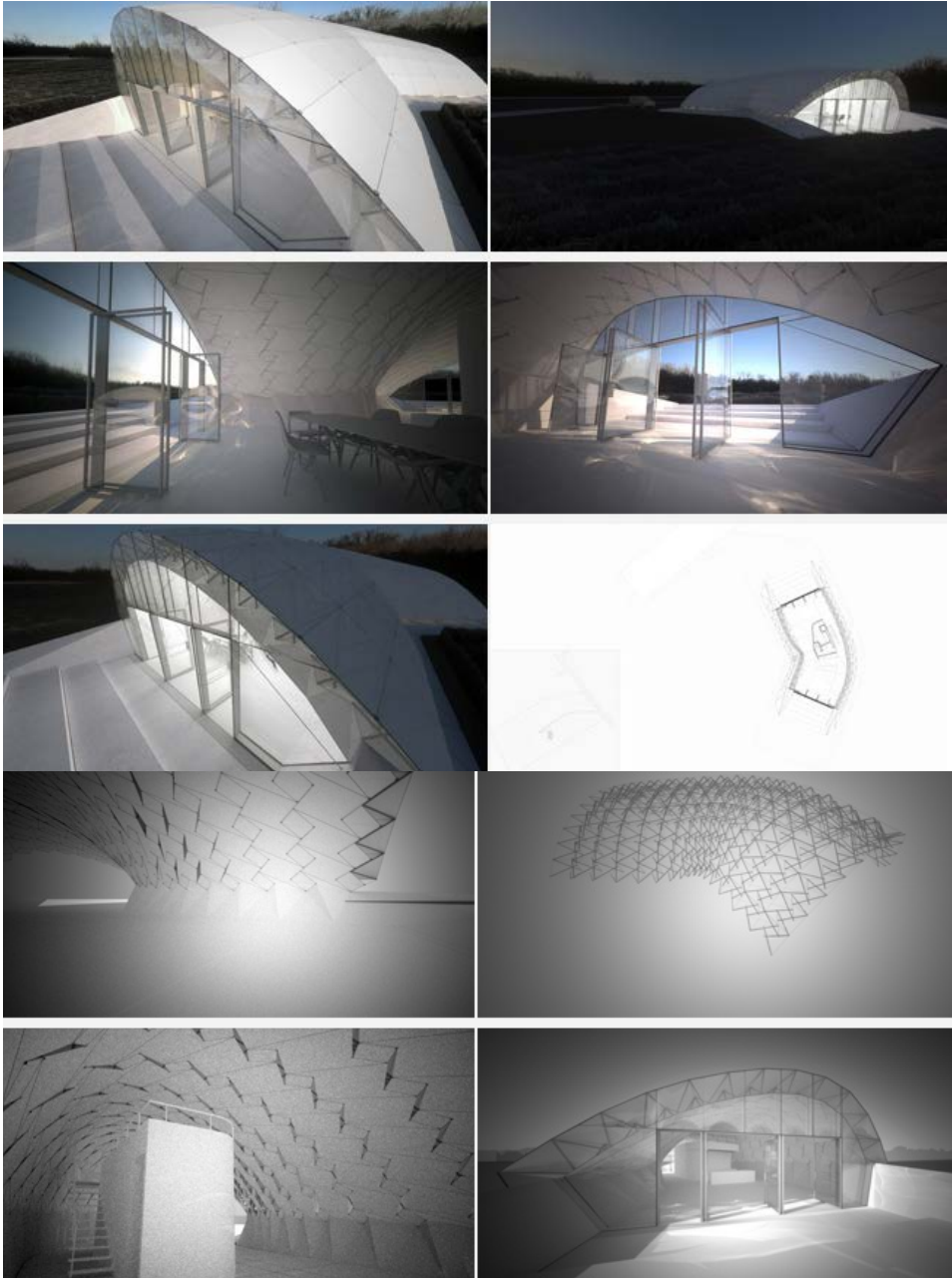
The shape in many ways reminds me of an airplane wing. It is integrated into the



**Figure 2:** Prairie House Northfield, IL Orambra

earth which is something that is appealing to me because I am intrigued by earth sheltered homes. However, the structural design is using the surrounding environments to respond in

a natural way to, even though the responses are programmed into the buildings makeup. It looks very clean and sterile on the interior because everything is white and monochromatic, this makes it have a modern feel, and some might see this as



**Figure 3:** Prairie House Northfield, IL Orambra<sup>12</sup>

<sup>12</sup> <http://www.orambra.com/~prairieHouse.html>

being uncomfortable. The parametric design of the roof structure takes cues from Buckminster Fuller's geodesic structures and from Nicholas Negroponte theory of incorporating computing power into built spaces and structures. Negroponte theorized that by incorporating those two areas better performing and more rational architecture will be the result. Actuated tensegrity structures makes this building able to be responsive. I am interested in the full life-cycle analysis way of designing and I don't know how this building would stand up to that analysis or any other sustainable design approaches that I have been researching without knowing the materials of construction. I feel that this type of responsive architecture is still in the beginning stages and there may not be enough proven empirical data to back it up.

## **Study 2:**

### **Bullitt Center by Miller Hull**

For this case study I wanted to choose a building that demonstrates sustainable design. Over the years of learning about sustainable design I haven't really come across an all-inclusive definition that demonstrates all the intricacies of sustainability in my opinion. So I have incorporated a few different definitions to come up with the one that relates to what I am interested in the most. That definition is: The philosophy of designing physical objects, the built environment, and services to comply with the principles of social, economic, and ecological sustainability that reduce or completely eliminate the negative environmental impacts through thoughtful designs. To design this way many different factors need to be taken into account whether it be for designing a small product or a large building.

The first factor is lowering energy and water consumption through the entire lifecycle – which means from extraction, processing, manufacturing, end use, to disposal. Second would be minimizing the impact on climate change by reducing the greenhouse gas emissions or alleviating them through carbon neutralizing acts. Another factor would be to limit the resource consumption through waste-free manufacturing, to prefer renewable resources, and to emphasize recycled materials. Reducing or eliminating waste by decreasing consumption, reusing, and recycling whenever possible and necessary is another factor. Also a very important factor, there needs to be a preference to non-toxic materials and those that will contribute to the health and wellbeing of humans. The last factor would be to emphasize quality and durability over the price.

I am interested in all of these factors playing off of each other and really creating the product or building experience and feeling that one gets when the use it. The building that I wanted to write about is the Bullitt Center by Miller Hull which is located in Seattle, WA. It is claimed to be the “Greenest” Office Building in the world. There are numerous articles about it and the architect’s website has a lot of information about it as well. It is designed as a Living Building.

This building caught my attention because of how many factors it is designed under to try and be truly sustainable. They include: power production and purchase, hydronic heat, building management system, foam flush toilets and urinals, composting toilets, greywater system, rainwater harvesting, regenerative elevator, heat pumps, wood steel and concrete construction, constructed wetlands, overhanging solar panels, window shades, passive heat recovery, and natural ventilation. These features make the building

100% onsite renewable energy, water and waste management, built to last 250 years.<sup>13</sup>



**Figure 4:** Bullitt Center Seattle, WA Miller Hull

The design process behind making this all happen is also very interesting to me. They used an integrated design process that

enabled them to move beyond the traditionally linear design, engineering and construction process to compose a diverse targeted team that made it all happen. They were excited about designing a building with essentially no environmental footprint using a mix of existing and new technologies, systems, and materials. It takes cues from nature and has been compared to a living organism because of its incorporation of simplicity and efficiency in its interconnected systems. Open concept floor plates with floor-to-ceiling operable windows allow for maximum daylighting and access to fresh air. Timber framing which hasn't been used in downtown Seattle for an office building since the 1920's was used given its prominence as a renewable regional material that offers strength, beauty, and carbon sequestration. There is also an "irresistible stair" that is located ideally for users to see the skyline that encourages occupants to walk among the floor. The exterior shades adjust throughout the day for maximum comfort and performance. All of the energy is being produced by the overhanging photovoltaic array on the roof.

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<sup>13</sup> <http://www.bullittcenter.org/>

All of these factors are incorporated in a way to facilitate the buildings inner workings but as the state of the world changes and other factors may need to be improved upon the building technology, building envelope and supporting structure are all designed as separate components that can be updated to meet the needs of the next generations. This flexibility is something that I am interested in when it comes to sustainability because we cannot predict the distant future. I believe that this building could be a catalyst in the sustainable design field and that it will set a precedent for more buildings to follow.



Figure 5: Bullitt Center Seattle, WA Miller Hull

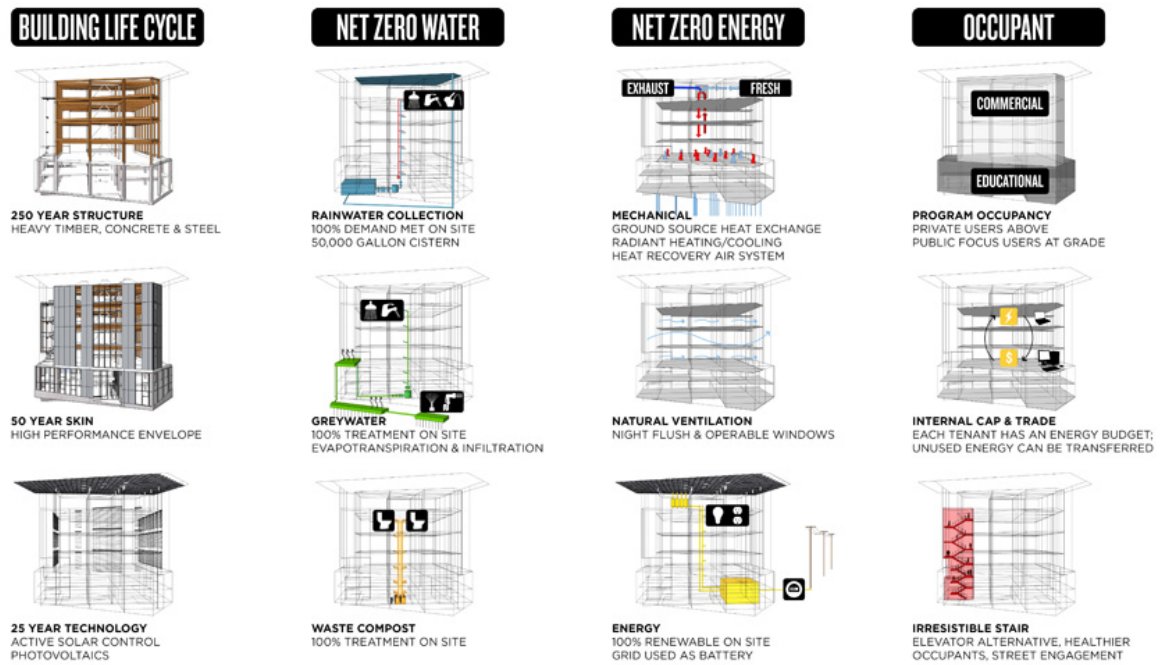


Figure 6: Bullitt Center Seattle, WA Miller Hull

### Study 3:

#### Snaidero's Skyline Lab Accessible Kitchen

For this case study I wanted to choose a way of designing that was new to me. I thought it could be related to my thesis topics but also bring something different to the table. Product design values are something that I am greatly interested in when researching my thesis topic and this precedent is really taking those ideas to the highest use. Snaidero's Skyline Lab Accessible Kitchen is the precedent that I wanted to focus on. Snaidero is an Italian furniture company with 65 years' experience that specializes in kitchens; their slogan is Kitchens for life. They design sleek modern Italian kitchens, bathrooms, closets, and cabinet designs. Their mission about design is that is means assuming the responsibility to first trace out and then develop a complete and harmonious



idea about the world, to really be dynamic and fully culturally-aware during the whole process. The end of the design process is the manufacturing, distribution of resources, and customer relations.

They have a firm aspiration to contribute to the creation of a balance that is able to involve both subjects, the manufacturer and the consumer. This is what they believe is right on a human level but they have been going further than that with their conceptual and design approaches for socially responsible processes that steamed out of design socially responsible products. They want to continue to contribute to the design for the responsible personal behavior.

Throughout their long existence they have been grounded in both craftsmanship tradition and technological innovation. They separate their designs into categories according to the time. The 1940s – 50s is the Reconstruct where it all started. The 1960s was the Boom the modular kitchen design “Spazio Vivo” was the first built in kitchen and was included in the Moma collection. The 1970s – 80s was the Design Era where they put design at the center of its company and product identity. The 1990s was New Experimentation collaboration between Pininfarina and the goal is the future, introducing the curve into the kitchen which is a symbol of a positive and reassuring way of thinking. And the 2000s is the Universal Design era where they design spaces free from complexity that can adapt to the individual user. This is where the “Skyline” was introduced as the first kitchen based on universal design.

Universal design is a modern design methodology that creates environments which are universally accessible to all users whether or not they have a disability. It is something that is enhancing the concept of human diversity, social inclusion and equal



**Figure 7:** Snaidero's Skyline Lab Accessible Kitchen

opportunities. The solutions that they have designed are clearly easy to use and interact with, as well as completely flexible. It is so interesting to know that the “Skyline Lab” that was established in 2002

was started up with two architects, Lucci and Orlandini who had been long time collaborators for Snaidero. Their “design for all” mentality was really to provide a useful service and support for people with disabilities and their families. They designed with the goal of improved autonomy and safety for disabled people. And they felt that this would directly reflect is their quality of life and that their family members do not have to help them out. They started with a study that was very intensive to find out about people with different disabilities would need to use a kitchen. Motor problems were monitored and studied and analyzed on an experimental level, this made it easier for the designers to provide the best solutions. Providing storage surfaces and building in domestic appliances so that they are both always easily accessible was something



**Figure 8:** Snaidero's Skyline Lab Accessible Kitchen

they were able to achieve. Also, pull-out shelves or worktops that are made to measure

for the person and not just made to measure for the space was another solution. Their main work surfaces hug the user to provide easy access to many elements at once. They have put efficient ergonomic design into place in these kitchens. The features of the open



**Figure 9:** Snaidero's Skyline Lab Accessible Kitchen

carrousel storage and the under counter cabinets that can be moved away to allow for knee clearance are not difficult to achieve but make a great deal of difference for the disabled users.

Their designs represent a flexible program that is able to adapt to anyone's needs. They are able to achieve these

using diversified solutions which I believe is something that I could

research more. I can see how this could play into architecture on a greater level. The company also focuses on being eco-sustainable, and adheres to the ISO 14001 certification standard.<sup>14</sup> They also are using water-based coatings, certified materials, and low emission panels. It is nice to see that they are conscious and respectful of the users as well as the environment.

<sup>14</sup> <http://www.snaidero-usa.com/>

## Case Study 4:

### Union Crossing Building 9 by Coldham and Hartman

This project was started in 2008 when Lawrence Community Works selected Coldham and Hartman and Steven Winter Associates to develop a master plan for a complex of textile

mills on the

Merrimack River in

Lawrence. The

architecture firm

Coldham and

Hartman took on this

complex working

collaboratively. There was a focus on transforming the historic mill interiors with the

pedestrian experience and the whole complex. The design is stacking town house

apartments which consolidate circulation on two levels instead of four to make a strong



Figure 11: Union Crossing Building 9 Lawrence, MA Coldham and Hartman

sense of community.

To date Phase

I renovation of

Building 9 has been

completed with 60

comfortable, energy-

efficient, well-lit units

with views of the River, mills, and downtown. There is a community feeling on each floor with shared common spaces and laundry rooms. The project has utilized an integrated design approach by engaging hundreds of community members. There is a rigorous performance standard for the project and a focus of health, energy-efficiency, and sustainability. The units are meant to be affordable family housing which has never



**Figure 12:** Union Crossing Building 9 Lawrence, MA Coldham and Hartman

been done in a mill retrofit before. The preservation and adaptive re-use of a former brownfield/industrial site is what they achieved. The project

improved circulation on the East Island and Center Islands because of new sidewalks and street improvements. Rain water harvesting was put in place as well as storm water treatment systems. There are trash and recycling chutes integrated into each floor.

They used low-VOC materials and finishes to maximize indoor air quality and ambient comfort. They had to adhere to the codes



**Figure 13:** Union Crossing Building 9 Lawrence, MA Coldham and Hartman

that mandate a buildings seismic assessment and limiting dead loads. They did not pour heavy acoustic-mat concrete over the existing wood floors like in most mill building renovations because of the unnecessary addition to the dead loads. They knew that this solution would not make for the best air sealing so they treated the underside of the floors. The addition of insulation to the exterior walls and replacement of the windows increased the performance of the buildings envelope.

Their original design was to have Mitsubishi electric air-sourced heat pumps with multiple zones per apartment that would allow for heating and cooling at an individual level. But the Owner decided to switch to a gas fired boiler with air handling units on a loop and single control point in each apartment because of the initial cost savings and reliability.

The building has high-efficiency lighting fixtures throughout and rooftop photovoltaics to make the building inexpensive to live in which is part of their goal. The building was first occupied in 2011.<sup>15</sup>



**Figure 14:** Union Crossing Building 9 Lawrence, MA Coldham and Hartman

<sup>15</sup> Coldham and Hartman.com <http://www.coldhamandhartman.com/completed.php?id=36>

## CHAPTER III

### PRECEDENT ANALYSIS

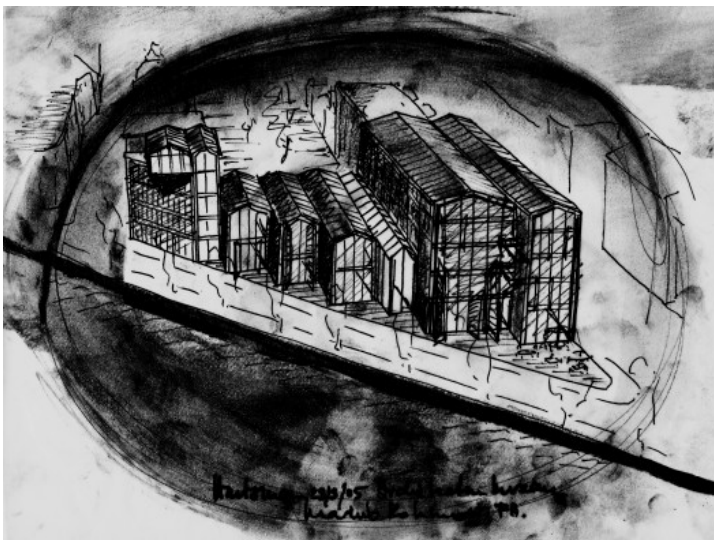
#### 3.1 Existing Buildings

##### Precedent 1:

##### Houtsma Site Live/Work Factory by Architectenbureau Marlies Rohmer

The architect for this building was Architectenbureau Marlies Rohmer. It is located in Amsterdam, Netherlands and was completed in 2010. The inspiration for the site was the small scale charm of the surrounding buildings of the Bellamy Neighborhood with their varied scales. The neighborhood follows the old farming field boundaries from the 19<sup>th</sup> century and is on a shipping canal location, Kostverlorenvaart. The Houtsma site is named after the former Houtsma kitchen furniture factory.<sup>16</sup>

The site was constructed based on an urban development brief that consulted with the local residents. They wanted functional mixing, livelier atmosphere, better public



**Figure 15:** Houtsma Site Live/ Work Factory Amsterdam, Netherlands  
Architectenbureau Marlies Rohmer

safety, and a varied program of housing which could boost the social structure. The site was designed with a prominent building up to five stories plus a section no more than two stories tall on the side facing into the neighborhood so that it would not impede on daylighting and

<sup>16</sup> <http://www.archdaily.com/120300/houtsma-site-livework-factory-architectenbureau-marlies-rohmer/>

views.

The architects were challenged to synthesize all the local residents' specifications to form a result that was a sum of its parts. The varying articulation and height differences had to be combined with a



**Figure 16:** Houtsma Site Live/ Work Factory Amsterdam, Netherlands  
Architectenbureau Marlies Rohmer

building respecting the existing plot boundaries. They also wanted to make the final building a contemporary icon that would still belong intertwined in the individualistic



**Figure 17:** Houtsma Site Live/ Work Factory Amsterdam, Netherlands  
Architectenbureau Marlies Rohmer

buildings flanking it.<sup>17</sup>

It has a street level occupied with small scale businesses like a youth facility and café, and the rest of the complex is residential. For the relationship between the residents and the site they

<sup>17</sup> Archdaily.com Houtsma Live/Work Factory <http://www.archdaily.com/120300/houtsma-site-livework-factory-architectenbureau-marlies-rohmer/>



made each unit have large folding glass windows that can fully open to the streets below. The residential units range from one to two bedroom apartments, homes for elderly occupants, maisonettes, and a penthouse with a roof terrace. The design utilizes concrete and features steel escape stairways and a saw tooth roofline which is in keeping with the factory like identity.<sup>18</sup>



**Figure 18:** Houtsma Site Live/ Work Factory Amsterdam, Netherlands Architectenbureau Marlies Rohmer

## **Precedent 2:**

### **The Cracker Factory: Miles & May Furniture Works by Amy and Brandon Phillips**

In Geneva, New York Amy and Brandon Phillips renovated a 19<sup>th</sup> century factory into their home and furniture manufacturing business. The Cracker Factory is the building's new name. It is a three story building with a 200 foot high smokestack left

<sup>18</sup> DesignBoom.com Marlies Rohmer: Houtsma Site, Neighbourhood Factory



**Figure 19:** The Cracker Factory Miles and May Furniture Works  
Geneva, NY Amy and Brandon Phillips

over from the previous factory's use. The building is separated into different spaces with the workshop and showroom on the bottom floor. The second floor has the couple's apartment which is 1,700 square feet. The second floor also incorporates an event space and a letterpress studio. There are plans to convert the untouched third floor into artists' residences in the future.

The couple really wanted to respect the original buildings design and character, but also put their own artistic touch on it. They use a lot of reclaimed wood and found objects to decorate with because repurposing is a staple in their design aesthetic. They find found objects and incorporate them into their space with purpose and much more specialty was incorporated in the design. The found objects are all in keeping with the factory industrial undertones of the original building.<sup>19</sup>

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<sup>19</sup> Dwell.com 19<sup>th</sup> Century Live/Work Factory <http://www.dwell.com/my-house/article/19th-century-livework-factory-new-york>



**Figure 20:** The Cracker Factory Miles and May Furniture Works Geneva, NY Amy and Brandon Phillips

### **3.2 Furniture Making Practices and Requirements**

#### **Furniture Making Process:**

There are different processes for furniture making depending on the material selection. The focus of this project will be on wood furniture because of the traditional wooden furniture that the city produced in the past and the durability in material. Wood is a renewable resource. Wood is becoming a leader in the reduction of the overall embedded carbon footprint of goods. Wood has low embodied energy which means lower air toxins such as carbon dioxide, sulphur dioxide, particulates, nitrogen oxides, and hydrocarbons that are released into the atmosphere.

Wooden furniture starts out as raw material and is then shaped. Then the shaped pieces of wood are usually finished and assembled to finish the wooden furniture piece for use. The process for turning a piece of timber into wooden furniture has many

intricate steps which mainly include: receiving timber, drying timber, cutting timber to size and shaping, drilling, sanding, gluing, painting/spraying, polishing/varnishing, assembly, screw fixing, screen printing, pad printing, storage, packing, and shipping/transport.<sup>20</sup>

The machinery necessary to produce wooden furniture is all dependent on the type of furniture production. In the case of this project the small furniture making schools machine supply was researched and then added upon. That small furniture making school was The Center for Furniture Craftsmanship in Rockport, Maine. It was researched to form a better understanding of all the equipment that was necessary for a small professional shop in a 4,200SF Workshop. For the scale of this project the increase of the machine sizes and the amount of them will be ideal considering that it will be for a furniture school/furniture manufacturing facility. There is enough space in the basement and the first floor for the amount of storage, machines, and woodworking space required.<sup>21</sup>

The layout of the machines and woodworking benches is usually aimed to maintain a constant flow of production. The machines necessary for the operations of the woodworking process should be in order of their operation. The wood needs to be planned to size before it can be drilled for joinery pieces. Therefore, the planner would be towards the start of the production line and the drill press would be closer to the end.<sup>22</sup>

The start to all furniture making processes is the provision of working drawings. The design needs to be finalized with working drawings and drawings for production. The materials are selected and a cutting list is prepared as well as the fittings and finished

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<sup>20</sup> [www.britannica.com](http://www.britannica.com) Storage and Transport

<sup>21</sup> [www.woodschoool.org](http://www.woodschoool.org)

<sup>22</sup> [www.britannica.com](http://www.britannica.com) Modern factory layout

established. After these are determined there is an estimate of machining and assembly time worked out.<sup>23</sup>

### 3.3 Materials and Production Methodologies

#### Wood:

Massachusetts is a heavily forested state, 62% of it is forest cover. White pine, Red Maple, Northern Red Oak, and Hemlock are the most common tree species. The forests are covered by five major forest types: northern hardwood, oak/hickory, white and red pine, mixed oak/white pine, and elm/ash/red maple.<sup>24</sup> Furniture making requires different woods depending on the piece of furniture. Most pieces of wood furniture are made out of Maple, Birch, Cedar, Oak, Walnut, Ash, Fir, Pine, and Elm.

Using natural wood in furniture can be wasteful depending on the extraction and conversion from tree to useable lumber. The loss in sawdust, off cuts, sawing shapes, turning, planning, cutting joints, and final cleaning up all contribute to the wasted material. With sustainable extraction and processing methods some of the waste can be avoided. Using plywood for furniture has significantly less waste associated with it. Veneers are peeled in a rotary fashion from the log fitted on a lathe like machine. The same process is used to make laminated board. Chipboard is made by reducing the logs into fine chips that are dried, compressed, and assembled into boards with resin glue. These applications need to be machined because cutting and trimming the edges by hand show deterioration.<sup>25</sup>

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<sup>23</sup> [www.britannica.com](http://www.britannica.com) The production process

<sup>24</sup> [Masswoods.net](http://Masswoods.net) Massachusetts Forests

<sup>25</sup> [www.britannica.com](http://www.britannica.com) Materials

**Plastic:**

The combination of wood and plastic will be used in the construction of the furniture. Plastic laminate is widely used for table tops and other surfaces. The advantages for using plastic laminate are resistant to stains, very heat proof against burn marks, and are easy to wipe clean. There are many new laminates made with recycled plastic. There is a plastics prototyping business in Gardner and fifteen minutes away in Leominster there are plastics companies that may have scrap plastic to use for the laminate as a way to recycle and reuse. Final material selection is stated later in this document.

## CHAPTER IV

### SITE ANALYSIS AND BUILDING PROGRAM

#### 4.1 Site Analysis

The site is in Gardner, Massachusetts. Gardner was once a much more thriving industrial city, with a focus in the furniture field. Gardner is coined as the Furniture capital of New England and became known as the “Chair Town” of the world.<sup>26</sup>

Gardner Massachusetts is located in the central part of Massachusetts called Worcester County. It is 28 miles northwest of Worcester, 59 miles west of Boston, and 61 miles northeast of Springfield. It is surrounded by Winchendon and Ashburnham on the north, Templeton on the west, Westminster on the east, and Hubbardston on the south. The major highway for east-west traffic is Route 2. There are two enter and exit ramps for Gardner. There are many resources in Gardner including shopping areas, chamber of Commerce, Mount Wachusett Community College, and Heywood Hospital.<sup>27</sup>



**Figure 21:** Massachusetts State Map with Gardner Highlighted<sup>28</sup>

<sup>26</sup> Gardner Ma.gov History

<sup>27</sup> Open Space and Recreation Plan

<sup>28</sup> <http://www.maliving.com/towns/gardner>

#### **4.1.1 Geographical Site Description**

The majority of the soil make up of much of the soils in Gardner are be made up of very deep, loamy and sandy soils. These formed in glacial till resulting from granite, schist, and gneiss on upland fill plains and moraine. Some of the soils are very deep, loamy and sandy soils formed in glacial outwash, which are lacustrine and alluvial sediments on outwash plains and in stream valleys.

Gardner is located in the Northern Worcester County and this area is fairly hilly which has many slopes greater than 10%. Elevations range just over 900 feet above sea level around Otter River and to a high of 1300 feet at the top of Reservoir Hill.<sup>29</sup>

The city has an abundance of watercourses which include nine brooks, one river, and nineteen water bodies that occupy 471 acres. Most of the lakes or ponds were formed naturally but others were constructed to provide for the industrial revolution. Crystal Lake is a natural lake that at one time was a recreational resort with groves and pavilions but now it is closed to the public and serves and the city's primary water supply. The lake is fed mainly by the springs from surrounding hills. There is a good forest quality in Gardner but does require ongoing management efforts.

#### **4.1.2 History of Gardner**

Gardner was formed by a petition in May, 1785 asking for a body to erect certain portions of Winchendon, Ashburnham, Westminster and Templeton, into a township called Gardner. It received the name of Gardner in honor of Colonel Thomas Gardner who died in the battle of Bunker Hill. The surrounding towns had access to one another by one of three roads. This road was hard to travel in good weather and impossible in

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<sup>29</sup> Open Space and Recreation Plan



inclement weather. Therefore, the reasoning to make this area a separate town was because of the inability to worship or purchase supplies during winter months because of that road.<sup>30</sup>

After its inception as a town it became a center for industry. The businesses that opened included a sawmill, livery, blacksmith, dry good stores, and many woodworking factories. By the middle of the 1800's the major industry was the manufacture of chairs and other wooden furniture. There were twelve furniture companies in Gardner which produced 1.2 million chairs per year and employed a workforce of over 850. Some of the furniture companies are Heywood-Wakefield, Conant-Ball, and Nichols & Stone.<sup>31</sup>

In the latter part of the 1800's there was a great deal of growth. More houses were built during 1879 in Gardner than in any other town of its population within the state. Gardner had electricity in 1891 and the Gardner electric Railway began to operate in September of 1894 which created more businesses to open along the route and travel. The Town of Gardner became the City of Gardner on January 1, 1923.

Growth continued throughout the 1920's when the West Gardner Square housed chain stores such as Woolworth Five and Ten, J.C. Penney, J.J Newberry's, and more. In the 1930's the Post Office was opened, a twelve-hole municipal golf course and the organization of the City's first labor union. The labor union was associated with the United Furniture Workers of America.<sup>32</sup>

During World War II Gardner rationed supplies and converted the old Town Hall into an Armory. During the Korean War a new school building, library, and increases in the water supply at Crystal Lake were all taking place. As well as the establishment of

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<sup>30</sup> Gardner Ma.gov History

<sup>31</sup> Greater Gardner.net

<sup>32</sup> Gardner Ma.gov History

the Greater Gardner Industrial Foundation that promoted industrial development. That organization is now known as the Gardner Redevelopment Authority. During the 1960s there was the construction of Route 2, and new shopping plaza, Mount Wachusett Community College opened in 1964, and the golf course added six more holes.

In the latter part of the 1900's many changes occurred in Gardner, with the majority of them in the furniture field. The majority of the furniture manufacturers stopped producing in Gardner and transferred their operations to the South or overseas. There are now many furniture outlet stores and still some remaining manufactures located in Gardner at this time which is why the Furniture Capital of New England title still holds.<sup>33</sup>

#### **4.1.3 Population, Demographics, and Housing Characteristics**

In 2012 Gardner was home to 20,254 people, this has changed since the 2010 census which was 20,228 people. There is a Mayor and City Council governing Gardner.<sup>34</sup> The population growth is slowing, in 1990 the population was 20,125 then there was an increase of 3.2% in 2000 to 20,770 and then an increase of 0.9% to 20,967 in 2004. The population in Gardner now is decreasing and slightly aging.<sup>35</sup> There are 3,286 residents that also work in Gardner.

Males comprise 50.2% of the population and Female are 49.8% of the population. The median resident age is 40.6 years old compared to the Massachusetts median age of 39.2. The races in Gardner are 86.8% White alone, 6.9% Hispanic, 2.3% Asian alone, 1.8% Black alone, 0.3% American Indian alone, 1.9% Two or more races, and 0.07%

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<sup>33</sup> Gardner Ma.gov History

<sup>34</sup> Gardner Ma.gov About

<sup>35</sup> Open Space and Recreation Plan

Other race alone. The ancestries of Gardner are French 15.2%, Irish 13.3% French Canadian 9.5%, English 8.4%, Italian 6.0%, and German 5.3%. There are 1,741 residents that are foreign born.

The median household income in 2012 is \$46, 365. The median house or condo value in 2012 is \$171,242 and the median gross rent in 2012 is \$722. Most common house heating fuel in Gardner is fuel oil 64%, electricity 15%, utility gas 14%, wood 4%, other fuel 1%, and bottled, tank, or LP gas 1%. The median real estate property taxes paid for housing units with mortgages in 2012 \$2,669 and with no mortgage \$2,593.<sup>36</sup>

#### **4.1.4 Gardner Urban Renewal Plan**

The Gardner Urban Renewal Plan was approved in 2011. The Urban Renewal Plan is poised to promote revitalization opportunities within a large portion of the greater downtown area of Gardner. This area has commercial/retail, office, residential, manufacturing, and public space land uses. Gardner from the late 19<sup>th</sup> to mid-20<sup>th</sup> century, the majority of the commercial/retail venues, worker housing and employment were located in the developed Downtown area.

In the 1950s this area saw a decline which was due to the increased suburban and automobile oriented retail destinations. Gardner's furniture manufacturing also declined at this time and the growth in population has not been consistent with the region's growth rate. Because of these trends there have been higher rates of commercial and residential vacancies and blight in Downtown and also underutilized manufacturing building nearby.

Large scale furniture manufacturing has mostly ceased in Gardner. Four out of the six regional furniture outlet showrooms are located in Gardner and draw people to

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<sup>36</sup> City Data Gardner, MA

shop from all over New England. There is still an importance of manufacturing in Gardner but it has moved away from the concentration in chairs and furniture to be more diversified. New England Woodware manufactures corrugated containers and high quality displays and packaging is an example of diversifying the manufacturing.

It has been a goal to improve the city's Downtown and reestablish the historic

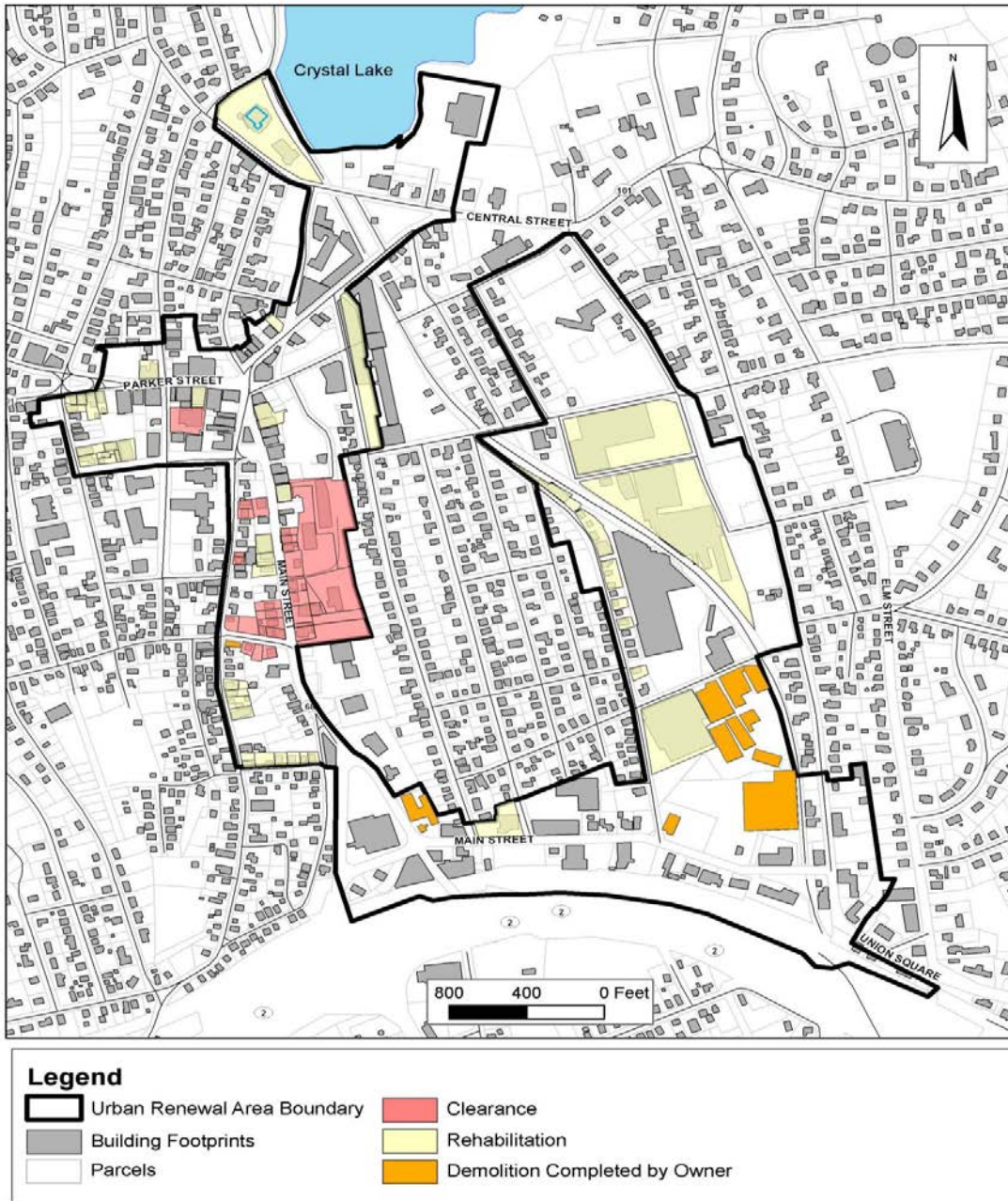


Figure 22: Gardner Urban Renewal Plan Map

vitality of Gardner which will in turn provide enhanced opportunities for urban economic development, improved quality and diversity of housing. The area of the URP was a result of many studies. The area is composed of upper Main Street which is traditional commercial zone, as well as the lower Main Street and the Sherman/Chestnut Street industrial area that ties in with historical connections. The city believes that the projected area has the most potential for private investments.<sup>37</sup>

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<sup>37</sup> Gardner Urban Renewal Plan



Figure 23: Gardner Urban Renewal Plan Map

#### 4.1.5 Open Space & Recreation Plan

The five year update 2006 – 2010 plan. This is meant to review and update community information and determine appropriate open space, conservation and recreation goals and objectives. The main goals are to:

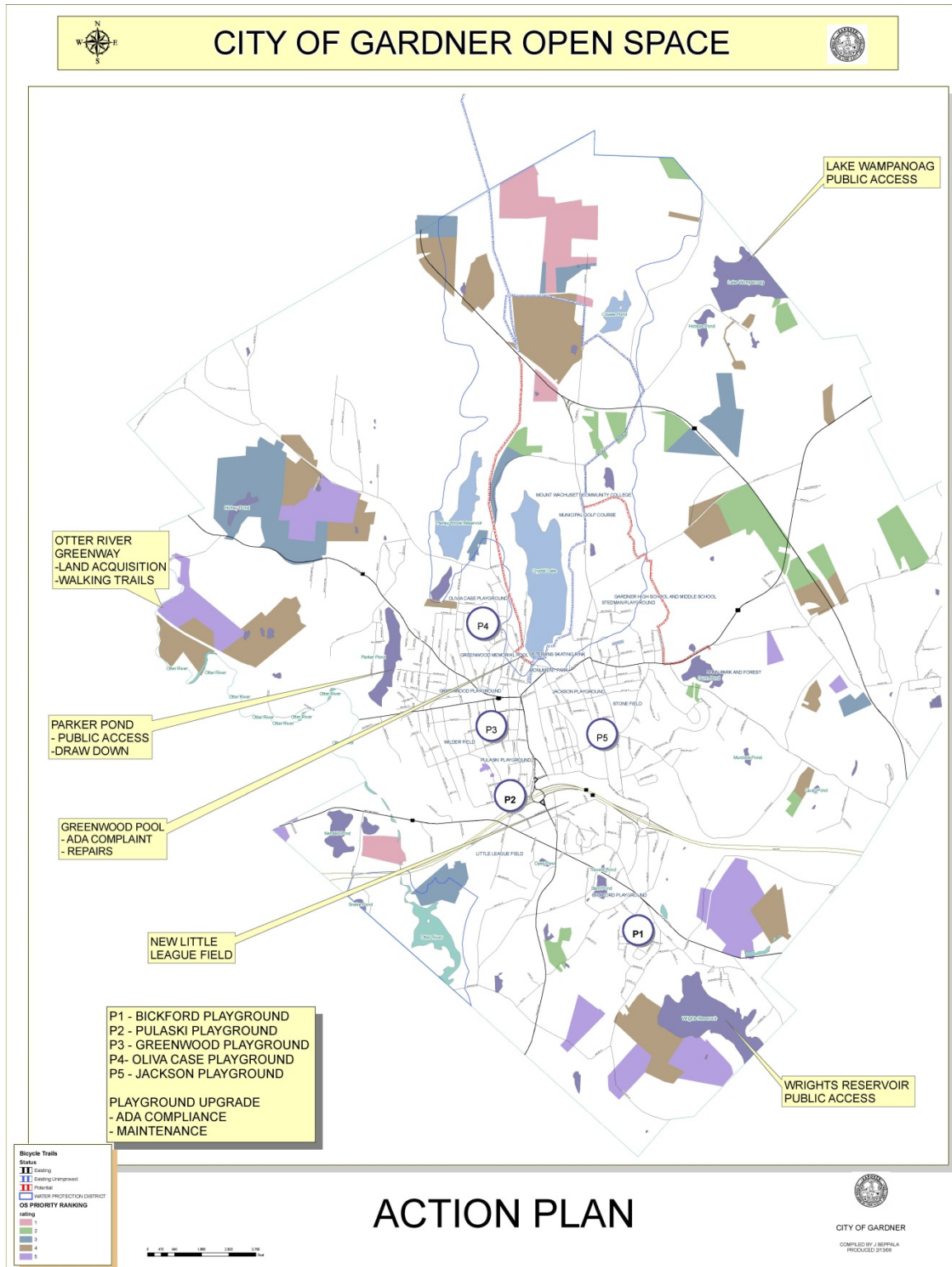
1. “Protect open space and preserve scenic character
2. Improve and expand recreational resources and facilities
3. Protect public water supplies and improve the quality of water resources
4. Accommodate new growth where the environment can best support it
5. Increase public awareness of their role in protecting natural resources.”

There are federal and state records of confirmed brownfields sites in Gardner. The EPA website lists 128 sites in Gardner. All redevelopment projects that are proposed in Gardner’s downtown and other established industrial areas require site assessment. Because of this there has been a shift of commercial development to outlying areas.

Gardner has been protecting open spaces well in the past and they plan to shift available resources toward programs that would maintain existing recreational structures and provide for new and improved ones. The goal of accommodating new growth where the environment can best support it promotes mixed use development, infill development, encourage use, coverage, effectiveness of Development Overlay District, and support redevelopment of Brownfield sites.<sup>38</sup>

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<sup>38</sup> Open Space and Recreation Plan 2006-2010



**Figure 24:** Gardner Open Space and Recreation Plan Map



#### 4.1.6 Zoning

The site (57-67 Parker Street Gardner, Massachusetts) is located in a commercial and industrial zone. Specifically the Commercial I district in the downtown area which extends along parts of Parker Street, West Street, Main Street, and City Hall Avenue. Businesses and professional offices are permitted in the Commercial I district. In the Commercial I district multiple dwelling units are allowed by special permit from the board of appeals.

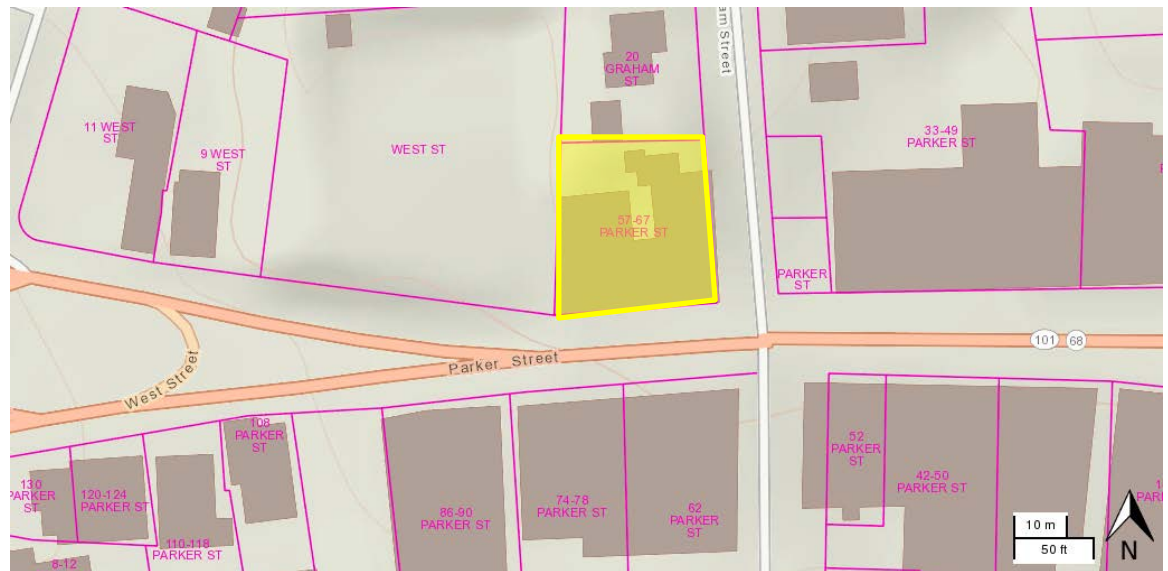


Figure 25: Site Plan<sup>39</sup>

#### 4.1.7 Building Code

The lot has an 80 foot requirement for frontage, with the minimum 10,000 square feet of area and the minimum depth of 100 feet. It is by code that it has a maximum three stories or 40 feet above the grade of the street for apartment use.<sup>40</sup>

<sup>39</sup> <http://www.city-data.com/city/Gardner-Massachusetts.html>

<sup>40</sup> Haynes Lieneck and Smith, Gardner Department of Community Development and Planning

#### **4.1.8 Climate Conditions**

Gardner has an elevation of 1,079 feet. The climate of Gardner, Massachusetts is mild in the summer and very cold in the winter. Average temperatures tend to be in the 60s during the summer and the 20s during the winter. The warmest month is July with an average temperature of 81.1°F. The coldest month is January with an average temperature of 7.6°F. The temperature variation between night and day is moderate during the summer and winter. There are 198 sunny days per year on average. The measure of our comfort index is based on the humidity during the hot months and it is out of 100, Gardner's comfort index is 52. The higher the comfort index indicates a more comfortable climate. The United States average on the comfort index is a 44 for comparison.<sup>41</sup>

Annual average precipitation is 46.47 inches. The rainfall is for the most part evenly distributed throughout the year. The average is 44 inches of rain per year. Average snowfall is 75 inches. November is the wettest month of the year with an average rainfall of 4.11 inches<sup>42</sup>

#### **4.2 Building Program**

The site for this thesis project is 57 – 67 Parker Street Gardner, Massachusetts 01440. It is currently a condemned three story building in the downtown Gardner area. The building used to be the Maki Building; it had multiple shops on the ground floor and efficiency apartments on the upper two floors. The owner of the property is Maki Building Trust Judith Falite, Trustee 7 Glen Dr. Lynnfield, Massachusetts 01940.

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<sup>41</sup> [www.bestplaces.net](http://www.bestplaces.net) Climate in Gardner, Massachusetts

<sup>42</sup> [www.idcide.com](http://www.idcide.com) Gardner, MA Weather

This property has been on the Distressed Property list from the City of Gardner Department of Community Development and Planning since 1996. This property has a Municipal Tax Lien, it is vacant, unsecured, open to weather, structural fault, condemned, has fire damage or fire risk, the wood support columns are compressing under weight of building, damaged roof, and vandalism. It also is in the priority redevelopment area which means it is in the downtown target area and adjacent to residential area which was what helped determine my choice to work with this building. Retrofitting and renovating this property will be in line with the Urban Renewal Plan for Gardner because it is in the border of that plan.

The goals for this thesis helped to determine the programmatic spaces of the retrofitted building. Those goals are:

1. Learning the craft
2. Displaying the craft
3. Community setting
4. Producing furniture for the surroundings

The achievement of those goals will be implemented through the programmatic spaces.

The implementations are:

1. Workshops
2. Showroom / Mock Apartments
3. Live / Work Factory
4. Production ability

To determine all the programmatic needs the focus was on breaking down each piece: 1) The Furniture School, 2) The Kitchen Design, 3) The Live/Work Relationship, and 4) The Community Engagement component.

The Furniture School was determined to as a two to three year program with a very small student body. There would be one to two teachers and one staff member that would handle the administration responsibilities. The students would apply to the school for interest in learning the craft of furniture making by hand and also a live/work environment. The furniture school is structured around the leaning aspect as well as the factory production. The school needs room for the classroom learning and workshop learning. The workshop also needs to be fully functioning for manufacturing the furniture. For these spaces to be fully functioning the program requires restrooms, circulation paths, and ease of material / product movement.

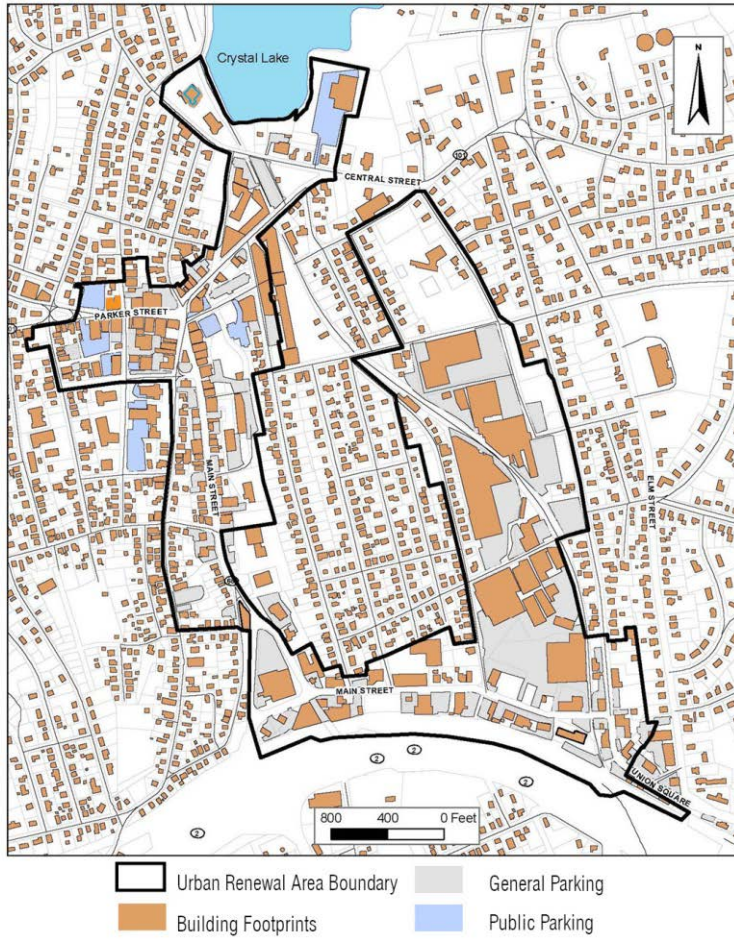
The Kitchen Designs programmatic needs are the freight elevator, as well as ample storage space for raw materials and finished product. The furniture making flow was determined as a continuous loop whereas raw materials come in get used during production, assembly, finishing, and then get sent out the same location they came in. The materials in / products out flow needed to be in a good location for loading and unloading trucks.

The Live / Work Relationship was something that needed to be incorporated in almost all of the programmed spaces. The relationship of student and teacher from their place of work to their residence is both public and private. The sense of community needed to be prevalent when it came to the program of the working spaces as well as the

living spaces. The sense of living and working in a small city and the proximity to the downtown area lead to the programmatic needs in the building.

The Community Engagement component needs for program spaces truly center on visibility. Visibility to the street for pedestrians and drivers called for the location closest to the sidewalk. This component also needed space for display to show the furniture pieces to the public. The ability to see the students in action working on the kitchens was a focus of the program. Space for viewing was needed. The administration staff member needed space for engaging with the public for guiding them around the facility or for purchase of the kitchens.

After considering all the programmatic needs of the different piece of this thesis many spatial diagrams were made and tested out. Adjacencies were determined and the program took shape within the building. With the programmatic pieces determined the initial program was set using three-dimensional software for a better understanding of the sizes of the spaces.



**Figure 26:** Gardner Urban Renewal Plan Map



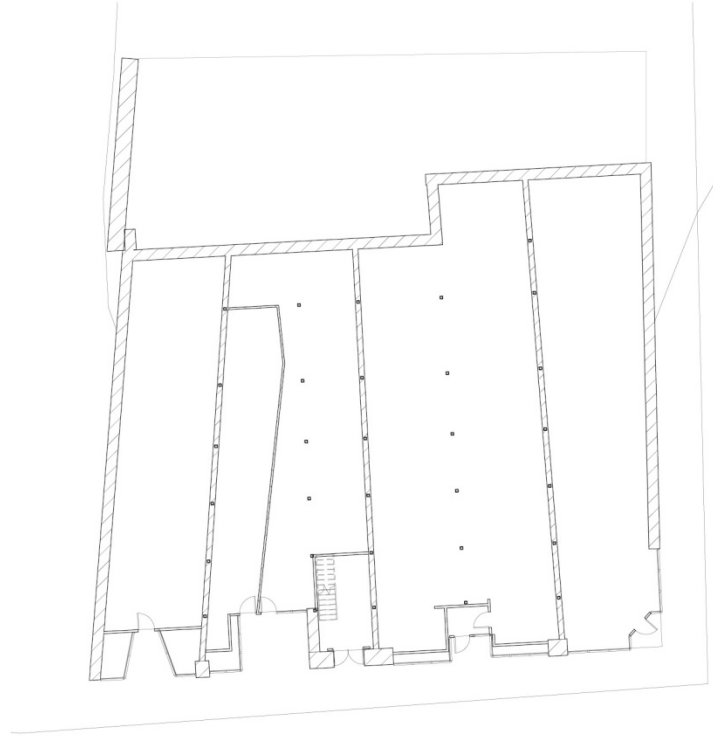
**Figure 27:** Site Plan (Image by author)



**Figure 28:** Photograph of Existing Building (Photo by author)



**Figure 29:** Photographs of Existing Building (Photos by author)



**Figure 30:** Existing Conditions First Floor Plan<sup>43</sup> (Image by author)



**Figure 31:** Existing Conditions South Elevation

<sup>43</sup> Modeled in Revit by author from plans by Haynes Lieneck and Smith, Gardner Department of Community Development and Planning



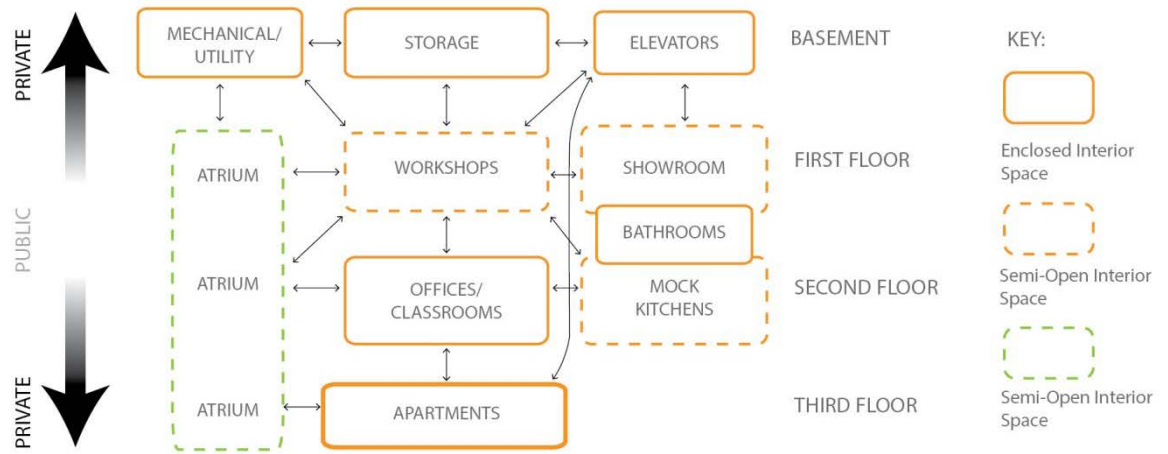


Figure 32: Program Relationships Diagram (Image by author)

27,403 Total Square Feet	
Basement - 7,088 SF	Freight Elevator
	Storage
	Mechanical
	Utility
	Circulation Elevator / Stairs
First Floor – 6,989 SF	Showroom
	Restrooms
	Workshop
	Freight Elevator
	Atrium
	Circulation Elevator / Stairs
Second Floor – 6,663 SF	Freight Elevator
	Atrium
	Office
	Classroom
	Showroom / Mock Kitchens
	Restrooms
	Circulation Elevator / Stairs
Third Floor – 6,663 SF	Freight Elevator
	Atrium
	3 Apartments
	Community Living Space
	Laundry Room
	Circulation Elevator / Stairs

**Table 1:** Program Breakdown Table (Image by author)

## CHAPTER V CONCEPTUAL AND SCHEMATIC DESIGN

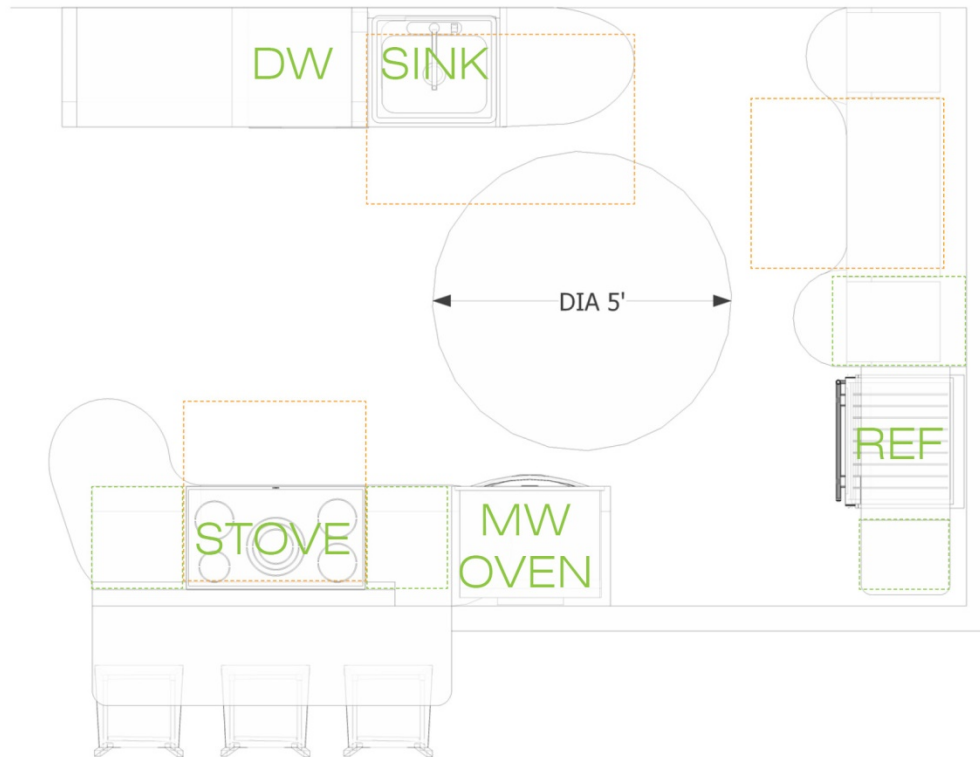
### 5.1 Conceptual Design

The conceptual design phase started with the design of the programmatic elements before the overall design. There was a need to determine the universally designed kitchen pieces to inform the ideas on the production layout. The kitchen production determined the scale of the workshop. The machines and spaces required for the workshop determined the layout of that space. The Furniture School program needed to be realized before the classroom and apartments could be designed. All of these considerations had to be fixed into the existing building and then the design of the overall building took form. This was a building designed from the inside out.

The existing building was used as a shell for the concept. The exterior walls and floors were kept but the location of the elevator and stair circulation cores were determined by the program and zoning requirements. An atrium was designed to start on the first floor and extend above the roof. There was an inset in the back of the building that allowed for the design of the atrium to work. The design replaces the three walls that formed the inset in the back of the building and adds another wall to close it off. The walls will be replaced with Low E argon filled glazing for a transparent atrium with a glass roof.

During this phase a study model was made to try and understand where the public and private circulation would be located. It was made with the existing structural grid and floor plates with different colored twine woven through to signify circulation paths.

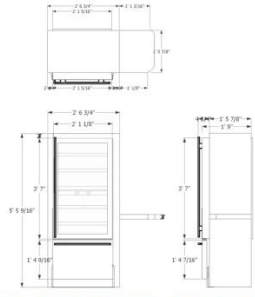
There was also an exploration into the exterior façade and how to open that street scape visibility up.



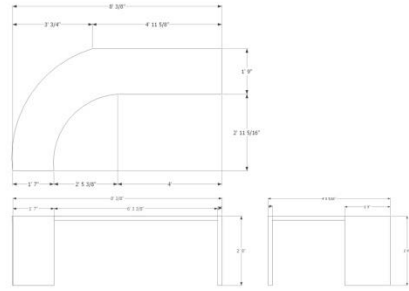
**Figure 33:** Universally Designed Kitchen Layout Diagram (Image by author)



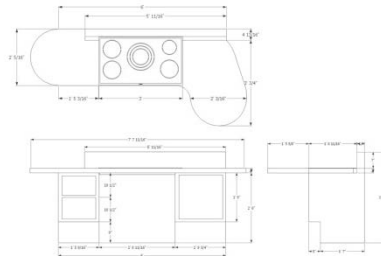
**Figure 34:** Kitchen Modules (Images by author)



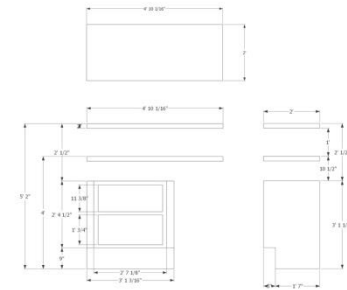
REFRIGERATOR



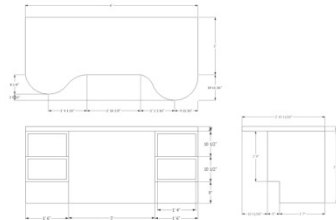
CORNER COUNTER-TOP



STOVE-TOP / PREP AREA



STORAGE



WORK AREA / STORAGE

Figure 35: Kitchen Modules (Images by author)

The Strategies used in the kitchen designing process were:

- Counter top Height = 32" - 34"
- Minimum Width for Knee Space = 30"
- Minimum Depth for Knee Space = 19"
- Bottom of Sink to Floor = 27"
- Depth of Cabinet = 24"

Wheelchair footrest clearance Height = 9"  
Wheelchair footrest clearance Depth = 5"  
Wheelchair Turning Diameter = 5'-0"  
Minimum Width for Walkway = 3'-0"  
Storage range:  
    Height = 48" - 15"  
    Depth = 21"  
Rounded counter tops for better functionality  
Sink and Dishwasher next to one another  
Landing areas (counter top space) next to the Refrigerator, Oven, and Stovetop  
Open under the Sink, Stovetop, and Work-surface  
Easy on faucet  
Lighting should be adjustable and from multiple locations

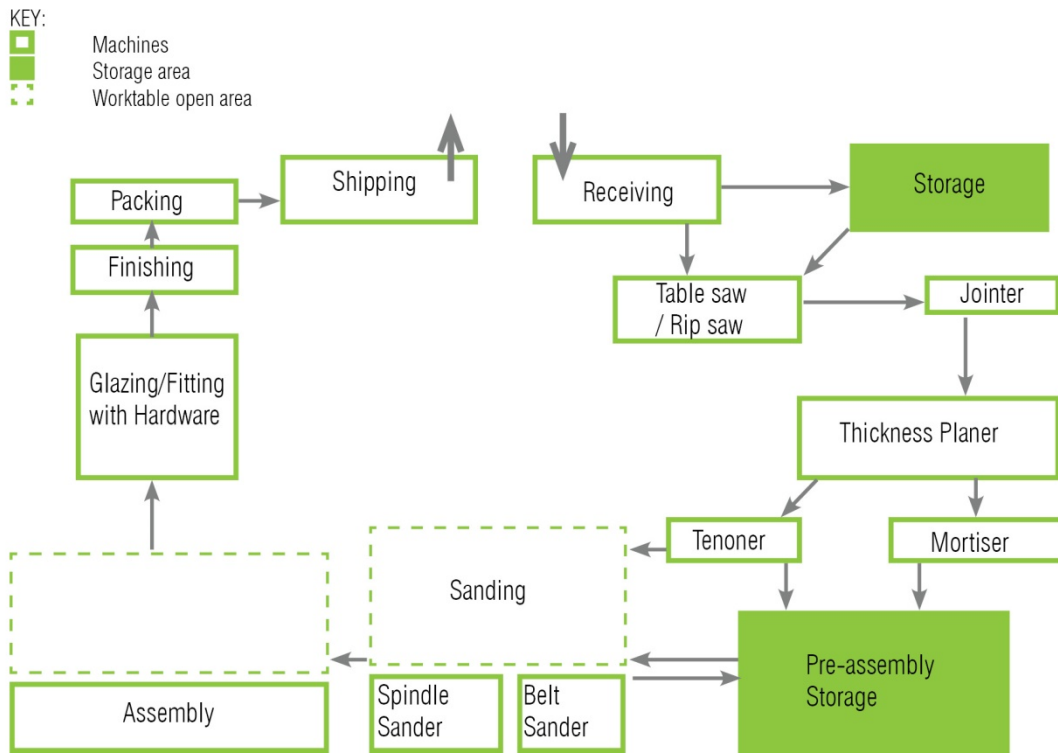
## 5.2 Schematic Design

The schematic design phase took into account the design of the furniture pieces for the production aspect of the design. The strategies used to determine the kitchen modules were universal design and the study of how a kitchen is used. The physical use of a kitchen as an able person and as a disabled person was taken into consideration during this process. The different stages of use in a kitchen were researched and in this phase it was determined what kitchen staples needed to be next to each other. For example the sink and dishwasher pairing was recognized. The determination of sizes of the modules was established. The sizes informed the relationship between the kitchen modules to one another. Different configurations were tested out by hand with drawings and then in three dimensional form.

The shipping / receiving door and loading area was determined in this phase. The existing retaining wall that blocked off the public parking lot and the back of the site is to be demolished. The trucks will have access to the back of the workshop floor for shipping and receiving materials and product. The realization that the existing structural column grid was too close together in the workshop area introduced the idea of changing

the structure. The wooden structure is failing so taking out some columns and supplementing with glulam beams was proposed. This will create a wider bay for the furniture production as well as in the upper floors. The structure will also be stabilized with this approach.

During this phase the apartment styles were decided and roughly configured into the third floor. The locations of the elevator and stair cores were also in rough locations at this time. Sketches were done during this time to layout the different spaces on all of the floors. The iterations were also done in three-dimensional software along the way.



**Figure 36:** Furniture Production Flow Diagram (Image by author)

## WORKSHOP EQUIPMENT BREAKDOWN

	Location Indicator	Equipment Name	Dimensions	Quantity
RECEIVING / SHIPPING STORAGE PRODUCTION	1	Storage Racks	Varies	1
	2	Table Saw	24" x 30"	1
	3	Sliding Table Saw	15" x 48"	1
	4	8" Jointer	9" x 75"	1
	5	12" Jointer	13" x 84"	1
	6	12" Thickness Planer	12" x 28"	1
	7	15" Thickness Planer	15" x 42"	1
	8	14" Band Saw	14" x 14"	1
	9	20" Band Saw	20" x 20"	1
	10	Drill Press	28" x 28"	2
	11	Wood Lathe	65" x 36"	2
	12	Shaper	26" x 27"	2
	13	Chop Saw	20" x 18"	1
	14	Scroll Saw	16" x 23"	1
PRE-FINISHING	15	Slot Mortiser	19" x 7"	1
	16	Grinder	19" x 29"	2
	17	Belt Sander	18" x 19"	2
	18	Oscillating Spindle-Sander	29" x 26"	1
ASSEMBLY	19	Hand Tools	Varies	20+
	20	Hand Held Power Tools	Varies	10+
FINISHING		Woodworking Bench	Varies	3
		Dust Collection	Varies	2

- - - PRODUCTION PATH     - - - MACHINING PATH

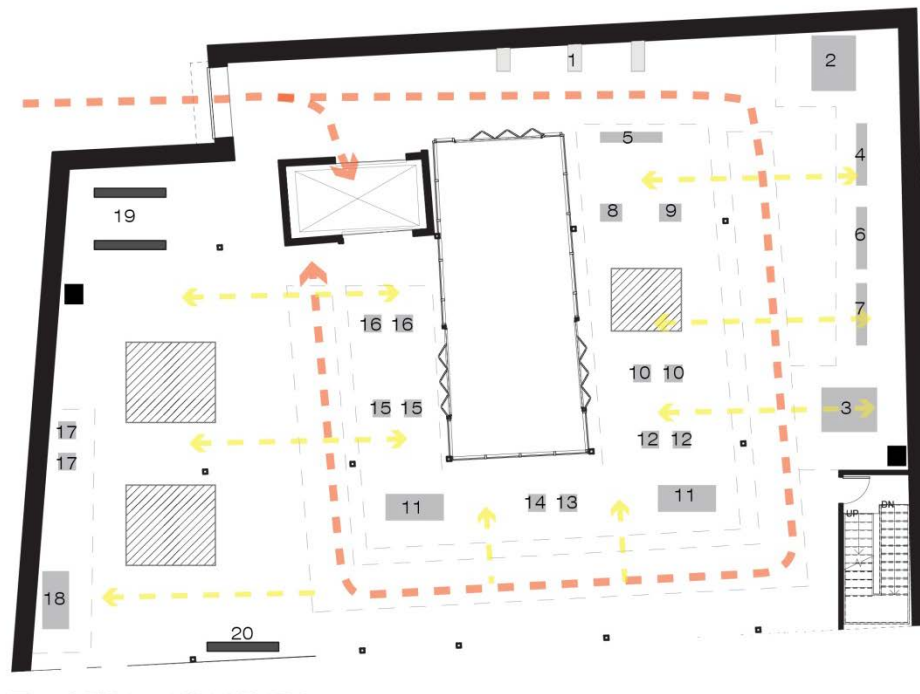


Figure 37: Workshop Equipment Breakdown Chart and Workflow Diagram (Image by author)



## CHAPTER VI

### DESIGN DEVELOPMENT AND FINAL DESIGN

#### 6.1 Design Development

As I developed the programmatic spaces to work in the building I also focused on the final designs of the kitchen modules. This concentrated my attention on the material selection of the kitchen modules. The countertop materials were something that I wanted to develop more through material selection, as it was something that I overlooked in the schematic design phase.

Materials:

I plan to combine wood and plastic in the construction of the furniture. Plastic laminate is widely used for table tops and other surfaces. The advantages for using plastic laminate are resisting stains, very heat proof against burn marks, and easy to wipe clean. There are many new laminates made with recycled plastic. There is a plastics prototyping business in Gardner and fifteen minutes away in Leominster there are plastics companies that may have scrap plastic to use for the laminate as a way to recycle and reuse.

Local Wood -

- a. Hardwood - Maple, Birch, Cedar, Oak, Walnut, Ash, Fir, Pine, and Elm. There are many manufacturers in Massachusetts
- b. Laminated Board – Plywood, Softwood, and Hardwood Plywood. There are many manufacturers in Massachusetts

Recycled Plastic -

- a. 3 Form makes solid surfaces out of recycled HDPE<sup>44</sup>
- b. Durat uses recycled postindustrial plastics and is 100% recyclable.<sup>45</sup>

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<sup>44</sup> <http://www.3-form.com/>

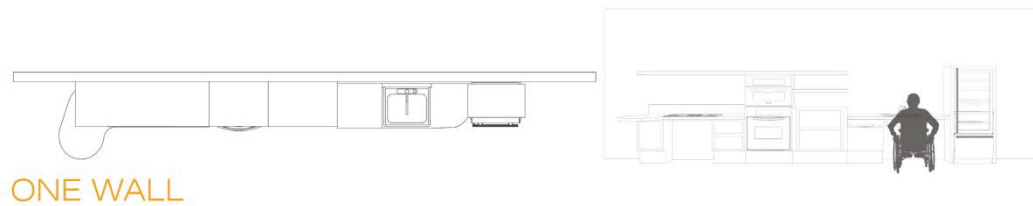
<sup>45</sup> <http://www.durat.com/>

- c. Possibility to make their own surfaces with the excess materials from the surrounding plastics companies

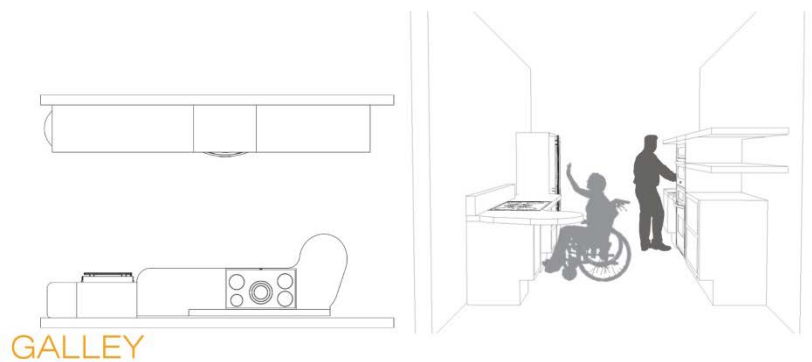
#### Recycled Glass -

- a. Recycled glass from the windows could be used in combination with the recycled plastic to form the surfaces

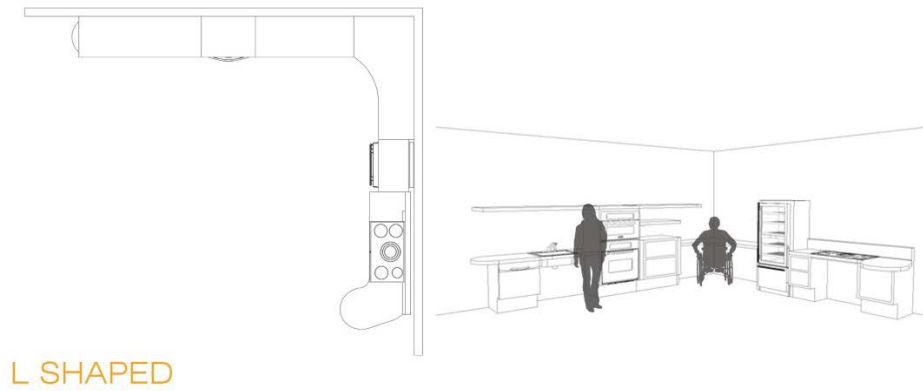
The images showing the final designs of the kitchen modules are all line drawings and perspectives that do not show the materials because the exploration process did not lead to a single outcome. Instead it leads to many different variations that could be implemented to the modules. These materials could be selected on a project by project basis depending on the intended user. This approach is in keeping with the universal design principles.



**Figure 38:** One Wall Kitchen Layout (Image by author)

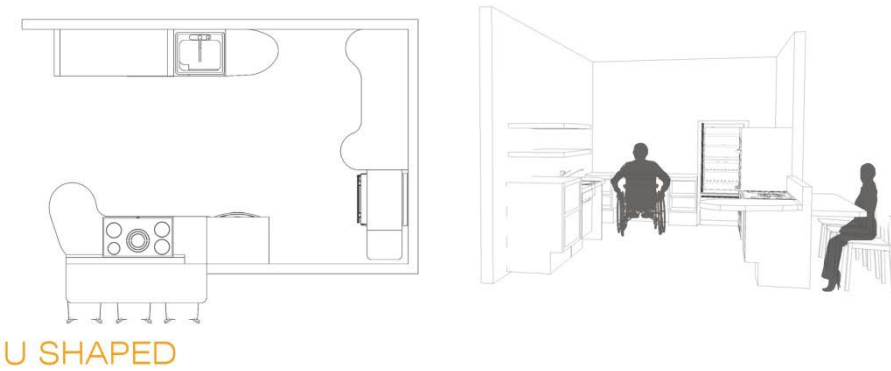


**Figure 39:** Galley Kitchen Layout (Image by author)



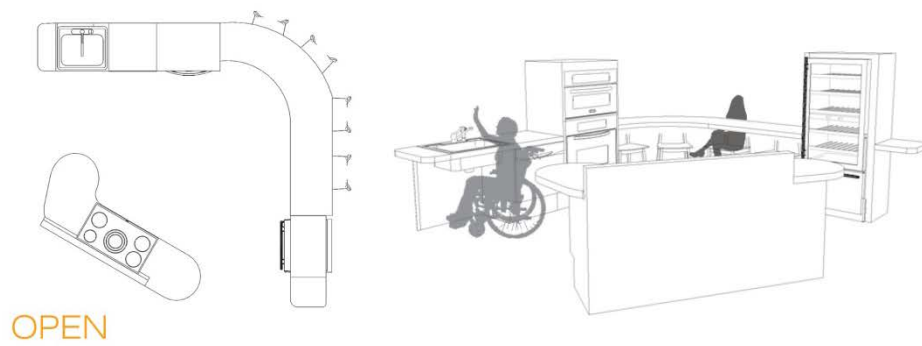
L SHAPED

Figure 40: L Shaped Kitchen Layout (Image by author)



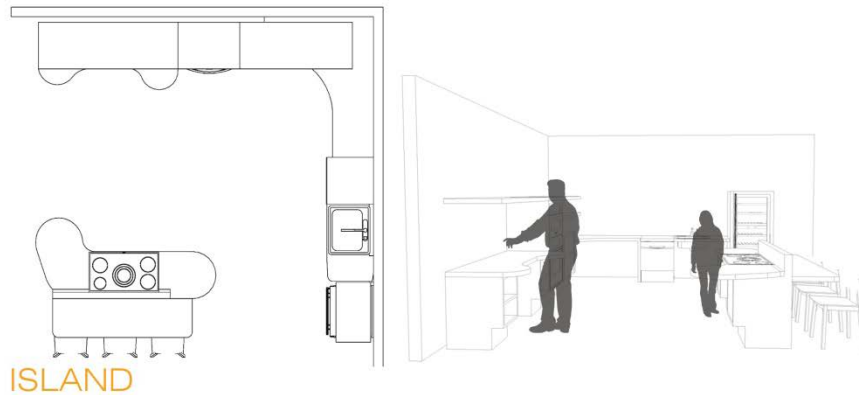
U SHAPED

Figure 41: U Shaped Kitchen Layout (Image by author)



OPEN

Figure 42: Open Kitchen Layout (Image by author)



**Figure 43:** Island Kitchen Layout (Image by author)

### 6.1.1 Development of Program Organization

After the parameters of each program piece was established the spaces were determined. The basement floor would have space for the mechanical and utility needs as well as the storage space for the raw materials and finished products. The existing two front entrances would be kept for the public to enter the building and enjoy the showroom. The showroom was designed to be open to the workshop. The workshop and showroom users both have access to restrooms (one handicap accessible) and to elevator / stairs to the second floor. The students and staff have access to the atrium hang out space. On the second floor there is enough room for the public to walk through the kitchen layouts with access to restrooms as well. The students have ample classroom and study room as well as access to restrooms. The staff has office space on this floor as well. The circulation continues for the students and staff up to the third floor where they are able to join as a community in the space around the atrium or they can be in their private apartments. In their apartments they have living areas kitchen areas restrooms and bedrooms. In the shared space there are couches for lounging and a large dining

table for community dinners. The residences also have access to a laundry room on this floor.

The designs of all of these spaces with the exception of a few dorm rooms are all ADA accessible. The goal was not only for the furniture to be universally designed but for the whole facility to be universally designed. Anyone can visit the building and get to all the public spaces with ease. Additionally, anyone that wishes to become a student or staff member can work and live in this building without a worry that their disabilities could prevent them from doing so.

### **6.1.2 Sustainable Strategies**

The sustainable retrofit practices for the project started with the selection of the site itself. It has great potential because of its proximity to the downtown. This location promotes walking and biking. A new business in downtown encourages growth and the initiative to stay local. The community nature of the facility can encourage the development of surrounding buildings to renovate abandoned buildings instead of letting them go to ruin. The success of this furniture manufacture could lead for the need of a larger facility; leading to the expansion and use of other distressed buildings in Gardner for production.

Community engagement opportunities with this project could reach people that are unaware of the stress humans put on the environment. The betterment of the city could result from this not only economically but on a personal level. Keeping furniture manufacturing practices in the United States and fostering the growth of handcrafting is the revitalization that can be sustainable.

The sustainable practices used in the building itself started with the buildings envelope. The envelope was improved with added insulation. The windows would be replaced with Low-E argon filled glass. Daylighting is created from the front glazing addition and also from the interior atrium. The interior atrium also serves as a natural ventilation path with operable parts. There would be a grey water system in place to recycle water in the whole building. The heating and cooling system would be an Air source heat pump to radiant floor with refrigerant cooling. Air source heat pumps take energy from the outside air and generate heat from it to be used in the building. This energy is tied into the hydronic heating application of radiant floors to give off the heat to the spaces that need it. When the building is in need of cooling during the summer the process is reversed and the system can cool. There would be an energy savings with this approach as opposed to a more conventional active heating and cooling system. Using hydronic system is more efficient when it comes to the amount of heat input as opposed to an air distribution system. There would also be waste heat recovery unit to use the waste heat from the machines and dust collectors. There is potential for photovoltaic panels on the roof for electricity production as well as a green roof.

## **6.2 Final Design**

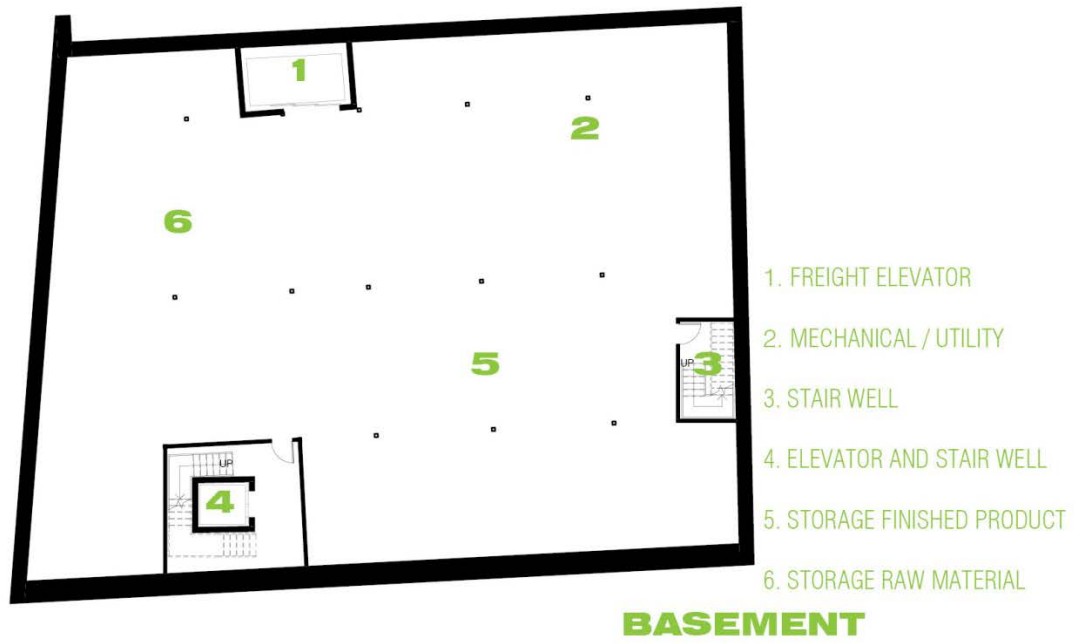
During the final design phase the building program was fine tuned. There were improvements made to the living spaces in the apartments and also the addition of a shared laundry space. The gathering space around the atrium for residents was finalized with the addition of the large dining table and lounge space. The apartments themselves were finalized with the kitchen layouts that fit the needs of the space available, as well as

the type of use they would be getting. The addition of the kitchen modules and layouts were made to the showroom and mock kitchen areas.

The seating and lecture accommodations were finalized in the classroom space on the second floor. A long high-top seating row was determined for the west side of the atrium for views to the workshop floor as well as study space. The curved seats and small table tops are Magnes II sofas (450, 490, and 300 series)<sup>46</sup>. These were decided on for east of flexibility for students to attend a class and face in one direction and also to form groups and sit in circles or half circles together. The large boards were determined for use of the teacher; they could be in the form of a blackboard, a dry erase board, or a pin board. The rectangular tables with stools were determined for working with hand tools in a more hands on learning environment. Surrounding the classroom space are bookshelves that could house research materials, text books, and reference work. Along the north and east wall in the classroom intermitted with the bookshelves is a horizontal surface to be used as a desk.

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<sup>46</sup> Magnes II. BN Office Solution. <http://www.bnos.com/en,meblewypoczynkowe,33,13.html>



**Figure 44:** Basement Floor Plan (Image by author)





**Figure 45:** First Floor Plan (Image by author)

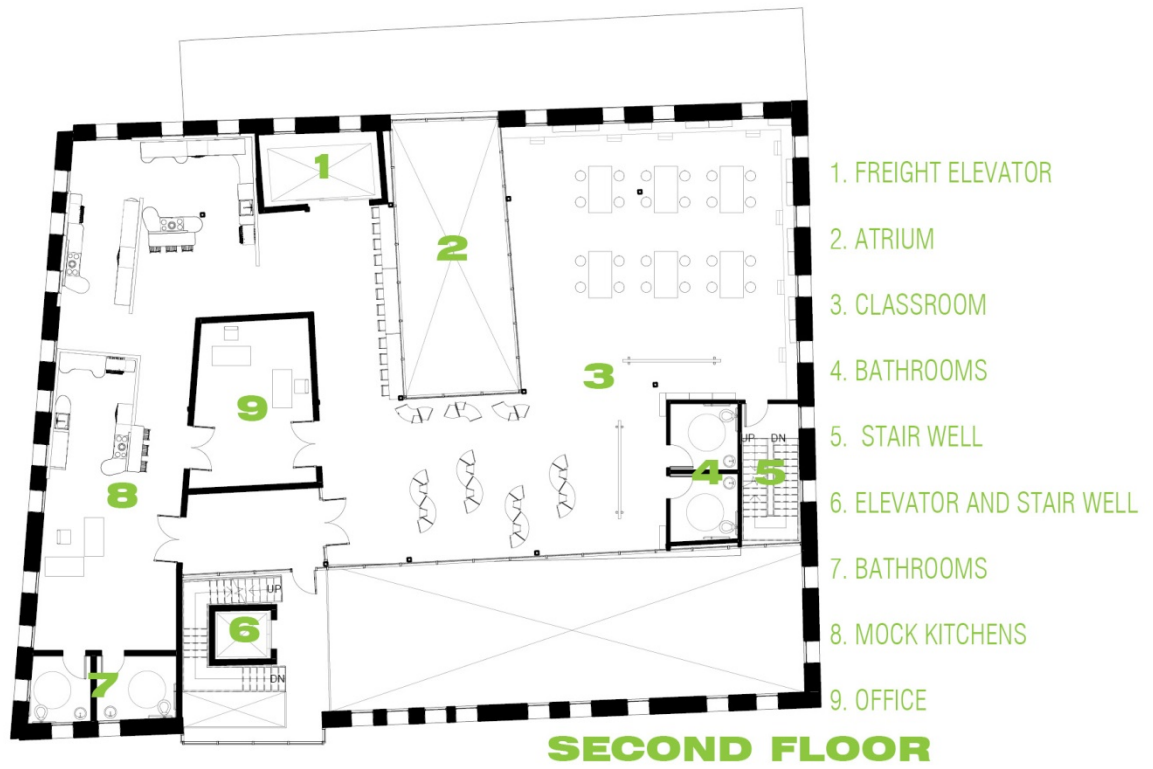


Figure 46: Second Floor Plan (Image by author)

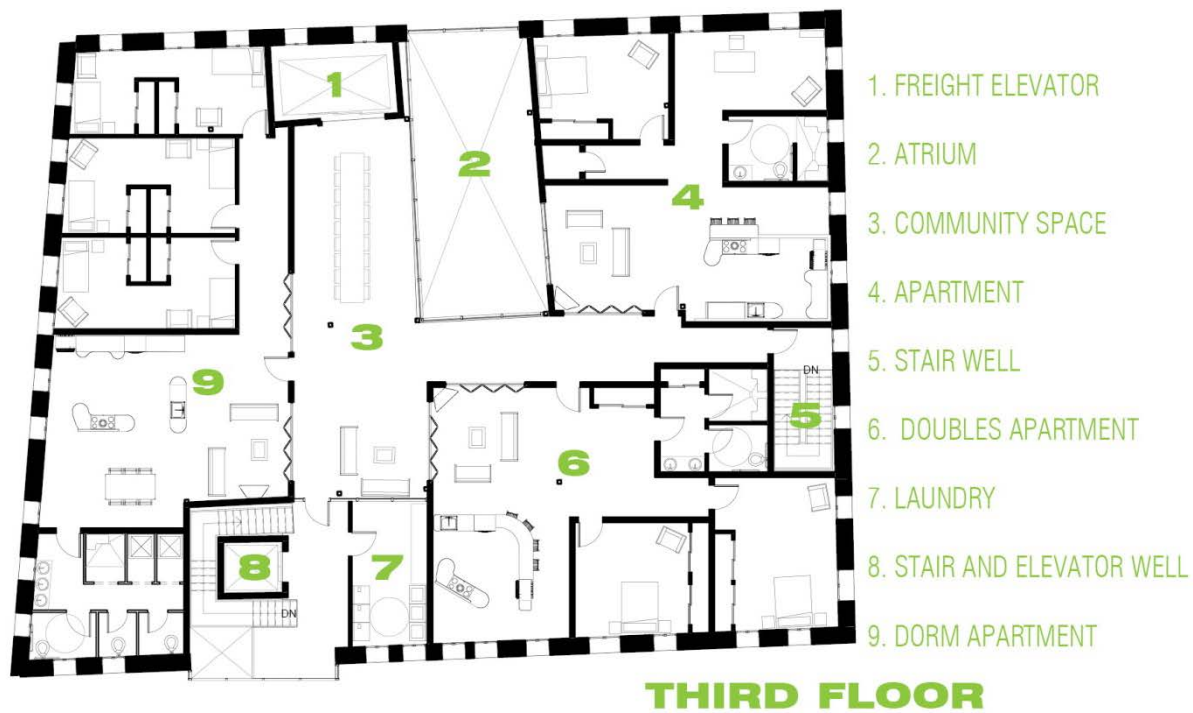


Figure 47: Third Floor Plan (Image by author)



## EAST ELEVATION

Figure 48: East Elevation (Image by author)



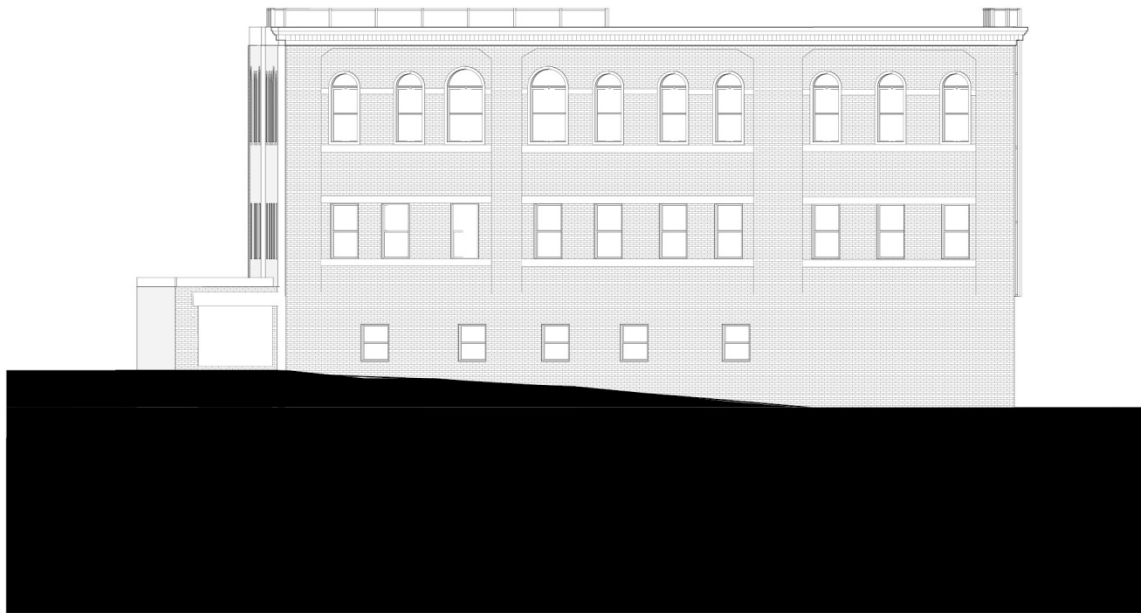
## NORTH ELEVATION

Figure 49: North Elevation (Image by author)



## SOUTH ELEVATION

Figure 50: South Elevation (Image by author)



## WEST ELEVATION

Figure 51: West Elevation (Image by author)



## SECTION A

Figure 52: Section A (Image by author)



## SECTION B

Figure 53: Section B (Image by author)



**Figure 54:** Exterior Rendering (Image by author)



**Figure 55:** Interior Rendering 1 (Image by author)





**Figure 56:** Interior Rendering 2 (Image by author)



**Figure 57:** Interior Rendering 3 (Image by author)



**Figure 58:** Interior Rendering 4 (Image by author)

### **6.3 Concluding Summary**

At the forefront of this research was the furniture making craft, and how it could be reestablished in the small city of Gardner. The goals reached farther than the universally designed furniture production aspect but to a broader form of living and working in a small communal setting that foster community engagement. All of this research and investigation lead to a new form of architecture for living, working, and teaching. The approaches of universal and environmental design steered the project along. This framework of a revitalized crafting industry housed in a retrofitted building could radiate out to other communities and cities over the nation. Although, this projects’

feasibility is dependent on a multitude of factors this thesis project proposes a very plausible direction for redevelopment and could spark new interest in the city.

Specifically for Gardner this thesis examines a gap that could be filled in the downtown area to revitalize the community interest back to local manufacture. The process of universally designed facilities and furniture making practices is a step in the right direction when it comes to architecture in the future. New activity in the downtown area will be created through the students and staff of the furniture school. This activity and production on a local city scale is proposes a step Gardner can take to better itself universally, environmentally, and economically.

## APPENDIX A

### SUSTAINABILITY ETYMOLOGY

Sustainability. Such a broad term, that has so many meanings associated with it. There are so many views on this topic all over the world. This word has come a long way from its inception into the mainstream. I have been interested in the topic of sustainability, sustainable development, environmental thinking, and green practices among many other terms that it is known under. Even though I have been interested in this topic for many years, after learning about it formally and researching about it independently, I have never once tried to delve into the origins of the word sustainability itself. My hope is to find some answers about how the word has come to be, and the progression of its meanings over the years. These meanings will be different in various cultures. And it is my goal to find where these shifts in perception come from, after knowing all about the linguistics of the word Sustainability.

After taking a few environmental and sustainable driven classes I am still unaware as to where the origins of the word come from. The main focus of those classes were all about the implementation and method that is sustainability, whether it be for architecture, product design, development, economics, and all other things that can become a sustainable method. The way in which to follow the method was what I have studied in great depth and it is not until now that I have actually stepped back and realized that I was missing the original language itself. The background of the linguistics and how the meanings have changed over the years will be the first part of this essay. The second part

will be about the progression into today's world, and what the future of sustainability is, and what it means to the inhabitants of the Earth at this time.

First in this exploration I needed to look into the word itself for the origins. Sustainability is ultimately the union of the words sustain and ability. Sustain has a very early origin in the French language, starting as far back as 880 as *soutenir* which at that time meant to bear, withstand, endure. The progression of the word follows along with the definitions: providing food for, to strengthen, to bear the weight of, to defend, to bear a charge or expense, to support, to preserve, to keep from failing or giving way, to support with food or resources, to endure, to tolerate, to hold, to keep. All of these definitions were from 1050 through 1340. In 1340 the classical Latin word for sustain – *sustinēre* emerged. As well as Old Occitan – *sostener* in 1272, Catalan – *sostenir* also in 1272, Spanish – *sostener* in 1218, Portuguese – *suster* in the thirteenth century, and Italian – *sostenere* in 1292. The definition that most relates to sustainability is:

“to keep in existence, maintain; spec. to cause to continue in a certain state for an extended period or without interruption; to keep or maintain at the proper level, standard, or rate; to preserve the status of.”

This form of the word shows up as early as 1300, in the Early English language and many others, and then continues through to the more present and in the English language recognized today in 1667. The use of the word sustain in an environmental nature first appears in 1945 in *New Biology*, stating “a gross reproduction rate sustained at a level

below 1-0 signifies that no reduction of mortality could save the community from eventual extinction.”<sup>47</sup>

This progression over the years gave rise to the incorporation of the –ability ending to the word sustain. This form of the word originated in Germany, the word was, Nachhaltigkeit, during the eighteenth century. The term in itself is ‘nachhaltiger Ertrag’ which means sustainable development, and originated with the context being associated with the professional terminology of forestry. Its origins can be traced back to the era of European Enlightenment. This was when German Kameralists were designing their dynasties of ‘woodland nachhaltig’ it was their intention to hand them off to future generations undiminished. The German Kameralists were people that were interested in Cameralism which is the science of administration, and a mercantile economist during the seventeenth and eighteenth centuries. The word was officially coined by Hanns Carl von Carlowitz in 1713. He was head of the Royal mining office and it was a fear at the time that their greatest natural resource timber could be at a shortage. The term sustained yield was a staple for foresters during this time period, long before the term was interpreted into English.<sup>48</sup>

The definition of the word more commonly known from 1835 on to present day is pertaining to “the quality of being sustainable by argument; the capacity to be upheld or defended as valid, correct, or true” and “the quality of being sustainable at a certain rate or level.”

The second definition part b starts to incorporate the environmental aspect that the word sustainability is more associated with in the present day. This context of the

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<sup>47</sup> "Sustain." *Oxford English Dictionary*.

<sup>48</sup> Ulrich, Grober. "Deep roots - A Conceptual history of "sustainable development" (Nachhaltigkeit)." (2007): n. page. Web. 1 Nov. 2012. <<http://skylla.wzb.eu/pdf/2007/p07-002.pdf>>.

definition is taken almost directly from the concept of Nachhaltigkeit. This definition and word use originated only in the 1980s.<sup>49</sup>

“**b.** *spec.* The property of being environmentally sustainable; the degree to which a process or enterprise is able to be maintained or continued while avoiding the long-term depletion of natural resources.”

To understand why this progression of the word to incorporate the environment we need to understand the context in which it was changed. The roots of the idea of sustainability come from the 1970s environmentalism movement where the ideas were about the notion of human beings outstripping the carrying capacity of the earth. Carrying capacity is defined as a noun:

“the maximum, equilibrium number of organisms of a particular species that can be supported indefinitely in a given environment.”<sup>50</sup>

There have been many thoughts on the idea of overpopulation. This means that the Earth would or will be overpopulated with humans and therefore unable to support such an abundance of people. Thoughts about this occurrence date all the way back to the 1700s, with Thomas Malthus. Thomas Malthus was an English economist and demographer that came up with this idea that the Earth would eventually become overpopulated and unsustainable of human life.<sup>51</sup>

He was not the only person to think this way, there were many to follow that had similar thoughts on this subject. The major factor in this idea is the fact that there are resources that the Earth only has so much of, so if there is a growing population there

<sup>49</sup> "Sustainability." *Oxford English Dictionary*.

<sup>50</sup> "Carrying Capacity." <[http://dictionary.reference.com/browse/carrying capacity](http://dictionary.reference.com/browse/carrying+capacity)>.

<sup>51</sup> Higgs, Eric. *Nature by Design*. Cambridge, Massachusetts: MIT Press, 2003. Print.



may not be enough of these resources to maintain life on this Earth for all the inhabitants forever. This thinking centers around parameters that are environmental, which means involving the environment and nature. This way of thinking is greatly related to the ideas and thoughts of the very first environmentalist movement and even farther back with the transcendentalism movement where political thoughts were introduced to the United States by Thomas Jefferson, Ralph Waldo Emerson, and Henry David Thoreau.<sup>52</sup>

These men introduced the main points of the environmental concerns that needed to be taken into consideration many years ago. The main points were to protect the continuity of life and quality of life through the conservation of the natural resources of the world. More of the points in environmentalism were to prevent pollution and control land use. From this there was another movement in the 1950s and 1960s that was called the “New Environmentalism” movement. This movement was more directed to the industrial development of the world and how to preserve life on the Earth.<sup>53</sup>

The economic outpours of the post-war period were being realized. The other realization was that the natural resources were being consumed at a much too rapid pace because of the elevated population of the Earth. But even after these realizations the term was not at a prominence that it is today. There was an acknowledgement in the academic community about this word and the meanings of it in the new environmental context, but to the general public it was not realized. Even the word ecology was not a prominently known word. In Rachel Carson’s book *Silent Spring* she had to define ecology because it was not a commonly used word in the general population. Her book, published in 1962,

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<sup>52</sup> Hall, Jeremiah. "History Of The Environmental Movement." Montana's for Multiple Use. N.p., 08 2008. Web. Web. 1 Dec. 2012.

<sup>53</sup> "Environmentalism." <<http://www.merriam-webster.com/dictionary/environmentalism>>.

changed the environmental awareness and the ecological thinking that was more or less restricted to the academic community branched out to the mainstream population.<sup>54</sup>

It was not until within the environmentalist and development experts in the United Nations came to a synthesis about this issue of sustainability. This synthesis was stated in the report of the World Commission on Environment and Development “*Our Common Future*” in 1987.

The common misconception before this realization of the environmentalists and the development experts was that for the environment to be healthy the industries must be regulated and restrained. The attitudes were also that if an industry wanted to take off and grow, nature cannot take priority, because these two systems cannot flourish in the same world. This gives rise to a dilemma between living towards the American dream or making sacrifices to give equal opportunities with the natural Earth to the future generations. A definition of sustainability stated by the National Research Council, in 1991:

“a person could justify farming, hunting, or other use of natural resources so long as the integrity, stability, and beauty of the particular natural community has been maintained.”

The ethical dilemma is also brought up in this quote about the theory of ethical holism:<sup>55</sup>

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<sup>54</sup> Yates, Joshua J. "Abundance on Trial: The Cultural Significance of "Sustainability"." *Hedgehog Review*. 14.2 (2012): n. page. Web. 1 Nov. 2012.

<sup>55</sup> Various, . *Science and Sustainability: Selected Papers on IIASA's 20th Anniversary*. Vienna, Austria: Novographic, 1992. Print.

“world conservation strategy should include management of the use of a resource so it can meet human demands of the present generation without decreasing opportunities for future generations.”

Janna Thompson argues that the beauty of wilderness makes them valuable in their own right and that we have a moral duty to preserve and protect them to be attractive. She feels that the appreciation of natural environments and the appreciation of great works of art are activities more similar than people have supposed. My interpretation of this is the feeling that the natural environment and great works of art should be looked at the same way. We preserve great works of literature for educational purposes for future generation’s interests. This is true for historic and great pieces of artwork are preserved in museums for future generations. The natural environment is in many ways more important to the wellbeing of our future generations needs because of how much humans rely on it for their everyday desires.

The idea of the natural beauty of the environment being an instrumental part of human beings wellbeing is G. E. Moore’s idea, as Janna Thompson states, “he regards beauty whether in nature or art, as an intrinsic good, something worthy of respect for, its own sake, and therefore something we have an ethical duty to promote. This idea is often argued between philosophers and environmentalists. The idea is that beauty is not just an instrumental value, and not just a matter of taste, because when it is properly appreciated the existence of natural beauty is enough of a reason to preserve it.

It is a common thought in a majority of the readings for researching this topic that many environmentalist and philosophers truly believe that the present generation has an

ethical obligation, right, and duty to refrain from causing drastic harm to the future generations, and this may have to happen with sacrifices and refraining from enriching itself. This enriching of the past and present generations has already caused some major environmental damage to future generations.<sup>56</sup>

These damaging effects have become apparent because of the negative side effects that were noticed on the environment and nature. Some major environmental side effects were air pollution, especially in large cities with many skyscrapers and large buildings. From air pollution, came the wider and more harmful idea of global warming. Global warming is alleged to be caused from the rise in the Earth's air temperature. In other words what are being increased are the anthropogenic greenhouse gases.<sup>57</sup> Anthropogenic are the effects, processes, objects or materials that are derived from humans. The opposite of anthropogenic would be the actions and processes that happen in the natural environment without human interactions. So in other words humans are contributing to this harmful occurrence, which has become known as global warming. Humans are contributing because it is through their actions that these green house gases have become more prevalent in the past century. Just in the past century the overall global surface temperature of the Earth has increased. If these green house gases keep increasing at such a steady rate this earth may not be able to sustain all the humans that live on it. The effects would make the Earth very cold and without the natural sources that the Earth's ecosystem provides then the effects on the Earth may become irreplaceable.

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<sup>56</sup> Boylan, Michael. *Environmental Ethics*. Upper Saddle River, New Jersey: Prentice Hall, 2001. Print.

<sup>57</sup> Hall, Jeremiah. "HISTORY OF THE ENVIRONMENTAL MOVEMENT." *Montana's for Multiple Use*. N.p., 08 2008. Web. Web. 1 Dec. 2012.

Humans need nature to survive and their dependence on nature weakens nature as a whole. More than just the dependence on physical nature, humans are mainly becoming more and more dependent on the non-renewable energy and materials that nature only has a limited supply of. This relationship does not go both ways for an even balance between both parties. The fact that “natural systems are sensitive to human sources of population, noise, and other disturbances”<sup>58</sup> are just the start of all that humans do to the environment. Although, the relationship is changing at the present time because nature is becoming more dependent on man now because of the fact that humans find happiness in the direct and indirect presence of nature.<sup>59</sup> Human actions are the causes of much of the destruction of the natural environment of the Earth. With the construction of more highways and cities, there is the destruction of more trees and forests. Having better public transportation and well-designed business and residential landscapes will prove to be more efficient to the natural environment as a whole, because it will be better for the air supply and quality.<sup>60</sup>

There are activities and less traditional factors that are practiced in everyday life that most humans do not realize as detrimental to their health. Like for instance humans do not see the factors “such as housing characteristics, land-use patterns, transportation choices, or architectural or urban-design decisions, as potential health hazards.”<sup>61</sup> In

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<sup>58</sup> van den Bergh, Jeroen C.J.M. *Toward Sustainable Development: Concepts, Methods, and Policy*. Washington, DC: Island Press, 1994. Print.

<sup>59</sup> van den Bergh, Jeroen C.J.M. *Toward Sustainable Development: Concepts, Methods, and Policy*. Washington, DC: Island Press, 1994. Print.

<sup>60</sup> Kochtitzky, Chris, and Richard Jackson. "Creating a Healthy Environment: The Impact of the Built Environment on Public Health." *Center for Disease Control and Prevention*. N.p.. Web. 1 Nov 2012. <<http://www.cdc.gov/healthyplaces/articles/Creating A Healthy Environment.pdf>>.

<sup>61</sup> Kochtitzky, Chris, and Richard Jackson. "Creating a Healthy Environment: The Impact of the Built Environment on Public Health." *Center for Disease Control and Prevention*. N.p.. Web. 1 Nov 2012. <<http://www.cdc.gov/healthyplaces/articles/Creating A Healthy Environment.pdf>>.

many of the same ways that most humans choose to disregard or ignore these potential hazards, they disregard or ignore the strain that they are putting on the environment. By ignoring the fact that humans are causing the deconstruction of the Earth's natural environment as we know it, there is more damage that is being done by those that choose to do this. I feel that it needs to be known by all, because these effects that humans have caused are not just going to go away easily, or at all.

The damage done on the environment that is inflicted by human activities render those activities unsustainable, and with this it is clear that those activities cannot be projected to continue in to the future. The reasons for this is the fact that the activities may have already destroyed the environmental conditions necessary for that continuation, or because the activities environmental effects will cause massive unacceptable damage to human health and disruption of human way of life on this Earth. (Towards Sustainable Development 26) I believe that humans need to become mindful of the risk that their actions can endanger the survival of their life and the lives of others on the Earth. The opposite of sustainability is unsustainability. Unsustainability is defined as an effect on biota or the human way of life that prevents the way of life from continuing, or incurs an unacceptable risk of preventing it from continuing in the future.<sup>62</sup> The three main problems when talking about unsustainability are: 1) Qualitative - which is the excessive emissions that lead to excessive concentrations, which lead to unsustainable effects. 2) Quantitative – Which is the excessive extraction that lead to excessive depletion, which leads to unsustainable effects. 3) Spatial – which is excessive occupation (of space) leads to excessive congestion, which leads to unsustainable effects.

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<sup>62</sup> van den Bergh, Jeroen C.J.M. *Toward Sustainable Development: Concepts, Methods, and Policy*. Washington, DC: Island Press, 1994. Print.

This planet is our own and as humans, being the most evolved species, we are directly affecting everything else on this Earth. And even in some ways humans destroy Earth altogether, by harming the natural environment to the point of no return. Humans are native to this planet and this planet alone which William McDonough and Michael Braungart would agree, as they state that,<sup>63</sup>

Focusing on the planet that is in need of an overhaul is just what sustainable ways of thinking are all about. I feel that the thoughts of the environmentalists and philosophers from the early days of sustainability are being lost in the mainstream ideas

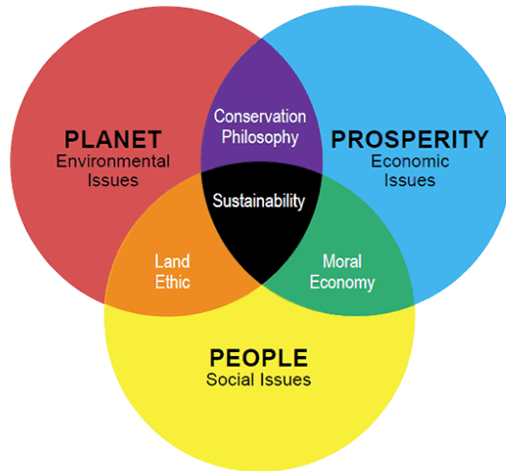
“Humans evolved on earth, and we are meant to be here. Its atmosphere, its nutrients, its natural cycles, and our own biological systems evolved together and support us here, now...Let’s not make a big mess here and go somewhere less hospitable even if we figure out how. Let’s use our ingenuity to stay here; to become, once again, native to this planet.”

of sustainability. The realization is not clear to many people that what they are doing and using could affect the environment. Why would one want to trash the Earth that they live on? Not only would this effect themselves but also generations to come. It would be so much easier to follow the sustainable design and architecture processes when living life on the planet that one is accustomed and native to.<sup>64</sup>

This is something that one would hope all human being are thinking about but in my research I have seen that the word sustainability has moved from what the meaning started out as, into this word in itself. To put that in a different way, I feel that just like Joshua J. Yates, the word sustainability has reached the status of a master term. It is a

<sup>63</sup> McDonough, Braungart, and Michael William. *Cradle to Cradle*. New York, New York: North Point Press, 2002. Print. Castree, Noel. *Nature*. New York, New York: Routledge, 2005. Print.

<sup>64</sup> McDonough, Braungart, and Michael William. *Cradle to Cradle*. New York, New York: North Point Press, 2002. Print. Castree, Noel. *Nature*. New York, New York: Routledge, 2005. Print.



**Figure 59:** Sustainability Venn Diagram

word of our moment and it has stretched away from its deeper environmental, ecological, economical, and social meaning.<sup>65</sup> It has become a word for our time beginning in 2011 when there were two publications reporting a global call for sustainability. The two reports were “The Stockholm Memorandum” and “Fate of Mountain Glaciers in the Anthropocene” and they both called for our current population to “protect the habitat that sustains us”. And there are many more organizations dedicated to the cause of sustainability in one way or another. These efforts are ranging from sustainable economic development, sustainable architectural design and city planning, fashion and apparel, energy, farming, education, healthcare, and more.<sup>66</sup>

There has been a great increase of management programs including the word sustainability over the past years and the word has been showing up in various fields. I believe that in the industries their intentions are truly sustainable, but in the mainstream population their views on what is actually sustainable is not correct. This cartoon, which I know is meant to be funny, for me really sets in that the word itself could just continue

<sup>65</sup> Yates, Joshua J. "Abundance on Trial: The Cultural Significance of "Sustainability"." *Hedgehog Review*. 14.2 (2012): n. page. Web. 1 Nov. 2012.

<sup>66</sup> <https://greenznthingz.wordpress.com/2013/09/18/you-can-only-pick-two/>



without any grasp of the deeper meaning:

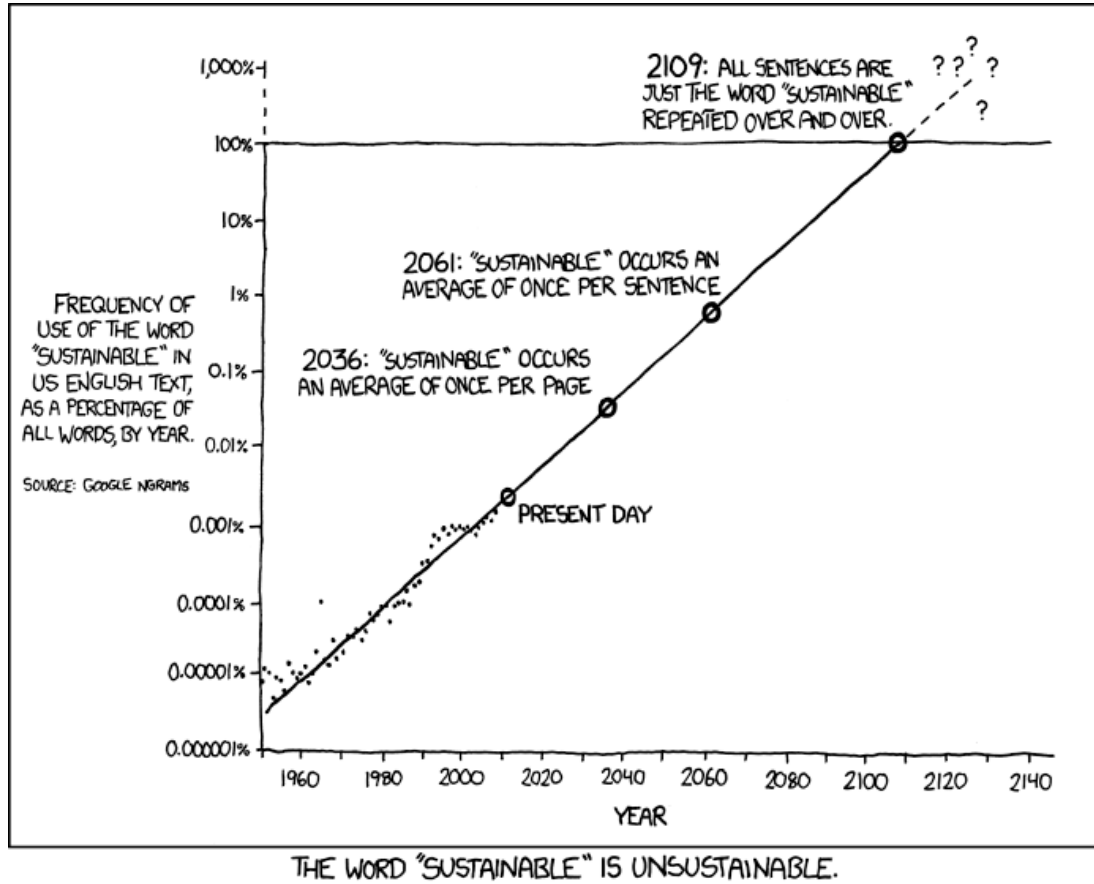


Figure 60: Sustainable Word Projection<sup>67</sup>

This illustrates to me the great loss of meaning of the original language of the word itself. I can relate to Heidegger thoughts about how language shapes our views on Being. Our ability to exist in the eyes of Martin Heidegger must also not be hidden and that language can conspire to hide Being from us. The misuse of language can destroy our authentic relation to things. In the ways words and language come to being is how they should remain and we should use them in that context and way to fully represent

<sup>67</sup> <http://mjperry.blogspot.com/2012/01/cartoon-of-day-word-sustainable.html>

what can be manifested from the language.<sup>68</sup> I feel that humans should step back and go back to the actual language of the word sustainability like I have done over the course of this research paper, and really see the greater meaning that it has.

I believe that the word could really be an economic ethic that is capable of addressing the challenges that it points to, but in the present generation I do not feel that they are capable of allowing this to happen. The need for lessening the harm on future generations is something that sustainability stands for greatly, and the simple cutbacks that humans should be taking, like recycling for example, are not practiced globally. The implementations that could negatively affect the world are not yet understood by many humans. I for one have been lead into the idea that it is just a master term of our times and that it is used just to talk about the issues that need to be taken care of in the world. To stop and take a moment to really understand that the future generation's wellbeing is in our hands would open up the eyes of the people that only think of the word sustainability as a word. But it is so much more than a word, it is a discovery, challenge, objective, and the meaning has been ever-changing since its inception. This exploration into the word itself was extremely eye-opening and much more satisfying than any other study of sustainability that I had done in the past.

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<sup>68</sup> Lawhead, William F. *The Voyage of Discovery: A Historical Introduction to Philosophy*. 3. Belmont, CA: Thompson Higher Education, 2007. Print.

APPENDIX B  
FINAL REVIEW BOARDS

The final thesis presentation boards were presented on April 15, 2015. The actual size of each board is 36" x 48".

# BUILDING FOR THE FUTURE: Revitalization through Architecture

## GARDNER, MASSACHUSETTS

### Reviving the Furniture Making Craft

#### Gardner Furniture History:



## SITE

57 - 67 Parker Street  
Gardner, MA 01440



**B. Bent & Brothers, Inc.**  
Founded: 1827  
Location: Mill Street, South Gardner  
Products: Colonial chairs, rockers, stools  
1872 - Children's chairs, rockers, stools  
1900 - 1905s - Breakfast sets and multi-  
functional furniture  
1900s - specialties: college  
and university chairs  
Closed: 2001

**Brewster - Basuchemin, Inc.**  
Founded: 1956  
Location: 114 Leamy Street  
Products: Full line of maple furniture dining,  
bedroom sets, and accessories sold  
countrywide  
Closed: 1998

**Chambers Mill Company**  
Founded: 1852  
Location: West Lynde Street  
Products: Case seat chairs, bedroom  
and dining room chairs, kitchen din-  
ing rooms and bedroom furniture in Early  
American design then Modern design  
Closed: 1990

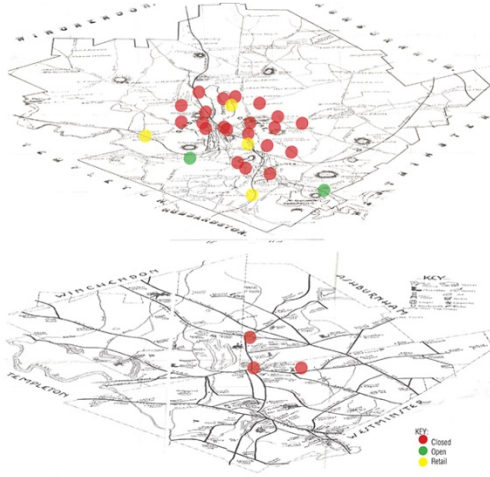
**Ralph Curtis Company**  
Founded: 1928  
Location: Route 2A near Westminster  
Products: Ladderback chairs and stools  
exclusively made to order seats are hand  
woven of rush or fiber material  
charms/wideawake.com for orders

**J.P. Darby & Company**  
Founded: 1893  
Location: Main Street  
Products: Case furniture and tables in  
1897 second largest chair manufactur-  
er in United States has branches in New  
York, Boston, and Chicago  
Closed: 1935

**John A. Dunn Company**  
Founded: 1886  
Location: East Gardner  
Products: Primarily chairs  
Closed: 1920

**Fontaine Brothers**  
Founded: 1904  
Location: 14 Leamy Street  
Products: High backs, croquet and occa-  
sional chairs  
Closed

**Gardner Craftsmen, Inc.**  
Founded: 1945  
Location: 10 Chelsea Street  
Products: Vinyl covered upholstered furni-  
ture  
Closed



**Gann Industries, Inc.**  
Founded: 1911  
Location: 214 Main Street  
Products: Bassinets and nursery furniture  
Closed: In the mid 1950s the Gardner  
plant was closed and all manufacturing  
is done in Georgia. There is an office in  
Gardner at 525 Parker Street

**Gardner Machine Works, Inc.**  
Founded: 1884  
Location: Union Square  
Products: Made special machinery for  
chair industry and repaired machines for  
chair shops  
Closed: An effort to save the site was  
made in 1980

**Dowsewood Associates**  
Founded: 1827  
Location: East Broadway  
Products: By 1900s they made rush and  
saw chairs, Windsor chairs, bow seat  
chairs, crickets, and top-top tables  
Closed: 1938

**C.H. Hamshorn, Inc.**  
Founded: 1893  
Location: near Chelsea line  
Products: Upholstered maple living room  
furniture: ender sets, children's rockers,  
and four baby strollers  
Closed: 1993

**L. & Z. Kammann Company, Inc.**  
Founded: 1948  
Location: 93 Mechanic Street  
Products: Early American chairs hand  
decorated  
Closed: 1991 building burned in 1998

**R. Singh Upholstery Company**  
Founded: 1966  
Location: 289 South Main Street  
Products: Took special orders and sold  
furniture to retail stores  
Closed: Late 1980s

**Rousseau Brothers Manufacturing  
Company, Inc.**  
Founded: 1898  
Location: 624 Main Street  
Products: Manufactured boudoir chairs  
then colonial furniture  
Closed: In 1973 became part of George  
B. Bent Company

**L.B. Ramsdell Company**  
Founded: 1879  
Products: By 1879 it was the largest  
manufacturer of doll crammies in the Uni-  
ted States they also made toy furniture,  
juvenile and adult furniture  
Closed: Sold the business to the Ameri-  
can Mills, Inc. in 1957

**S.C. Brewer & Son**  
Founded: 1830  
Location: South Gardner  
Products: Chairs for chamber suites, din-  
ing chairs, rockers with cane or oyster-  
shell seats, and some and spring office chairs  
Closed: about 1997

**Wichus & Stone Company**  
Founded: mid 1900s  
Location: Logan Street  
Products: Manufactured exclusively  
handmade reproductions of Windsor  
and other early American chairs. In 1968  
they expanded to include dining room ta-  
bles, cabinets and occasional furniture.  
In 1970s they added Shaker and country  
designs and alumni chairs with institu-  
tional logos  
Closed: 2008 terminated production and  
was bought by L. & J.S. Bockley of Man-  
hous, New York

**Winn Manufacturing Company, Inc.**  
Founded: 1959  
Location: 31 Barneil Avenue  
Products: Made Colonial upholstered fur-  
niture and sold the furniture to retail stores  
Closed: The furniture making stopped but  
they are still doing re-upholstery

**Lily Chemical Products, Inc.**  
Founded: 1825  
Location: 29 Maple Street  
Products: Manufactured coatings and  
colors for the wood and metal industries  
and developed new color treatments and  
systems for furniture  
Closed: 2000

**Kelly Brothers**  
Founded: 1889  
Location: Logan Street  
Products: Baby carriages, sun room fur-  
niture, bassinets, solid maple living room  
and din furniture  
Closed: Late 1970s early 1980s

## PRECEDENTS:

### UNIVERSAL DESIGN



### LIVE / WORK



### RETROFIT / RENOVATION



### SUSTAINABILITY



## MATERIALS

### Local Wood

**Hardwood**  
Maple, Birch, Cedar, Oak, Walnut, Ash, Fir, Pine, and Elm  
There are many manufacturers in Massachusetts

**Laminated Board**  
Plywood, Softwood and Hardwood Plywood  
There are many manufacturers in Massachusetts

### Plastic

**Recycled**  
3 Form makes solid surfaces out of recycled HDPE  
Durtal uses recycled post industrial plastics and is 100% recyclable  
Possibility to make their own surfaces with the excess materials from the  
surrounding plastics companies

### Glass

**Recycled**  
Recycled glass from the windows could be used in combination with the  
recycled plastic to form the surfaces



## PUBLIC vs PRIVATE



### First Floor Plan



## PROGRAM

27,403 Total Square Feet	
Basement - 7,088 SF	Freight Elevator Storage Mechanical Utility Circulation Elevator / Stairs
First Floor - 6,989 SF	Showroom Restrooms Workshop Freight Elevator Atrium Circulation Elevator / Stairs
Second Floor - 6,663 SF	Freight Elevator Atrium Office Classroom Showroom / Mock Kitchens Restrooms Circulation Elevator / Stairs
Third Floor - 6,663 SF	Freight Elevator Atrium 3 Apartments Community Living Space Laundry Room Circulation Elevator / Stairs

Figure 61: Final Review Board 1 (Image by author)

# PLANS



## SUSTAINABLE RETROFIT OBJECTIVES

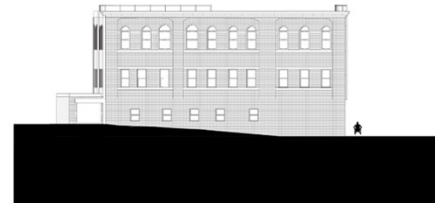
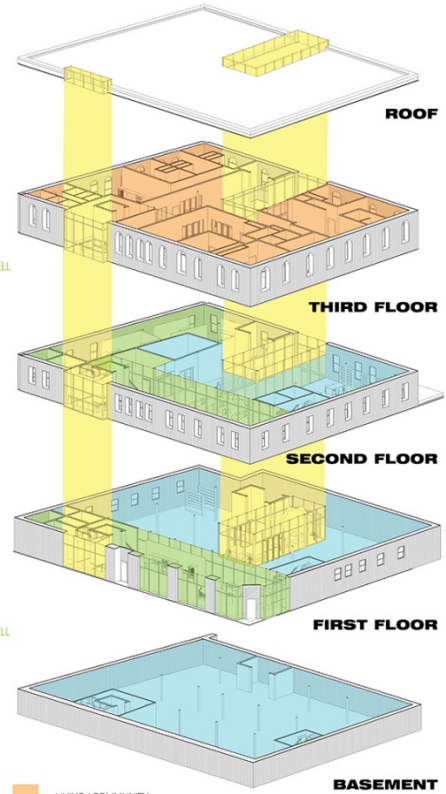
Proximity to Downtown will encourage walking and biking

Created daylighting with Interior Atrium

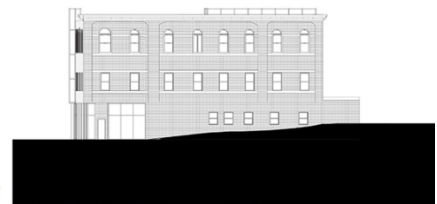
Improved Envelope with added Insulation and replaced windows with Low E Argon Filled glass

Air Source Heat Pump and In-Floor Radiant System

Waste Heat Recovery from machines



WEST ELEVATION



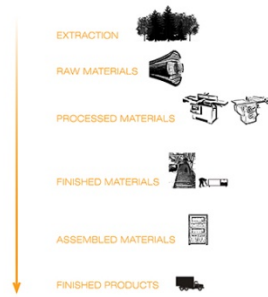
EAST ELEVATION

Figure 62: Final Review Board 2 (Image by author)

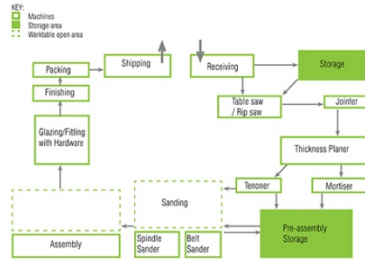
## SECTIONS AND ELEVATIONS



## FURNITURE PROCESS



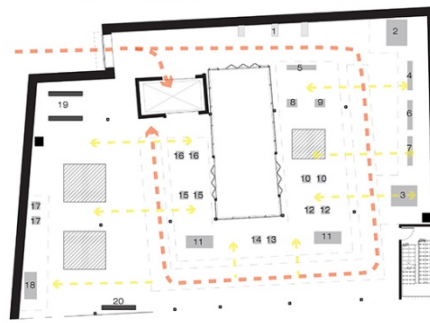
## PRODUCTION FLOW



## WORKSHOP DIAGRAM

WORKSHOP EQUIPMENT BREAKDOWN

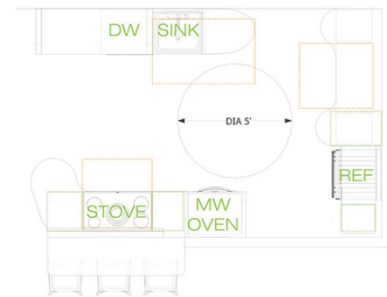
Location Indicator	Equipment Name	Dimensions	Quantity
1	Storage Racks	Varies	1
2	Table Saw	24' x 30"	1
3	Slicing Table Saw	15' x 48"	1
4	8" Jointer	9' x 75"	1
5	12" Jointer	13' x 84"	1
6	12" Thickness Planer	12' x 28"	1
7	15" Thickness Planer	15' x 42"	1
8	14" Band Saw	14' x 14"	1
9	20" Band Saw	20' x 20"	1
10	Drill Press	28" x 28"	2
11	Wood Lathe	65" x 95"	2
12	Shaper	26" x 27"	2
13	Chop Saw	20" x 18"	1
14	Scroll Saw	16" x 23"	1
15	Slot Mortiser	19" x 7"	1
16	Grinder	19" x 29"	2
17	Belt Sander	15" x 19"	2
18	Oscillating Spindle-Sander	29" x 26"	1
19	Hand Tools	Varies	20+
20	Hand Hold Power Tools	Varies	10+
	Woodworking Bench	Varies	3
	Dust Collection	Varies	2



There will be a conveyor belt system on wheels for ease of move ability. The pieces of furniture will be able to move along the production line easily.



## UNIVERSAL DESIGN

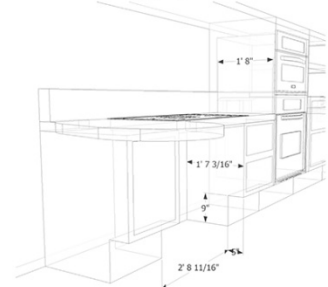


The principles of Universal Design are:

1. Equitable use
2. Flexibility in use
3. Simple and Intuitive use
4. Perceptible information
5. Tolerance for error
6. Low physical effort
7. Size and space for approach and use

Strategies Used in Kitchen Design:

- Counter top Height = 32" - 34"
- Minimum Width for Knee Space = 30"
- Minimum Depth for Knee Space = 19"
- Bottom of Sink to Floor = 27"
- Depth of Cabinet = 24"
- Wheelchair footrest clearance Height = 9"
- Wheelchair footrest clearance Depth = 5"
- Wheelchair Turning Diameter = 5'-0"
- Minimum Width for Walkway = 3'-0"
- Storage range: Height = 45" - 15" Depth = 21"



Rounded counter tops for better functionality

Sink and Dishwasher next to one another

Landing areas (counter top space) next to the Refrigerator, Oven, and Stovetop

Open under the Sink, Stovetop, and Work-surface

Easy on faucet

Lighting should be adjustable and from multiple locations

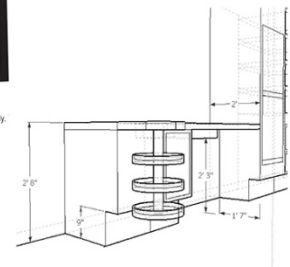
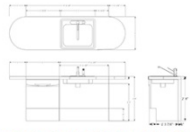
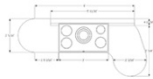


Figure 63: Final Review Board 3 (Image by author)

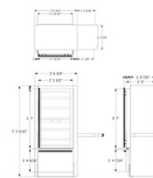
KITCHEN MODULES



SINK / DISHWASHER



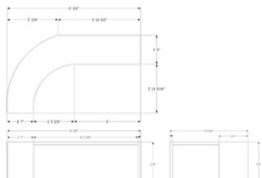
STOVE-TOP / PREP AREA



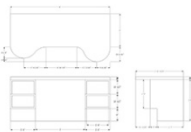
REFRIGERATOR



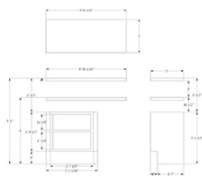
MICROWAVE / OVEN



CORNER COUNTER-TOP

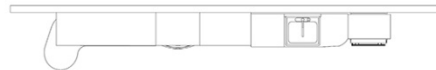


WORK AREA / STORAGE



STORAGE

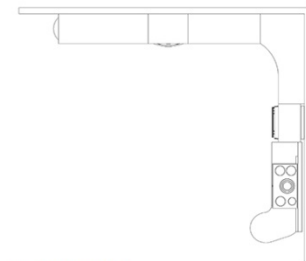
KITCHEN LAYOUTS



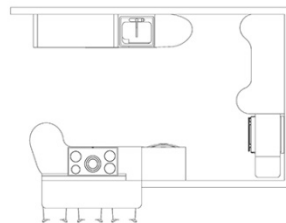
ONE WALL



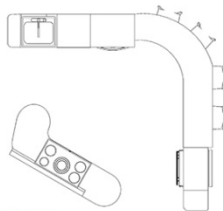
GALLEY



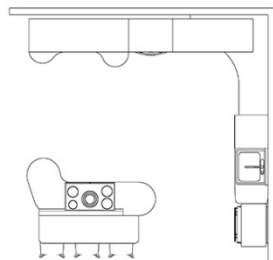
L SHAPED



U SHAPED



OPEN



ISLAND



Thesis by Rebecca Perry  
ARCH-DES 699 Master of Architecture Design

Figure 64: Final Review Board 4 (Image by author)

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