2013

Riverside Brewing Facility: The Sustenance of Water Allocation

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RIVERSIDE BREWING FACILITY: THE SUSTENANCE OF WATER ALLOCATION

A Thesis Presented

by

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

MASTER OF ARCHITECTURE

May 2013

Architecture + Design

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ACKNOWLEDGEMENTS

I wish to express my appreciation to all my professors, teachers, friends and family and especially those who were kind enough to review my work.

I am fortunate enough to have great support from the department of architecture who helped the work and design process of the project. I want to give a special thanks to Kathleen Lugosch and Stephen Schreiber who were my advisors for the project. I also want to thank Caryn Brause, Sigrid Miller Pollin, and Joseph Krupczynski for each spending time with me to discuss my thesis topic.

I am very thankful for all my friends in the architecture department who spent many hours in studio discussing our projects together.

This thesis was by far the most interesting, involved, fun, and exciting project I have worked on in my college career and I would not have been able to perform the way I did without the support of all of these people.

ABSTRACT

RIVERSIDE BREWING FACILITY: SUSTANENCE OF WATER ALLOCATION

MAY 2013

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Water is the most vital resource on Earth. We are facing a global water crisis and the time has come to investigate how we can cope with this issue at a local basis. We live in a culture that is facing economic recessions and is striving for a developmental change. In the advancement of our technological age we are looking for new innovative means of development. Our existing infrastructural conditions cannot handle the sort of social shift we are striving for. We have to become sustainable but the most important is the allocation of water. The issue I am addressing is a social reconnection. This reconnection is not specifically a human relationship but a fundamental collaboration with people, water, and architecture.

As an investigative solution, I will be developing an architecture that responds to the issue of water and social remediation. It is important to consider this investigation as a potential catalyst to show how we can cope with our needs for advancement and appropriate usage of water. To connect people, water, and architecture I will be designing a small brewery which purifies its own water and uses water to produce hydroelectricity. The architectural concept is of hydrodynamic movement. The notion is to perform a design in which water plays the main designing role. In a sense I will be designing the allocation of water as part of the architecture. I believe water as a social connector can be

a catalyst for a more symbiotic relation between a human and natural life. My intention is to present a new architectural system that is based on the premise of hydrologic conditions.

The architecture will be an involving and engaging social event. Visitors will be submerged in the architectural conditions of aquatic mechanics. The architecture facilitates an experience for a new social position in the way water is allocated. This is a place where people can converse, consume beer, and enjoy a fascinating architectural experience. A general expectation is to create an architecture that is well designed and fitted appropriately to conception of hydrologics.

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CHAPTER I

WHATS WRONG WITH WATER?

1.1 Introduction

This is a story of people, water, and architecture. Maude Barlow, author of Blue Covenant and Blue Gold, suggests that we are living in a world that faces a global water crisis and even parts of the United States have succumbed to water stress. Fresh water has been privatized and is not recognized as a human right which means we cannot drink water as we breathe air even though we need both to live (Barlow, 2007). Barlow writes, "The WorldWatch Institute has declared: Water scarcity may be the most underappreciated global environmental challenge of our time."

Humans have developed lifestyles around a built and developing environment. The Romans brought clean water into towns and cities through aqueducts and developed an underground waste water system, (Fazio, 2004). Designing the allocation of water as part of our built environment has been part of our social life for centuries. Cultural development once relied on its relation to water. Today we live in an age of technology where water is a hidden, polluted, and governed resource. Our cultural development has come to a halt along with economic recessions and environmental challenges. Water is a key tool in these areas and allocating water through architecture is a way to communicate that relation to our social life. In this thesis I will be investigating a more symbiotic model of water allocation as part of the social idiom, through architectural work.

Water is a vital part in the process of growth. According to the U.S. Navy, 80% of all people live near water, most within 6 miles of water. Unfortunately, clean potable water is becoming more scarce. Only 2.5% of the world's water is fresh and less than 1%

of that water is accessible. The other sources of fresh water are locked in glaciers, snow covers and underground aquifers. When we induce toxins and other harmful substances we are depleting what is already a finite resource (Barlow, 2007). The implementation of sustainable design has not yet taken its full impression as the main influencing dynamic. Architectural theories based on regenerative design, such as biomimetic designs, have suggested possible solutions that could better our ecological relationship (Benyus, 1997).

There are about 7 billion people in the world today and approximately one billion of those people live without access to clean drinking water. Others travel on average 3.7 miles a day to retrieve fresh water. Even in the United States there are regions of water deprivation (Barlow, 2007). We are spending money to allocate harmful waste products, when we can be spending it on a better manufactured public water infrastructure. In the northeastern United States there is not what most would consider to be a water crisis. There is an abundance of access to the supply of fresh water. The usage of water is primarily taken for granted. Living in this environment, one cannot perceive the importance of water because of its given presence. The average American uses 176 gallons of water a day while a family of four in Africa uses only 5 gallons per day. Our societies have become displaced in some ways. With an economic diminishment, businesses and private interests are developing water cartels which diminish the true value and stature of what water is to human beings (Barlow, 2007).

There is a need for a social action to take place to motivate a growing stability in economics, businesses, and industries. A great majority of working systems and societies formed over the premise of water. Utilizing water for its qualities can potentially raise a logical principle of social movement. Performing and expressing the vitality of water, architecturally, also exceeds in the search for a social reason. I have been studying the logics of hydrology and intend to expand on a hydrodynamic architecture. Hydrodynamic architecture is as an architectural design that is influenced by water and hydrologics. Water as a social connector can catalyze a more symbiotic relation between a human and natural life.

Communicating this relation to water architecturally will be challenging. To convey the sustenance of water to people in a social event, I have designed an active brewing facility. The brewery is a place where movements of water become the dominant element. The brewery carries many of the sustainable questions of water allocation. Because a brewery is made of a network of piping and hydraulic systems, the principles of water conservation, preservation, and allocation can be facilitated in one experiential event. The experience of the brewery educates people by engaging them with the mechanical systems, consumption and revitalization of water and its allocation. Along with the brewery, I have involved onsite energy generation and water purification.

On a personal note, water has had a large impact on my life. Growing up beside one of the Great Lakes, I can't imagine a world living without water due to its poor allocation. In doing research on the subject I have come to understand that water, in this quantity and accessibility, is a privilege to have. To be able to understand the emotional effect of water is very difficult and different for people in various parts of the world. I am very passionate about expressing the vitality of water through architecture and potentially introducing a new way of understanding the logics of water and how it is allocated in architecture.

CHAPTER II

WHAT IS WATER? WHERE DID IT COME FROM?

2.1 The Development of Water

Water is commonly experienced in liquid form, but can be found in solid or vapor form. Water is a result from the amalgamation[1] of two hydrogen molecules and one oxygen molecule. This creates what is water or H_2O. H stands for hydrogen, O stands for oxygen, and the number denotes the quantity of units involved. H_2O is unique in that it can be formed in a solid stage for example ice, snow, frost, or hail. The liquid stage is known as water, and finally a gas stage which is known as vapor or steam. Temperature fluctuations control these different phases. When water surpasses 100 degrees Fahrenheit or 33 degrees Celsius it begins to convert into gas. From the gas stage, water can be cooled down into liquid form and if cooled to or below the freezing point being 32 degrees Fahrenheit or 0 degrees Celsius it becomes solid.

The existence of water is, theoretically, a result of conditional changes through the course of Earth's formation. In the beginning, our solar system formed by a process known as accretion. Originally the system was a circulating cloud of dust and gas revolving around the sun. Over time the dust and gases aggregated into masses creating our planets, comets, and asteroids. Early on, Earth was uninhabitable due to its hot temperatures and dough like surface. As the Earth cooled it began the process of outgassing, which is the release of gases from molten materials. In this same period, Earth was bombarded with comets which exposed other gases. The combination of these two effects resulted in the formation of Earth's atmosphere. Examples of some of the gases were methane (CH3), ammonia (NH3), water vapor (H2O), and carbon dioxide

[1] Amalgamation is the combination of two or more elements.

(CO_2). At this stage these elements remained gaseous until the Earth cooled below 100 degrees Celsius and then condensed into rain and formed the oceans. Earth's water systems cover about 70% of Earth's surface. After water formed, about 3 to 3.5 billion years ago, single celled organisms and bacteria began to develop, thus life begins. This was the commencement of a chain reaction to growth in life. Starting out small it was only microscopic life forms, but eventually they evolved into multi-cellular organisms and plant life began to emerge. Today, the planet is 4 ½ trillion years old. Humans have only existed for about 2 hundred thousand years. In comparison, we are a young life form and potentially have a long way to go. Our planet resides in a zone, in relation to other planets in our solar system, which is called the habitable zone. This means that Earth would not be a habitable planet outside this zone due to temperature changes. Earth is one of a kind. It is unique in the sense that it holds life in such a small region of space (Fix, 2008)[2].

Water has been observed to exist on Earth's moon, Mars, and Jupiter's moon Europa. Other outer sources of water have been discovered but in solid form. The discoveries on Earth's moon, Mars, and Europa have shown temporal evidence of flowing water (Fix, 2008). Coincidentally these objects reside in the habitable zone.

[2] The information referring to Earth's formation is based on principles explained in the Astronomy Journey to the Cosmic Frontier, written by J. Fix. (2008).

Beginnings of life

Earth's Age: 4,500,000,000 years

Water & Single Celled Organisms: 3,500,000,000 years ago

Multicellular Organisms: 1,200,000,000 years ago

Dinosaurs existed: 230-63,000,000 years ago

Modern humans appeared: 200,000 years ago

Habitable Zone

Too Hot Too Cold

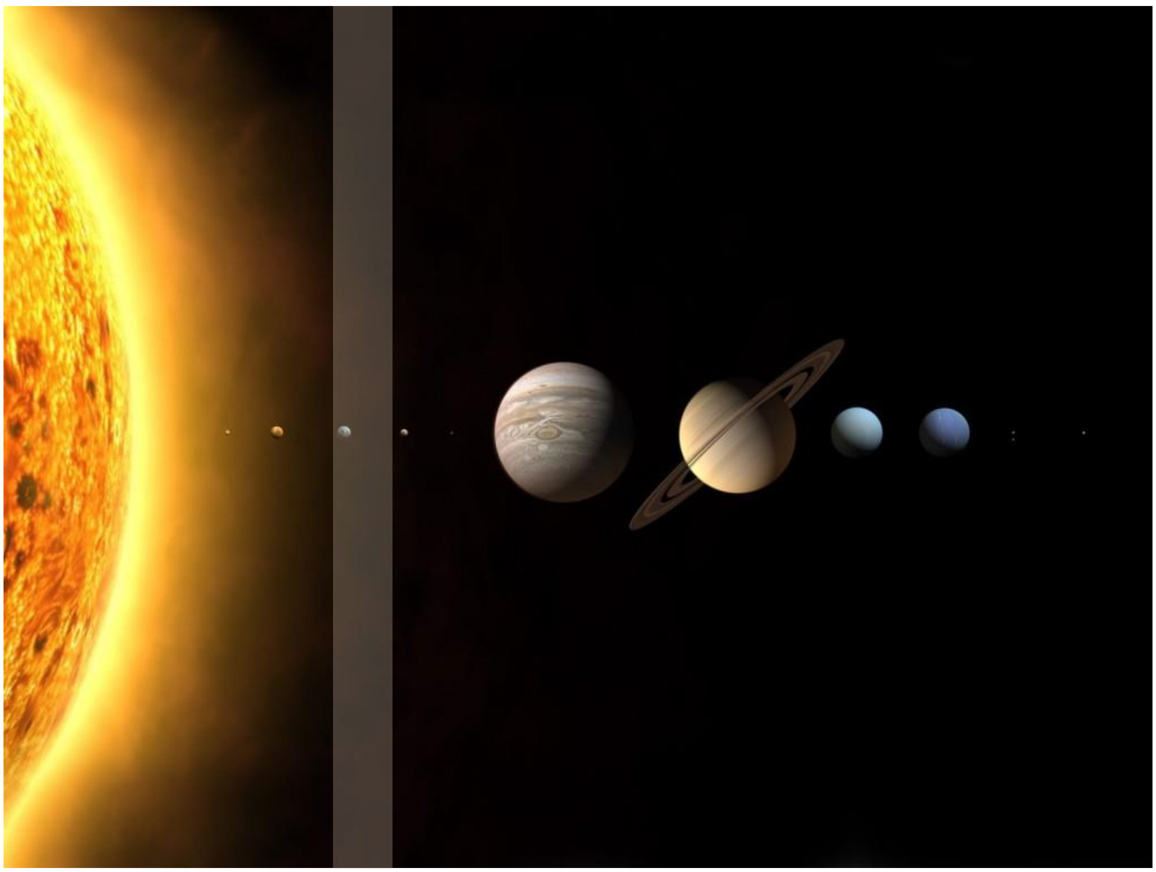

Figure 1 – Habitable Zone. The strip denotes the habitable zone which is an estimated range of the habitable distance from the Sun. Note: The image has beeen enhanced by Ryan Luczkowiak to portray a diagrammatic analysis.

CHAPTER III

THE VALUE OF WATER: LIFE AS IT EXISTS TODAY

3.1 The Sustenance of Water

Water is the supporter of life. Every living thing on Earth needs water to survive; in fact our bodies are made up of approximately 80 percent water. Our Earth's is covered by 70% of water, (Davydova, 2011). From the ocean depths to the most arid regions around the world, water becomes the most vital resource to allow a continuum of life.

Years ago during an Ice Age, much water was frozen in glaciers[3]. As glaciers formed and receded they left behind gouges within the Earth and filled these gouges with fresh water. The result of this is the Great Lakes basin in North America. The Great Lakes are comprised of 5.5 basins of fresh water. The Great Lakes holds the largest accumulation of fresh water on Earth.

Northeastern America has is fortunate to have a great accessibility to fresh water. The amount of accessible fresh water in Northeastern America surpasses any other region in the world. There are no regions on Earth where there is a higher quantity of accessible fresh water. The luxury of having this accessibility to fresh water is misconstrued. Around the world there is a desperate need for clean water. There are people who walk miles to collect their water from often polluted sources. It is easy to understand the significance of water if you live in water deprivation. In regions like Northeastern America the accessibility and resource of fresh water is not a major concern. As a society in northeastern America we expect the presence of water. Whether it is coming out of the faucet, pressing the button for the drinking fountain, or flushing the toilet, we

[3] A glacier is a large persistent body of ice that forms where the accumulation of snow exceeds its ablation over many years, often centuries.

use these amenities without question. The infrastructural system that provides water erases the significance and reality of water. Even though it may seem that water is unlimited it is not. Water is a limited resource. With population growth and higher demands for fresh water, the supply of fresh water becomes more and more stressful (Davydova, 2011).

The realization of the importance of water is an imperative social discussion. The qualities of regions like Northeastern America are extremely valuable. It is a problem that our society doesn't see that water conservation and preservation is important. The infrastructure providing water and the processes that water goes through, has become lost in the social event of architecture.

3.2 Significance of the Problem

Water stress is a global issue according to Maude Barlow. All over the world people and regions are experiencing water difficulties. Habitable lands are succumbing to desertification. An example of extreme desertification is the Aral Sea in Southeast Asia. This water basin has diminished by more than 50% in the last 20 years. In 20 years, or even less, it could possibly be completely waterless, (Barlow, 2007).

The water issue in an extreme reality happened in Johannesburg, South Africa. In August of 2011 there was a major conflict in Johannesburg, South Africa. Johannesburg holds approximately 8 million people. When the water supply was cut short and access to it was minimal, people began a major confrontation. Thousands of people fled to avoid the struggle. Crowds of people began to rebel over the political water struggle. There was an outbreak of dangerous disputes and police authorities were forced to take action. Many cases of arrest, due to assault, negligence, murder, rape, etc., were made to reestablish order. People were killed in this event over water.

Even when fresh water is accessible, it is sometimes polluted. Drinking water has the potential to be harmful. Disease and other infectious matter can infiltrate water systems which are then dispersed to water sources. People have succumbed to sickness even death from contaminated water. 90% of wastewater in developing countries is discharged into lakes and streams without any treatment. These lakes and streams are other sources of drinking water. “[The water and sanitation] crisis claims more lives through disease than any war claims through guns,” says Kevin Watkins, writing on power, poverty, and the global water crisis.

Water is the most valuable resource on earth, as it is the most vital resource to our wellbeing. Only 2.5% of the world’s water is fresh and of that, less than one percent is accessible freshwater. There is a continual increase in the standard of living and as populations increase so does the demand for fresh water. By the year 2015 it is predicted that the world population will increase by 38%. Also it is suggested that by the year 2025 more than half the world’s population could live in water stress. There is accelerating water crisis. As we induce toxins and other harmful substances we deplete what is already a finite resource. The supply of water is taken for granted in developed countries because of the infrastructure systems that provide it. People need to understand that this is an issue that will affect them in the future. Laws have been implemented in northeastern America against the overuse or misconduct of water. Developing an architecture that increases our awareness of this issue of water is an important catalyst to show how we can cope with our needs for advancement and appropriate usage of water.

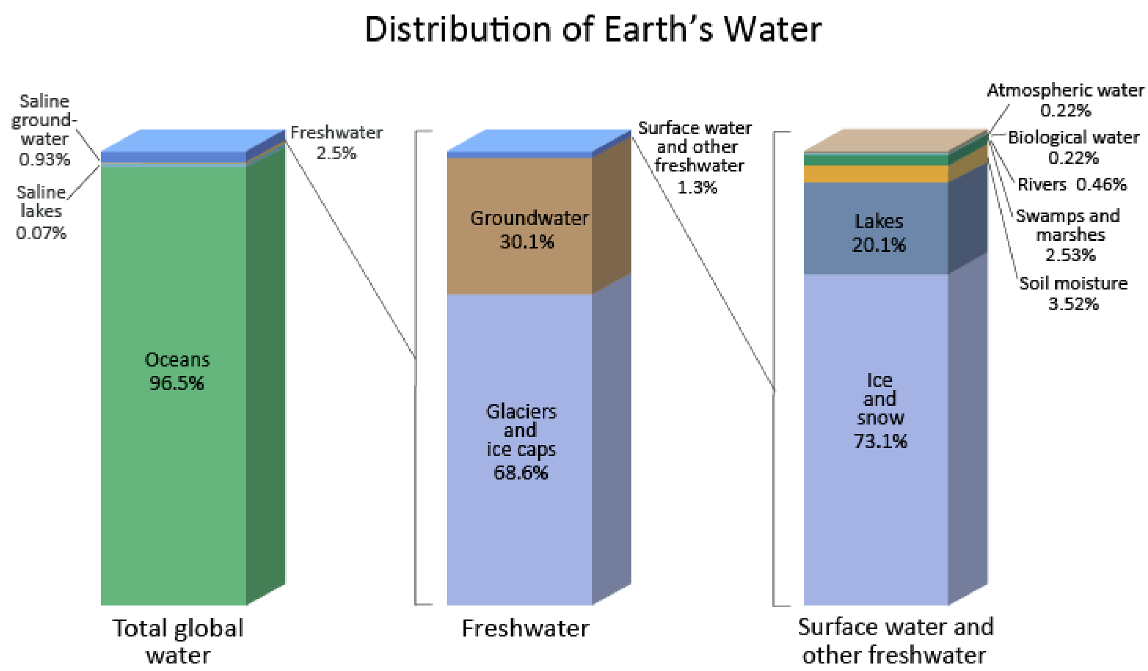

Table 1 – Diagram displaying the distribution of Earth's water. Note: Diagram retrieved from Igor Shiklomanov's chapter "World fresh water resources" in Peter H. Gleick (editor), 1993, Water in Crisis: A Guide to the World's Fresh Water Resources (Oxford University Press, New York).

Culture influences architecture, and architecture influences culture. In the northeastern United States we live in an architectural environment that is articulated in a way that misinforms our perspective of water. Water is provided in a multiplicity of systems and infrastructure to accommodate our desires and comfort. Because of the given luxury, water is abused. Our current buildings and infrastructure allocate water in a way that disconnects our social relation to water and architecture. As we strive to advance we use more fresh water than is ecologically acceptable. We are socially concentrating on matters of energy to continue developing, which disregards more important issues of water. The issue to be addressed is a social remediation. This reconnection is not specifically a human relationship but a fundamental collaboration with people, water, and architecture.

Our current infrastructural system works in a way that is not symbiotic to our growing lifestyle or to our ecologies. Many industries utilize vast amounts of water for production and services. Often times, chemicals and other harmful substances are induced to these utilities and are not allocated responsibly and ultimately return to our watersheds.

Recognizing that the water crisis is a global concern is critical to alleviating the problem. Understanding the fact that our actions have long reaching effects is vital. Water is finite. And the time has come to acknowledge and save this precious resource. I will be using architecture to illustrate potential solutions.

Looking more closely to the northeastern United States, I bring my focus to the Connecticut River watershed. The Connecticut River runs 410 miles from north to south beginning in Quebec, Canada and exiting finally to the Long Island Sound. It is the largest source of freshwater in New England. I chose to focus on the Connecticut River because it is a fresh water flowing river, it is an attraction to the area and many cities have developed alongside of the river. The risk of endangering the river qualities further would be devastating to the cultural development and the surrounding ecologies. In the development of an architectural work, the location should portray water as the dominant feature.

Working and learning in conditions that portray the essence of water could potentially bring a social cohesiveness between our relation to water and how we use it. Currently, the use of water is excessive and invisible. Many parts of our social patterns go through a process of water treatment and/or usage. The production of one hamburger requires an overall usage of 635 gallons of water, (Davydova, 2011).

The consumption of water is expected to increase by 40% in the next 20 years. The demand for fresh water is outreaching its limited reserve. We are facing a problem that has not been socially addressed through architecture. It is insidious however, because the issues of water are mostly invisible to us. In hopes to better our ecological relationship I have investigated an architectural experience that will educate the users about the allocation of water.

3.3 A Sustainable Quandary

Sustainability is a topic often brought up when designing a new architecture. In the society we live in today, sustainability is like a blob, an isomorphic[4]; it will take the shape of any given situation or object when applied. It is not just a blob to its scenario or object but also to its usage. The term sustainability is registered individually and due to an interpretation effect the usage of the word has also become isomorphic. An analysis of the word by various persons has suggested a multitude of influencing sources; therefore, expressing sustainability becomes a matter of indefinite meaning.

3.3.1 Recognizing and defining sustainable terminology

Sustain; Sustainable; Sustainability:

Sus • tain • abil • i • ty

According to Webster's New World Dictionary (2003), To sustain is to; "1. To keep in existence; maintain or prolong. 2. To provide sustenance for. 3. To carry the weight of; support. 4. To endure; withstand. 5. To comfort or encourage. 6. To uphold the validity of."

Webster's New World Dictionary (2003), also defines the word ability to; "1. A being

[4] Isomorphic is having a similar structure or appearance but being of different ancestry (Mifflin, 2009)

able; power to do. 2. Talent or skill."

The Metapolis Dictionary of Advanced Architecture (2003),

> Sustainability: "The concept of sustainability is the result of seeing a world with limited resources and limited capacity to absorb waste, where every act involves future consequences. This leads us to conceive of the construction of a building as an act which does not start with the delivery of materials to the site and end when its inhabitants move in. Building is a closed circle, including every step from the manufacture of the materials to a re-use which brooks no concept of waste: maintenance and disassembly are also planned. The biggest enemy of sustainability is the conservationist "ecological aesthetic" which is nostalgic for a rural past, for magical reasons in the face of a situation where nothing which cannot be generalized and easily conveyed represents a solution." (VALOR, Jaume, "Graft of hyper minimums," Quaderns 219, 1998)."
>
> "Use must encounter fissures in architecture upon which to concentrate, the form must be constructed while continuously aware of change. It's meaning lies in these superimpositions and continuities that the project must allow using soft strategies of composition."

The Metapolis Dictionary of Advanced Architecture (2003),

> Environment is no longer only context (or at least a limited and limitative vision of the context), but rather definitively glocal[5] milieu or environ: in the local it is place, or better said, field. In the global, scenario or, better said, reality (physical and virtual). An environment is a scenario of multilayered crossing.

-*Keywords- A Vocabulary of Culture and Society (1985),*

> **Nature** is perhaps the most complex word in the language. It is relatively easy to distinguish the areas of meaning: (i) the essential quality and character of something; (ii) the inherent force which directs either the world or human beings or both; (iii) the material world itself, taken as including or not human beings. Yet it is evident that within (ii) and (iii), though the area of reference is broadly clear, precise meanings are variable and at times even opposed. The historical development of the word through these three senses is important, but it is also significant that all three sense, and the main variations and alternatives within the two most difficult of them, are still active and widespread in contemporary usage.

Let's pull apart sustainability. Earlier we discussed the definitive meaning of sustain and ability. According to <u>Webster's New World Dictionary</u> (2003); Sustaining is

[5] Glocal is an abbreviation of glocalization. Glocalization is the fusion of globalization and localization. By definition glocal refers to an individual, group, division, unit, organization, and community which is willing and able to think globally and act locally.

to, one; keep in existence, maintain, or to prolong. Number four of the definition refers sustaining to be able to endure or withstand. The final pertaining part is number six which says to uphold the validity of. The idea to sustain is to have a longer existence of some 'thing'. Ability is to have power to do or to implement some 'thing'. These definitions are exact, clear, and concise. Sustainability is therefore the implementation of sustenance for some 'thing's' livable life.

I choose to use the word thing because a thing is not definitive to any particular. When we discuss sustainable attributes we apply it to cars, buildings, recycling, and various other aspects of our social life. There is no one thing that we discuss primarily as the principally appointed.

In the way that Federico Soriano defines sustainability he uses a quote that suggests being able to design in a way that is conditionally responsive to the environment in which it lies. The definition implies permanence within the consumption and waste stream. This cycle is referred to as a closed-loop cycle, meaning that there is a mutual response from production, consumption, and waste stream, then back to the production. After a product's livable life, the resulting waste, in this case, is transferred into an energy source for the production cycle to continue.

The definition quoted by Soriano also implies that there is an intentional design for the death of the architecture or product by saying "maintenance and disassembly are also planned," (Gausa, 2003, p. 580). Using architecture as an example, at some point in the future the usable life of a building is going to end. We can now build and design an architecture that fuses into the natural cycle of decomposition and regeneration. In this case we accept the fact that there is a life and death of architecture. Today we utilize the life of the architecture and cling to it so emotionally, many times because of an economic connection, that we find it extremely difficult to see it pass on. In the new sense of life and death, the death is accepted and embraced for new life to emerge.

Green building is of its time. There have been environmentally responsive buildings in the past; the only difference is today it is becoming a social action. Recycling, hybrid vehicles, recycled products, consumption waste, energy models, etc. are all becoming the new norm. In architecture new ways of building have emerged. Alternative methods and systems of collaboration are becoming a popular common practice in effort to grow into a more sustainably working class. An example of building design under a model of ruled format is the LEED[6] Green Building Rating System. There is a question of whether this is just a trend in our social desires or could it be a permanent action?

As a whole we are trying to positively respond to the environment and somehow reconnect. Connecting and designing for the environment is important. The concept of sustainability has become what is now the typical axiom of sustainability, meaning if words, for example, 'green' or 'eco-friendly' are superimposed; it's got to be sustainable. The environment is a fragile substance that inhibits our coexistence. We live in complex environmental conditions.

Leonardo da Vinci once said, "Human subtlety will never devise an invention more beautiful, more simple or more direct than does Nature, because in her inventions, nothing is lacking and nothing is superfluous." (Edwards, 2005, p. 97).

Sustainability is portrayed as a reconnection to nature, but what is nature? What is

[6] LEED is an abbreviation for Leadership in Energy and Environmental Design. LEED is a formatted design criterion for sustainable building qualities (U.S. Green Building Council, 2009, p. 23.)

it that we perceive to be natural or part of nature? Is a social separation between architecture and how it is involve with the environment?

We perceive the built environment separate from the natural. The built environment is an abstraction of the natural environment. It is within our nature to be within this ecology. In an essay discussing architectural political ecologies, David Gissen writes,

> "This disciplinary maneuver accomplishes several things: it warps our concepts of what architectural technologies are; it forces us to consider what nature has been and may yet become (particularly in the built context); it enables us to establish linkages between buildings and nature that are more dialectical than mimetic; and, most significant, it signals what nature can become when invested with new architectural concepts. That is, when we understand buildings as *producers of nature*, we unlock something that promises much more than just remaking the chemical and physical metabolisms of nature inside of buildings," (Blostein, 2010, p. 63).

This is suggesting a more substantive potential for regenerative design. As a designer, the concept of nature must take primary role. The axiom of nature has a separated entity in many of our current designing methods which destroys the part to whole relationship.

The nature of our lifestyle is becoming digitalized. In a digital realm the nature of programmatic functions are artificial digital matrixes. Socially, economically, and culturally our societal efforts revolve around a technological effort which increases and is evolving rapidly. In the matter of a short time our social interaction became an almost total cellular communication. The World Wide Web is also another example of a digital environment. <u>The Metapolis Dictionary of Advanced Architecture</u> refers to this as 'Technonature', it suggests partially "As a work resource, environmental awareness is useful when we cross it with its apparent opposite: the artificiality of all real physical experience, as a theme for creating new paradoxes and new questions," (Gausen, 2003, p. 449).

Combining the realities of both the artificial and natural milieu, one may propose a sort of fusion. The Naturartificial is a notion that accepts a thorough understanding of the artificial and the natural associations, (Gausen, 2003). Combining the two generates a new set of possibilities. Bringing in the uncontrolled principles and applying them to an artificial source allows one to generate a holistic approach to design. Allowing a digital canvas to be ungoverned but purposeful can have insurmountable benefits. The resulting production of the digitalized design could then be related and applied naturally back to a physical domain. Responding to physically natural edifices can give inspiration and principle action to influence a design or work.

CHAPTER IV

ARCHITECTURAL INTENTION

4.1 Architectural Hypothesis

In the search for an architectural solution, I have found that water can be a tool to be used as a connector for a new social effect. If we can implement an architecture that responds to the sustenance of water, the architecture can be a social tool that expresses the vitality of water. We as a society can respond to this and work on moving forward with development and technology. I am proposing to design a brewery that is hydro-dynamically infused, that could potentially raise a logical principle of social movement in way we allocate water. Performing and expressing the vitality and use of water through architectural works will be a main role in this movement. In design, we are influenced by what surrounds us or what the contextual relationship provides for us. If that context features water and hydrodynamic principles it can then become the parametric tool that influences the design decision making. I believe water as a social connector can be a catalyst for a more symbiotic relation between a human and natural life

My intention is to present a new architectural system that is based on the premise of hydrologic conditions. The vehicle for this exploration is to design a brewery that is based on hydrodynamic principles. The architecture is intended to be an innovative model that is a catalyst for future works. The building program, a brewery, will take advantage of zero net water loss and the social function of a brewery to create a learning opportunity. Architecture needs to care about water. Expressing the role of water in a building will be part of the experience. The beauty and natural aesthetic of water will be formulated in a way or ways that can involve the user. The architecture is intended to be designed in a way that connects people physically and mentally with the vitality of water and the role it takes in our buildings. The programmatic qualities will involve a brew house, water filtration, energy generating facility, and a small restaurant. These four components will coincide in one architectural piece which will activate an involvement with the systems and processes contained. The public members would be able to tour and experience the four events to understand and engage into a more intimate connection with the systems and processes of water. The building can be designed in a way in which future adaptation can be involved but still hold the hydrologic relationship. In terms of architectural qualities, the effects and conditions will be investigated to open a multiplicity of optional outcomes. A general expectation is to create an architecture that is well designed and fitted appropriately to this hydrologic condition. Also, the structural experience is meant to be fun and exciting for the users, creating an ambiance for a new social connection between people, water and architecture.

4.2 The Hydro Logics of Architecture

What are the hydro logics of architecture? Marcos Novak explains that, "Liquid logic alludes to flexible processes of fluctuations which project architecture either in time in space, by changing interactively according to duration, use and external influences." Hydro or having to do with water, (Abate, 1997) and logic which "is an organizational system or disposition: flexible – open – and vectorised – deliberate," said Manuel Gausa, are expressed together to create a whole new spectrum of the way water is perceived, or as hydro logics. Logic is perceived as correctness and preciseness. This is an expressive tense of the meaning of logic. Logic, in this sense, becomes the actor or facilitator for the event of some thing. How does one define the amorphous nature of water? The colorless, transparent, odorless, tasteless liquid water is part of us, it is within our nature. It is involved in every living thing on this earth. How to define the nature of water is not the question, the question is how can we design our nature in which water is defined? We are the logic to our built environment. Water in our environment can be used as a defining tool. As we accustom to the conditions of water, it becomes our defined nature in which we perceive our environment to be. The social existence of water in a new sense is our connection to the idea of an architectural environment. The goal is to invite social processes in which water becomes part of our social existence in architecture. This social experience is where water becomes a dynamic of architectural creation.

4.2.1 Water related innovations

As we move towards a new dynamic of architectural creation we are finding new ways of managing our energy demands and water consumption. The use of technology has been expanded in many new ways in hopes of creating social movements. If we can bring water into part of these social movements we can begin to solidify our ecological relationships. The connection we have with technology is strong. We can apply that connection to an environment of water and architecture, where the social comprehension can become an active part of our lifestyle. The connection with technology and demand for a cleaner source of energy has begun its investigation to become more attuned with the built and natural environments. Under investigations a study of nature has brought theoretical ideas, ideas of a bio-mimetic nature. The study is of habits and patterns that occur in and around biological systems. In many cases these are systems of water.

4.2.1.1 BioPower Systems

Figure 3 - bioWAVE. Note: BioPower Systems. (2011) Retrieved January 17, 2013, from http://biopowersystems.com/biowave.html

BioPower Systems is a technologic company striving to find new ways of renewable energy production. Their focus is ocean energy devices, the bioWAVE™ and bioSTREAM™. Although the two systems are ocean based the biomimetic nature of the devices are composed of nature-inspired design which generate a commercial quantity of renewable electricity (BioPower, 2011). The forms of energy are produced by capturing tidal wave and current energy, transferring it into useable energy. The first device, called the bioWAVE, functions in a tidal swells. The device is mounted on the seafloor, with a pivoting feature near the bottom. Three buoyant floats interact with the rising and falling potential energy of the sea motions and the sub surfaced kinetic energy. The pivoting action contains a hydraulic system that converts the mechanical energy into a form of pressure that is used to spin a generator.

Figure 2 – bioSTREAM. Note: BioPower Systems. (2011) Retrieved January 17, 2013, from http://biopowersystems.com/biostream.html

The bioSTREAM system was developed to synchronize with moving water currents. The device has a fish like fin feature, or hydrofoil that moves through water currents which oscillates and has the ability to continuously align with the current direction. The device is fastened to the ground and as water moves the fins transfer the current energy in a side-to-side motion which is then routed to a power collector. Both systems are ecologically safe as to not harm any locale life and result in clean, safe energy (BioPower, 2011).

4.2.1.2 Hydro Turbines

Hydro turbines and water mills have been used for centuries. These types of systems have been developed through years of change, social evolution and have resulted in some magnificent works. The technologies have evolved through the years but the concept to drive a turbine and collect a source of energy has remained the same. All systems depend on the potential and kinetic energy of moving water. Primarily a source of flowing water is dammed and focused into a chamber that channels water through a type of turbine, spinning the turbine to move and generate usable energy.

Figure 4 - Kempten Hydroelectric Station. *Note:* Kempton Hydroelectric Station. (2011). Retrieved January 16, 2013, from http://www.yatzer.com/hydroelectric-power-station-by-becker-architects

In the medieval centuries, water mills and hydraulics alike became a commonplace of social inquiry. It was the source of economic and industrial development. Many civilizations depended on the power of moving water. Today many rivers and other sources of moving water have been dammed to extract and focus the optimal amount of energy given by the water source that it has impaired many environments and ecological life involved. The idea is to collect energy without disturbing the natural flow of water. An example of this is the Kempten Hydroelectric station in Kempten, Germany.

The station harvests water energy from the Iller River, Kempten, Germany. Becker Architects describes the station as an amorphous organic form that appears equally placid and dynamic to the Iller River. The shape was generated almost in a natural fasion as if the cement structure formed as a gracefully flowing mass and

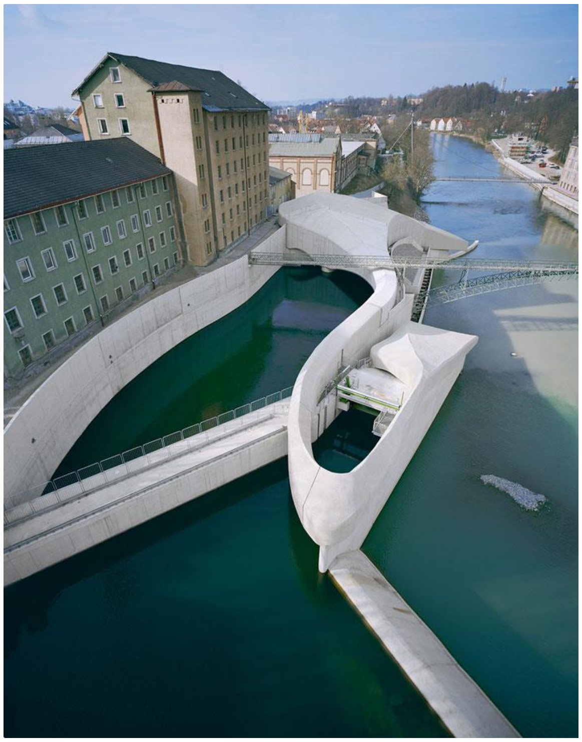

Figure 6 - Kempten Hydroelectric Station. *Note:* Kempton Hydroelectric Station. (2011). Retrieved January 16, 2013, from http://www.yatzer.com/hydroelectric-power-station-by-becker-architects

Figure 5 - Kempten Hydroelectric Station. *Note:* Kempton Hydroelectric Station. (2011). Retrieved January 16, 2013, fromhttp://www.yatzer.com/ hydroelectric -power-station-by-becker-architects

then solidified according to Becker. The power station is intended to mimic and exaggerate the channeled dynamism of the water as it streams into a holding basin, through the turbines and back into the river. The visual language is described as self-confident and modern creating interplay with the existing surrounding environment. The project appears futuristic but the process in creating it was conventional. The sculptural structure uses an architectural idiom of metaphors to associate itself with the river landscape. The ecological impact was a priority in design such as the inclusion of a fish ladder and measures to minimize noise. The sculptural form has biomorphic associations but still utilizes a more pragmatic solution for the performance of the turbines which is interesting (Becker, 2011).

4.2.1.3 Condensate Water Harvesting

Harvesting water via condensate is an interesting notion. This method is a process of collecting liquid vapor from moist air and condensing it into a liquid form. This technology has a multitude of potential opportunities for building design. The biomimetic

Figure 8 – Namibian Fog-Basking Beetle. *Note:* Biomimicry Chicago (2012). Retrieved January 17, 2013, from http://biomimicrychicago.blogspot.com/2012/03/humidity-be-gone-thanks-biomimicry.html

Figure 7 – Namibian Fog-Basking Beetle. *Note:* National Geographic. Retrieved January 17, 2013, from http://www.nationalgeographicstock.com/ngsimages/explore/explorecomp.jsf?xsys=SE&id=1156870

relation to this idea is the Namibian Fog-Basking Beetle. Over time this beetle has evolved by creating a way of harvesting its own fresh water. During the night it climbs to the top of a sand dune where moist breezes from the sea circulate. From these breezes, droplets of water begin to form on the back of the beetle’s shell. Just before sunrise it tips its shell upward and the water drains to its mouth. It then retreats back into a hiding place for the day. The shell is made up of a series of bumps with waxy textures in between so the water has a place to form. Even with the small amount of moisture present in the air, the beetle can harvest water to drink (Pawlyn, 2011).

Because this beetle lives in the desert, it has modified itself to its environment overtime by adopting the ability to harvest water. If the beetle lived in another location with abundant water resources it would not have a need to harvest water using this condensing method. By adopting the principles of the Namibian Fog-Beetle, Charlie Paton, an architect, designed a project that collects water from sea air. An excerpt written by Michael Pawlyn from Biomimicry in Architecture, Pg. 68 describes this project; "It is an invention designed by Charlie Paton that uses the evaporation of seawater at the front of the enclosure to create a cool and humid growing environment for crops in arid regions. The plants inside benefit from lower temperatures, and the high humidity results in much lower transpiration rates so that irrigation requirements are reduced by as much as a factor of eight. The flow of air is largely wind driven and at the back of the greenhouse a second evaporator, supplied with hot seawater from black pipes in the roof, raises the

Figure 8 – Seawater Greenhouse before construction. *Note:* The Seawater Greenhouse. (2010). Retrieved January 17, 2013, from http://myhero.com/go/hero.asp?hero=Seawater_Greenhouse

Figure 9 – Seawater Greenhouse after construction. *Note:* The Seawater Greenhouse. (2010). Retrieved January 17, 2013, from http://myhero.com/go/hero.asp?hero=Seawater_Greenhouse

temperature and absolute humidity of the air at this point. This hot, saturated air then passes a series of vertical polythene pipes which are supplied with cool seawater from the bottom of the front evaporators. The polythene pipes are equivalent to a large area of beetle's shell and form a condensation surface for the humidity. Droplets of water form on the surface of the pipes and run down to a tank to supply the irrigation water need from the crops. The building essentially mimics and enhances the conditions in which the beetle harvests water: evaporation of seawater is increased to create higher humidity, and then a large surface area is created for condensation. Saline water is turned into fresh water just using the sun, the wind and a small amount of pumping energy."

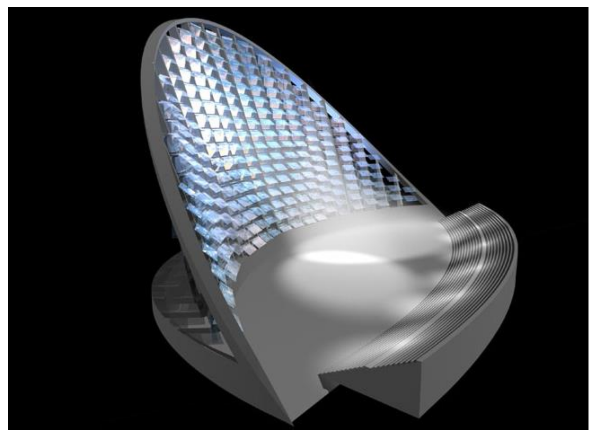

Figure 10 – Las Palmas Backdrop. *Note:* Las Palmas Water Theatre. (2011). Image retrieved January 17, 2013, from http://intricabox.tumblr.com/page/3

A theoretical project designed by Grimshaw Architects showcases a theater that collects water in a similar way to that of the Namibian Fog-Basking Beetle. This Theater takes advantage of the sunny conditions, steady wind fluctuations and the cold seawater to create a large amount of desalinated water. At Las Palmas, the evaporating and condensing technology is used to create a back-drop an outdoor

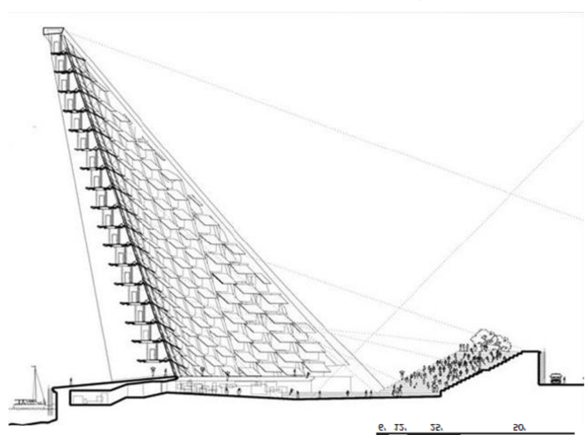

Figure 11 – Section through theater. *Note:* Las Palmas Water Theatre. (2012). Image retrieved January 17, 2013, from http://architecturebiomimicry.blogspot.com/2012/04/las-palmas-water-theatre.html#!/

amphitheater. It is interesting here, in terms of a structural strategy that the infrastructure is externalized and becomes a dominant feature, all into a sculptural work.

4.2.1.4 Rain Water Allocation

Rain water harvesting is a method that is performed in a number of different ways. A common form of rain water harvesting is roof run-off collection and conveyance. Rain is a form of fresh drinking water and when it cascades down a roof it is often conveyed away and poorly distributed throughout the surrounding landscape. Rain water can be allocated in a way or ways in which the surrounding environment receives a proper quantity of water. The butterfly roof design is a roof which is inverted unlike the typical upright roof. This roof collects rainwater in a central axis of the structure and conveys water, often times into cistern for later use. A cistern is a holding tank for water. The 1290 Live/Work Residence designed by Sigrid Miller Pollin uses a butterfly roof system to collect rain water which is stored in a cistern for later irrigation. Because the rainwater is considered to be grey water or non-potable water, the use of the water can go into other non-potable water uses in the household such as toilet flushing or hot water heating.

Figure 12 – Butterfly Roof System. *Note:* 1290 Live/Work Residence designed by Sigrid Miller Pollin. Retrieved January 17, 2013, from http://millerpollin.com/a-and-p/singlefamily/1290/1290.html#

4.2.2 Designing a Brewery

A brewery is made up of processes and systems. These processes happen in different units which are designed for each individual process. When allocating water in the processes, water is transferred from one to another in order to create the final product and the transferring methods are performed by various transferring systems. The primary use is the transfer of water and the contents involved in the water. Many of these processes involve heating and cooling at certain periods within the entirety of the processes. The conveyance of water and contents is important, as well as the efficiency in which the water and contents are conveyed and used. There are interim periods in which the ingredients are stored before brewing and also after the product is finished it needs time and a place to mature.

4.2.2.1 Pragmatic Qualities

A stainless steel manufacturer, Specific Mechanical Systems Ldt., who is the leading manufacturer of brewing systems in North America, suggested a number of building qualities for breweries. These qualities involved water, drainage, finish, electrical, space, and other various topics included in brewery design. The following information is a reference of what Specific Mechanical Systems has suggested

4.2.2.1.1 Water

According to Specific Mechanical Systems Ltd the main water supply to a brewery is recommended to have a psi of 60 @ 25 gallons per minute. It is also recommended that there is a uniform flow of water to the brewhouse. This is a critical component which shouldn't be interrupted by other water demands within the building. Another requirement is to have hot and cold hose bibs in all brewery spaces and lab areas. A hose bib can also be referred to as a "spigot" or "faucet head." Water supply is also required in any kegging or bottling areas. City water is commonly used as the source for brewing in which case a water analysis is performed to determine the need for addition water filtration.

4.2.2.1.2 Drainage

Drainage in a brewery is another important aspect to think about. Because a brewery contains multiple water and liquid containing systems it often goes through a cleaning process which involves almost all of the units within the brewery. There is also spillage that occurs. Drains are required in any area or areas where water and spillage may occur. The floors should be built with a pitch so liquid drains properly. The incline is suggested to be ¼" drop per foot of spatial run. Drains and grating can come in many different materials, shapes and sizes. The channels are recommended to be four inches wide with stainless steel or fiberglass grating. In some breweries the drains are formed within the concrete flooring system. The sizing of drains is also a consideration with a recommended size to handle 4-6 barrels of effluent for every one barrel of beer produced.

4.2.2.1.3 Finish

The floors in a brewery are usually made up of a water resistant material. The floor finish is something that needs to be sealed and resistant to both mild acids and strong alkalines. Because of the nature of the brewing process, walls and ceilings need to be a material that is mold resistant and washable as well.

4.2.2.1.4 Electrical

Many units in a brewery are energy intensive. There are boilers, coolers, condensing units, and other energy using devices. Specific Mechanical Systems Ldt. Recommended a 200 amp service for the units involved, but this is only a suggestion. Every brewery is different and will have different electrical requirements.

4.2.2.1.5 Square Footage

The square footage for a brewery depends on the units involved. The units need to be accessible. There is also a flow of traffic that is considered. The square footage will be determined by the architectural design and the spatial requirements for each unit and/or process.

4.2.2.1.6 Ceiling Heights

Ceiling heights for newly constructed breweries tend to be higher for planning purposes. The heights are recommended to be 12 to 14 feet high and the fermentation and serving areas to within 9 to 10 feet high. The ceiling heights will vary due to different sizes of the vessels.

4.2.2.1.7 Venting

Designing for venting is important because there will be much steam and buildup of heat so it needs to either be recycled elsewhere or escape as not to disrupt other systems. There is typically a flue for the venting of the steam from the brew kettle. An exhaust flue for a gas fired boiler is required in the boiler room if there is a steam fired system. If a direct gas fired system is selected, an exhaust flue will be needed in the brewhouse are for the kettle firebox system. Make-up air is required in the boiler room on a steam-fired system and in the brewhouse area for a direct gas fired system. Air conditioning is also recommended for all brewery spaces.

4.2.2.1.8 Additional Requirements

For loading, unloading, and installation purposes a forklift should be on site. The equipment and other materials usually come on an enclosed 48 inch pallet anyways so moving and storing the items with a forklift will save time and effort. The platforms and storage spaces should be designed for the use of a forklift.

The finished beer sits in a conditioning tank until it is packaged. The beer should be chilled in a cooling room until it is sold or shipped to preserve the quality of the beer.

Electrical conduits and wiring should be placed in positions relative to where the units are going to be placed. The design for future upgrades and installments should be considered when designing the passage widths. In addition to the above building requirements Specific also requires the following before your brewing systems arrives on-site.

4.3 Site Location

The site location is very imperative to the project parameters. The context of the site is one of the major driving forces for the design. The site I have chosen contains vast amounts of freshwater, deciduous and coniferous plant life, geological phenomenon, and a location within proximity of an active town.

4.3.1 Turners Falls, Massachusetts

Turners Falls, Massachusetts is one of five villages within the district of Montague, Massachusetts. Turners Falls resides in the mid-western portion of Massachusetts, within the county Franklin. The location is within close proximity of Rt. 91 which runs North and South. The location is also near larger municipalities. The population in Turners Falls is around 4,500 persons. The town is recognized for its vast damming of the Connecticut River. The dam controls the flows of water in the river and also focuses portions through a manmade canal which produces hydro-electricity. One of the village's major assets is the adjacency to the Connecticut River. The river provides a steady flow of water, within seasonal circumstances, for recreation, power generation, and ecological life.

Figure 9 – Project Site, Turners Falls, MA. Note: Image created by Ryan Luczkowiak

The particular site chosen is located on 8 Canal Rd. Turners Falls, Massachusetts. The site is a manmade island which divides the Connecticut River and a hydro canal. The island as a whole is zoned in a mixture of industrial and residential use. The site location is the most northern part of Turners Falls with the Connecticut River on its north side and the hydro canal on its south side. The neighboring site is zoned as industrial. The last use was a coal burning facility which ended in 2008 and was demolished. The site at 8 Canal Rd. has no specific zone acknowledgment. It sits between an industrial zone and the Turners Falls Dam and fish ladder. The land acreage is 3.193 AC. There are no known utility connections. The area is owned by Swift River Island. The land was valued at: $66,100 and the yard item value at: $1,700, totaling at $67,800. The sale price to this plot of land is $400,000 as of April 30, 2008.

The site seems to be an intermediation zone between people and water. There are areas of social involvement and paths to the water. The terrain sits on top of a geological phenomenon. The riverbed contains very interesting layers of mudstone and sandstone which have been molded by the passing of water. This event of hydrogeology inspired me to design a form which was almost part of the site and created by the movement of liquid. Water and liquid movement plays the dominant role in this area. The visual and physical characteristics of water achieve an intimate role as well as a more open, public venue. The aquatic nature of the river and hydro canal express a magnificent array of effects.

CHAPTER V

BREWING AND ENERGY ANALYSES

5.1 Brewing Process

5.1.1 Malting

Malting is the combination of *water* and *barley*. There are three steps in the malting process.

The first step is called Steeping. Steeping is the soaking of barley in water to hydrate to allow uniform growth during germination. This activates the metabolic processes of the dormant kernel. Water is drained, and grains are turned several times during steeping to increase oxygen uptake by the respiring barley.

The second step is Germination. The wet barley is germinated by maintaining it at a suitable temperature. There are numerous mechanical designs for pneumatic malting such as drum malting, compartment malting, continuous malting, and tower and circular malting, and flexi malting.

The final process for malting is Kilning. The final step is to dry the green malt in a kiln. This is done at different temperatures. The temperature regime in the kiln determines the color of the malt and the number of enzymes which survive for use in the mashing process. Low temperature preserves enzymatic power. Malts that are high in extract but low in coloring and flavoring compounds. This is usually a Pilsner and Pale Ale malt. Intermediate temperatures make Munich and Vienna malts. High temperatures make Crystal and Chocolate malts. The less enzymes there are the lower extract is.

5.1.2 Milling

Milling is where grain is physically crushed and broken apart for an efficient mash. The result is called grist. Contents should be broken into pieces so the contents of every seed can be extracted and converted into simpler compounds during mashing.

5.1.3 Mashing

Mashing occurs in the Mash Mixer unit. Mashing is the process of combining a mix of milled grain and water. Mashing allows the enzymes in the malt to break down the starch in the grain into sugars to create a malty liquid called wort. After this process the wort is transferred to a Lauter Tun.

A Lauter Tun is where the grains are heated in either an infusion method or decoction method. The infusion methods heat up the grains in a vessel. The decoction method boils the grains and then returned to the mash. Mashing involves pauses at certain temperatures.

The resulting wort is transferred to a kettle. The spent grains are given to local farms for feed.

5.1.4 Brewing

The spent grains are filtered out and the wort is ready for boiling in a kettle which involves many technical and chemical reactions. During this stage, important decisions will be made affecting the flavor, color and aroma of the beer. Certain types of hops are added at different time during the boil for either bitterness or aroma and to help preserve it. The wort is boiled for one to two hours to sterilize and concentrate it, and extract the necessary essence from the hops.

The wort goes through a whirlpool separator/filter to separate the hops and liquid.

It is then transferred quickly from the filter through a heat exchanger to be cooled. The heat exchanger consists of tubing inside of a tub of cold water. It is important to quickly cool the wort to a point where the yeast can safely be added, because yeast does not grow in high heat. The hopped wort is saturated with air, essential for the growth of the yeast in the next stage.

5.1.5 Fermentation

After wort is cooled it goes into the fermentation tank. The yeast is then added into the fermentation tank with the wort. The yeast is a micro-organism that eats the sugar in the wort and turns it into alcohol and carbon dioxide. The fermentation process takes ten days. The wort becomes beer in this process. The yeast cells rise and fall and are skimmed off to use for other beers.

5.1.6 Maturation

The beer is now brewed and transferred to a maturation or conditioning tank. This is where the taste ripens, the liquid clarifies as yeast and other particles settle.

5.1.7 Finishing

The beer is then filtered and carbonated. Filtering gives the beer a sparkling clarity. The beer is moved into a holding tank where it stays until it is bottled, canned or put into kegs.

5.2 Energy Usage

5.2.1 First Light Power Resources Hydro Electric – Turners Falls CT. River Canal

On average turbines produce: 8,322,000 kWh/yr
693,500 kWh/mo
160,040 kWh/week
22,800 kWh/day

5.2.2 Brewing 1BBL Energy Analysis

Note: The following information was performed, calculated, and analyzed by:

Ryan Luczkowiak

(bbl = barrel)
(1bbl = 42 US gallons)
(42 US gallons = 159 Liters)

Electrical = 20-35 kWh/bbl
Nat. Gas = 2-3.7 Thermos/bbl
Water = 6-8 bbl's water/bbl beer produced
Refrideration = 0-20 btu chiller/bbl
Direct Fired Brew Kettle = 25,000 – 30,000 btu/bbl

1 btu = 0.00029307 ~ 0.0003
1 kWh = 3412.14 btu

Brew 1000 bbl in a year
Electrical = 20,000-35,000 kWh/bbl
Nat. Gas = 0.0006-0.00111 Thermos/bbl
Water = 6-8 bbl's water/bbl beer produced
Refrideration = .003 - .006 btu chiller/bbl
Direct Fired Brew Kettle = 7.5-9.0 btu/bbl

Immediate Water Usage/1bbl of brew
1 bbl in product
1.2 bbl cooling (reclaimed)
.1 bbl evaporated
.25 bbl with spent grain
.85 bbl to sewer

3.4 bbl total

142.8 Gal of water to produce 42 Gal of beer

5.2.3 Water Usage Breakdown for Pub Breweries

According to Sound Brewing Systems, Inc., the usage and output of water per 10 BBL is on average:

"10 BBL in product
12 BBL Cooling-reclaimed
1 BBL Evaporated

2.5 BBL With spent grain
8.5 BBL To sewer
33 bbl TOTAL."

5.2.4 Turners Falls Hydro LLC

According to the Swift River Hydro Operations Company, "Turners Falls has a 950 KW vertical Francis turbine installed recently in a wicket gate case and scroll case built in 1918. On average this turbine could generate about 8,322,000 kWh per year. The average net head is 44 feet. If the Water Exchange Agreement (WEA) is continued, the combination of annual production of 1,662,000 kWh plus 7,391,000 kWh of compensated energy will be sold to a local municipal electric company or industrial customer on a long-term contract or sold to WMECO at the hourly ISO spot price." The expected output is simulated in the following table:

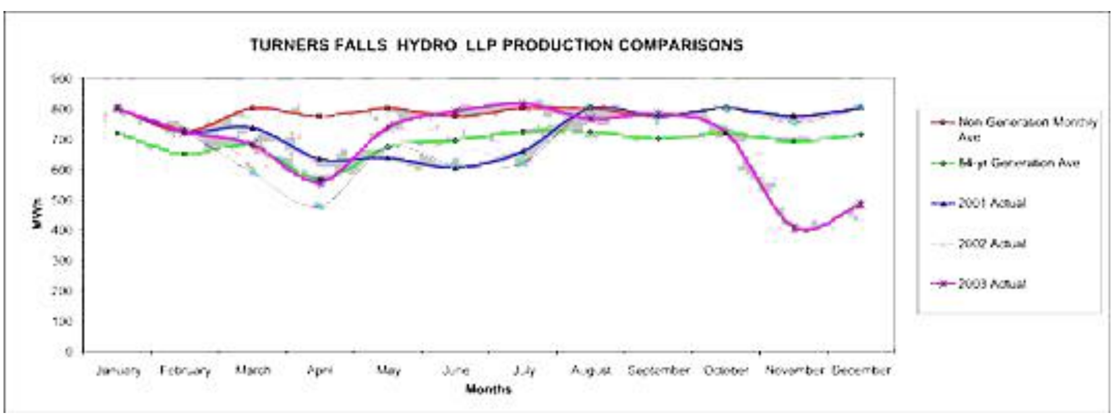

Table 2 – Hydro turbine energy production comparisons. Note: Hydro Electric Power "A Renewable Green Energy Source" Swift River Hydro Operations Company. Retrieved January 17, 2013, from http://www.swiftriverhydro.com/projects.htm

CHAPTER VI

WATER SYSTEMS

6.1 Water Purification

The town of Turners Falls has a public water infrastructure but no supply source within the town. The site I am working with has no utilities to connect to like water supply or gas supply. The idea is to utilize the Connecticut River as a fresh water supply. The water would be brought in to the building to go through a purification process and stored. Specific amounts of water will be extracted solely for the brewhouse and separately stored for various other facility uses. In search for different types of systems I discovered a company that produces water technologies. TAPROGGE is an international company that produces a multiplicity of water systems. I have chosen to relate to some products created by TAPROGGE in this thesis.

6.1.1 Water Intake

Because of the size of the project the amount of water extracted will be performed by the TAPIS single-stage intake system. A single stage system combines the functions of the multi-stage systems into a single stage. This saves building costs. The TAPIS system mechanically treats water at the place of extraction. This system doesn't need to separate debris from water which saves the environmental disposal of debris. TAPIS is a

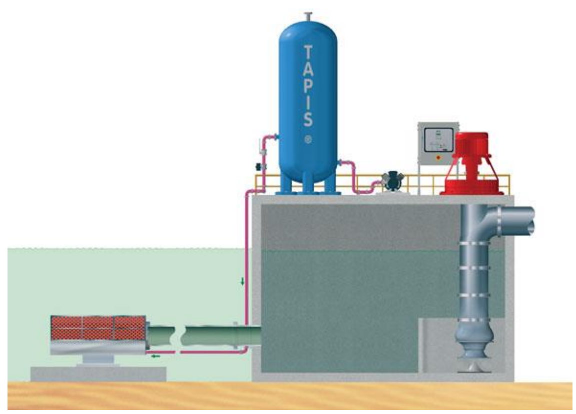

Figure 10 – Single stage intake system.
Note: Single-Stage System TAPIS. (2009). Retrieved January 17, 2013, from http://www.taprogge.de/products-and-services/in-ta-ctR/intake-systems/single-stage-system-tapisR/index.htm

fish-friendly system that protects aquatic life according to the manufacturer. The system doesn't require moving parts and works fully automatically. The structure is designed as a modular system so it is easily adjusted and ease of maintenance. The module is called a polyhedron. The module works efficiently with its geometric shape that allows the backwashing of the screens and involves a special Cling-Free© elements which have been optimized to respond to the fouling typology in surface water.

The water flows freely through the canal and passes through the TAPIS system where the primary debris filtration goes through. The filtered water is then transferred to a collecting tank where it undergoes a process called sedimentation. Sedimentation is where tiny particles in the water sink to the bottom of the tank and the water becomes clearer. The water is pumped from the tank to the secondary filtration process.

Overtime the polyhedron collects small particles and other debris. To rid of this debris it goes through a process called backwashing. This process is performed by a pressurized tank that forces air through the screen inlet panels to go through a process of macro fouling. Macro fouling is the removal of small to larger particle collected on the inlet panels.

6.1.2 Filtration

The secondary filtration goes through a PR-BW 100 unit. According to TAPROGGE this unit has an automatic backwash filter for the separation of macro fouling and other particles from liquids – without interruption of flow. This unit filters particles in a range of 1 to 9 mm. The unit is designed in a spherical shape to allow maximum flexibility and minimizes operation costs. The unit is compact and reliable for its use. Applications of this system include conventional mechanical and auxiliary cooling.

The process in which this unit works goes through four stages. The inlet housing, sifting, outlet housing, and backwash. The inlet housing is where the unfiltered water comes into. It is filtered through the sifting and transferred to the outlet housing where it is then distributed accordingly. After the filtration process is complete the unit backwashes to rid of any fouling.

Figure 11 – PR-BW 100 unit. *Note:* Filter-Type PR-BW 100. (2009). Retrieved January 17, 2013, from http://www.taprogge.de/products-and-services/in-ta-ctR/filtration/pr-bw-100/index.htm

6.1.3 Tube Cleaning

This process is involved in the water filtering and the brewery piping. In periods of time and use the piping systems must be cleaned of any fouling to allow maximum effectiveness of filtration. To clean the pipes there special cleaning balls are injected into the systems. Once in the systems the balls can go through a process of micro-fouling. Micro-fouling is a process of eliminating small particles lodged in piping systems. Monitors and collecting devices are installed to analyze the ball effectiveness. Once completed the balls return and are separated if worn. The worn balls go into a separate storage tank. The others go into a collecting tank and are reused.

6.1.4 Distribution

Water is distributed through a piping system. There are multiple options for piping such as material selection or whether it is an, underground, exposed, or concealed system. According to the DeWalt Plumbing Code Reference Materials to use for drains and vents are: Cast Iron, Copper DWV PVC Schedule 40 DWV, and ABS DWV.

Materials to use for water piping are: Galvanized coated steel, copper water, PVC Schedule 40, IPC 605 (CPVC), or PEX. These materials are usable materials to create infrastructure for a piping system.

The infrastructure of piping will be allocated appropriately to the design. The infrastructure of piping has the potential to become part of the spatial envelope.

6.1.5 Storage

Typically, for residences, water is stored in a cistern. Water can be stored in a water tower or other forms of holding tanks. The possibilities for water holding are unlimited for the composition in which the water is held. Water as a thermal element can be applied but with further investigation. Fresh water will be stored for consumption as well as use within the brewing systems.

6.2 Energy Production

The site that I have chosen provides a manmade canal that focuses water into a channel. First light power resources uses this water to generate energy for surrounding municipalities. My intention is to propose to use the energy provided by the canal as first light power resources does but within a scale appropriate to the building size.

I will be designing a hydroelectric station. To generate energy, water needs to be focused into a channel. The potential and kinetic energy of the water is then transferred through an oscillating turbine. The oscillating turbine turns a generator to conduct an electric current. Electricity is generated with a moving magnetic field. With an armature of copper coils wrapped around rotating magnets an electrical current can be conducted. The energy is then routed through a transformer to convert the energy into usable electrical energy.

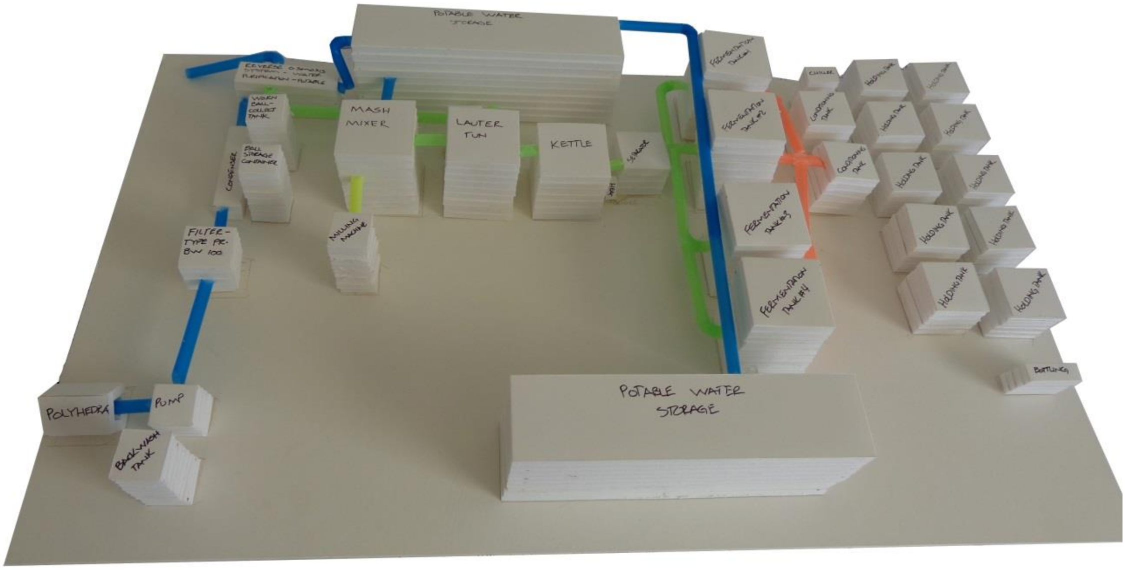

Figure 12 – Systems Model. This model portrays the various systems involved in the project. The volumes are proportioned accordingly and arranged in an efficient layout. *Note:* This model was made and photographed by Ryan Luczkowiak.

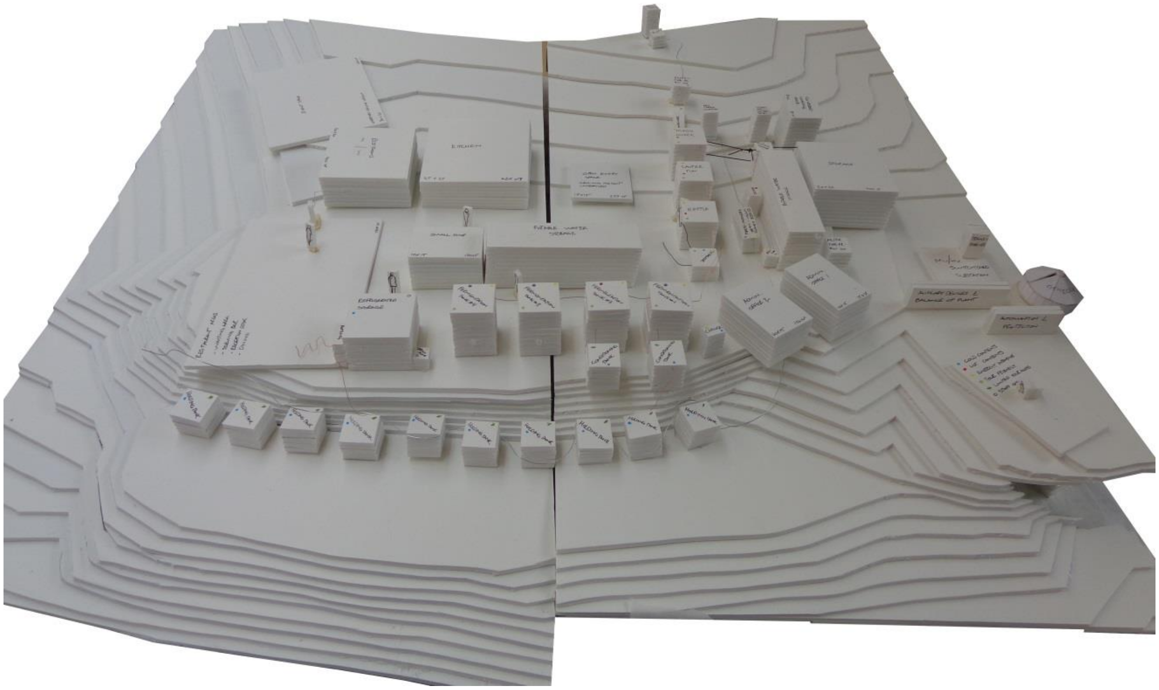

Figure 13 – Implementing Systems on Site. This is a model of the site and the systems involved in the site. This is showing the relationships between the program and topological dynamics. *Note:* This model was made and photographed by Ryan Luczkowiak.

CHAPTER VII

PROJECT PROGRAM

7.1 Program Description

The programmatic elements are the result of discovering and learning the social relationships we have with water and architecture. The structure of the program consists of five members. These members include: public, mechanical, support, administrative, and civil spaces. The spaces have been organized separately but are integral with one another to create a self-sustained building.

The public spaces are areas within the mechanical and support spaces. The definition of public, here, means the people that are here to experience the building and site amenities. The public areas are intended to be engaging with the user and the architectural work. The architectural work is intended to be designed by water. The publicness of the building a unique in that it brings the user to a new level of interaction with the architecture.

The mechanical areas contain the water purification and brewing equipment. This is where the water is extracted from the canal and brought into the building to be purified. The purified water is then allocated to the brewery or other facilities in the building. The mechanical spaces are where the hydro events take place throughout the facility.

I chose to place the generating components into the support area because these members are supporting elements for the entire building. The combination of water and electric generation are the main ingredients allowing the building to function as it does. The other areas included are components that provide similar aspects in which the building and activities need. The support spaces are intended to be part of the integral design.

The next programmatic section is the administrative portion. These are the areas reserved for the managerial staff. These spaces are needed to organized and maintain building function and organization. The administration needs a place of solitude to focus on the workings and care for the building.

Finally the civil working areas are not necessarily spatial organizations as they are circulatory paths. The bridge provides the main access to the site. Currently the bridge over the canal is in poor condition and would not allow common traffic to pass. Part of the proposal would be to restore the bridge. A secondary means of access would also need to be created to give optimal accessibility to and from the site. This is important for visitors as well as delivering vehicles.

7.2 List of Potential Users

7.2.1 Public

Adults – ages 21 and older

Can participate in all functions and activities performed in the building. Functions include: brewery tour, water purification, generator, and restaurant. Activities include: beer tasting, beer consumption, food consumption, events, hands-on experience with water properties within the building, socialize, interaction with river and canal, interaction with amenities in and around the building and building site, and a new experience with people, water, and architecture.

Adults – ages 18 – 21

This group of people cannot participate in the consumption of alcohol.

Young Adults – ages 13 – 18

This group of people cannot participate in the consumption of alcohol and should be supervised throughout the facility.

Children – ages 3 – 13

This group of people cannot participate in the consumption of alcohol and should be supervised throughout the facility and grounds. Parents and legal guardians are responsible for their children.

7.2.2 Staff

Administration:

Administration staff supervises and manages the entirety of the facility. Administration communicates with all staff to correlate a healthy relationship among the building staff and to keep checking order.

Engineering:

The engineers monitor and manage the power generation and water filtration sectors. Because the two sectors use highly advanced equipment the engineers are people specifically trained to work on and operate the equipment. Both sectors affect a wide range of people so it is important that the engineers are keeping the equipment from any dangers. The maintenance to the equipment is minimal but when it is needed the engineers perform the maintenance due to the advanced technology involved.

Brewing:

The brewing staff manages the brewing properties of the building, sales, tours, and brew pub. Manages raw materials inventories and finished product inventories. The brewers are involved with the education of brewing beer to others. The brewers also brew the beer.

Maintenance:

Maintenance staff works to keep other portions of the building in working order. This staff works similar to the engineers in terms of maintaining equipment and smaller electronic systems in the facility.

Kitchen and Restaurant:

The kitchen members prepare meals for the restaurant and events. Other responsibilities include cleaning the kitchen, hygienic and tidy, at all times. Working safely around kitchen equipment and reporting any maintenance issues is also important. These members assist the brewpub staff and have responsibilities to customers and workability.

7.3 Estimated Program Summary

Program				
Space	Area (net s.f.)	Quantity	Total	Comments
1. Public				
A. Vestibule	100	1	100	
B. Lobby	650	1	650	
C. Reception	100	1	100	
D. Restaurant	1200	1	1,200	
E. Restroom	600	2	1,200	
F. Event Space	1200	1	1,200	
G. Outdoor Space	1500	1	1,500	
H. Boardwalk	1000	1	1,000	
I. Small Shop	650	1	650	
		Subtotal	7,600	
2. Mechanical				
A. Water Intake	300	1	300	
B. Water Filtration	100	1	100	
C. Potable Filtration	150	1	150	
D. Storage	150	1	150	
E. Water Storage	1000	1	1,000	
F. Tube Cleaning	100	1	100	
G. Brew House	1500	1	1,500	
H. Milling Room	150	1	150	
I. Bottling	50	1	50	
		Subtotal	3,500	
3. Support				
A. Loading Dock	200	1	200	
B. Storage, grains	300	1	300	
C. Conditioning Room	600	1	600	
D. Refrigerator	800	1	800	
E. Generator	750	1	750	
F. Turbines	300	1	300	
G. Automation & Protection	100	1	100	
H. Auxiliary Devices & Balance of Plant	150	1	150	
I. Transformer Room	150	1	150	
J. Mv/Hv Switchyard Substation	250	1	250	
K. Control Room	150	1	150	

		Subtotal	3,750	
4. Administrative A. Kitchen B. Bar C. Staff Office D. Service Desk	 650 200 120 100	 1 1 1 1 Subtotal	 650 200 120 100 1,070	
5. Civil A. Restore Bridge B. Road Access	 2400 N/A	 1 Subtotal	 2,400 2,400	
Total Net Square Feet:			18,320	
Total Gross S. F. @ 25% Total Gross S.F Actual			22,900 20,000	

Table 3 – Programmatic Spaces. Table defines the program spaces for the project. The program consists of five divisions and within those divisions are the spatial organizations as well as the approximate square footage required for each space. Note: Table created by Ryan Luczkowiak

Note: Gross factor is an estimate. Circulation obtains approximately 20% of building space.

7.3.1 Internal Units

Unit Program					
Unit	Quantity	L x W x H	Material	Hot/Cold	Comments
Milling Machine	1	4’ x 4’ x 10’	Stainless Steel	N/A	
Mash Mixer	1	6‘ x 6’ x 10’	“	Hot	
Boiler	1	4’ x 3’ x 6’	“	Hot	
Lauter Tun	1	6‘ x 6’ x 10’	“	Hot	
Separator	1	6‘ x 6’ x 5’	“	Warm	
Heat Exchanger	2	1’ x 1’ x 3’	“	Warm/Cold	
Kettle	4	6’ x 6’ x 12’	“	Hot	
Conditioning Tank	2	6’ x 6’ x 6’	“	Cold	
Storage Tank	10	6’ x 6’ x 6’	“	Cold	
Chiller	1	4’ x 3’ x 6’	“	Cold	
Bottling Unit	1	3’ x 6” x 2’	“	Cool	
Pump	3	2’ x 2’ x 3’	Aluminum/PVC	N/A	

Table 4 – Internal unit program. Program displays the unit type, quantity, size, material, condition, as well as other comments made concerning the particular unit. *Note:* Table created by Ryan Luczkowiak.

7. 4 Adjacencies

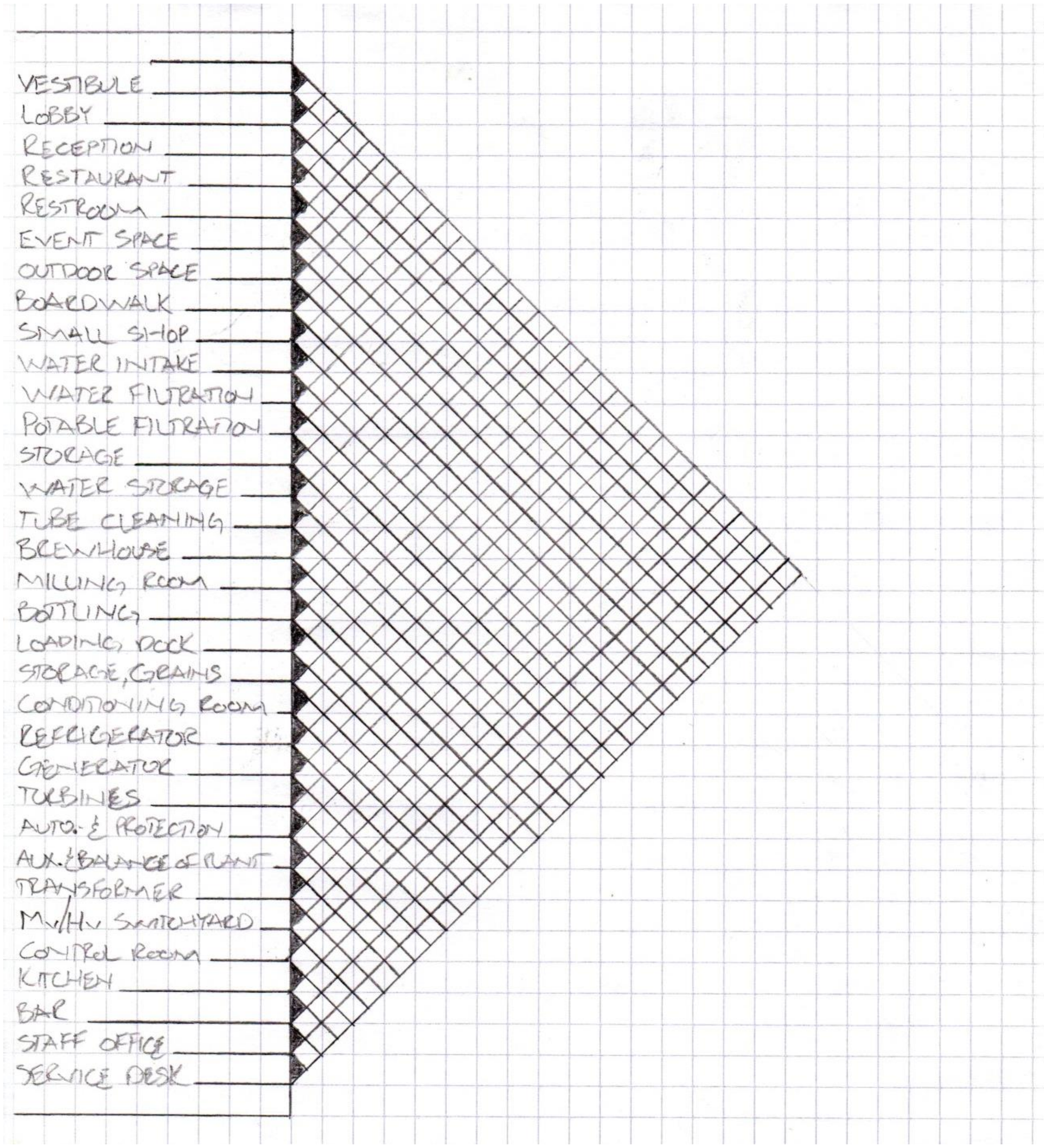

Table 5 – Adjacency Diagram. Programmatic space relationship diagram. *Note:* Diagram generated by Ryan Luczkowiak.

7.5 Building Code Analysis

Occupancy Group Classification F-1, Distilleries, (Allen, 2007).

The International Building Code requires two access ways leading to two independent exits if Group F occupant load exceeds 49 (Allen, 2007).

The National Building Code of Canada requires barrier-free design within buildings in group F-1, (Allen, 2007).

International Building Code: Stair, Nonresidential requirements: 7" Maximum Riser Height, 4" Minimum Riser Height, 11" Minimum Tread Run, 12' Maximum Vertical Distance Between Landings, (Allen, 2007).

International Building Code: Ramp Requirements: Maximum Ramp Slope, 1:12 for ramps part of means of egress or on accessible routes. Minimum ramp width, 36" clear width between sides of ramp, or handrails if any. Maximum distance between landings, 30" rise, (Allen, 2007).

CHAPTER VIII

CONCEPTIONS

8.1 Hydrodynamic Architecture

According to the Collins English Dictionary (2003) hydrodynamic or hydrodynamical is described as:

1. (Physics / General Physics) of or concerned with the mechanical properties of fluids

2. (Physics / General Physics) of or concerned with hydrodynamics

Hydrodynamic architecture is an architecture that is parametrically influenced by water and hydrologic properties. Hydrodynamic design takes precedent from water and marine ecologies. The idea is to design for and with water. Water is almost always rushed off and kept outside of architecture. The implementation of water can somehow take presence in becoming a part of the architecture.

Methods such as, but not limited to; condensation, absorption, detainment, responsive to conditional humidity, energy harvesting, irrigation, conveyance, filtration, and reuse are related properties that can be considered for design.

In my research for hydrodynamic architecture, I have found that it is not an often practiced subject. Some results relate to fields like surf board design or naval architecture. Although these studies have a good design connection to marine ecologies they are not a direct source to inhabitable architecture. I believe the dynamic of hydrology can be influenced into an architectural scenario. This would generate a new innovative approach to architectural design and theory.

The intention is to invoke a positive emotion using architecture and water. Spatial qualities can impact a user in different ways. Using water I intend to create some sort of public venue that is mysterious in which water and architecture are combined into triggering an extremely moving reaction.

8.2 Biomimicry

Biomimicry

The Metapolis Dictionary of Advanced Architecture

> **Mimetic Architecture (Salvador Perez Arroyo):** "Many organisms practice mimesis in order to survive or just to have more a peaceful and modest presence; snakes in the desert, fish and marine animals in the sea. To protect themselves, they mimetic and imitate acts and rites of other organisms in their immediate surroundings. Mimetic architecture looks to reduce the informative charge either in the city or in the landscape. Normally, mimesis is reached by mimicry acts or by mimetic materials. Skin and colours are the most used systems. In the future, we will see architecture doing real acts of mimicry, imitating noises, breathing or producing fog and vapour."

The philosophy of biomimcry is the process of design by imitation of biological principles and applying them accordingly. Janine Benyus is a biological sciences writer and author of six books including Biomimicry Innovation Inspired by Nature. Benyus has developed the theories of biomimicry and explains the definition:

Bi-o-mim-ic-ry

[From the Greek bios, life, and mimesis, imitation]

1. *Nature as model.* Biomimicry is a new science that studies nature's models and then imitates or takes inspiration from these designs and processes to solve human problems, e.g., a solar cell inspired by a leaf.
2. *Nature as measure.* Biomimicry uses an ecological standard to judge the "rightness" of our innovations. After 3.8 billion years of evolution, nature has learned: What works. What is appropriate. What lasts.
3. *Nature as mentor.* Biomimicry is a new way of viewing and valuing nature. It introduces an era based not on what we can *extract* from the natural world, but on what we can *learn* from it.

Designing with biomimicry takes conditions from biological entities and applies them through architectural function. Taking the idea of locality is very formidable because it is a method of designing nature. There is a controlled but yet uncontrolled design which gestures a natural essence. As a component to sustainability, the methods and principles that biomimicry portrays are significant to the original conception of creating a symbiotic relationship between architecture and nature.

In a book called Biomimicry in Architecture written by Michael Pawlyn, discusses biomimicry, bio-utilization and biophilia by stating, "Julian Vincent defines it as 'the abstraction of good design from nature', while for Janine Benyus it is 'The conscious emulation of nature's genius'. The only significant difference between 'biomimetics' and 'biomimicry' is that many users of the latter intend it to be specifically focused on developing sustainable solutions, whereas the former can be, and on occasions has been, applied to fields of endeavour such as military technology. I will be using biomimicry and biomimetics as essentially synonymous, and I like to define the discipline as ‘mimicking the functional basis of biological forms, processes and systems to produce sustainable solutions’.”

“There are two other terms that are worth clarifying: firstly ‘bio-utilisation’ and secondly ‘biophilia’. Bio-utilisation refers to the direct use of nature for beneficial purposes, such as incorporating planting in and around buildings to produce evaporative cooling.” “Biophilia was a term popularized by the biologist E. O. Wilson, and refers to a hypothesis that there is an instinctive bond between human beings and other living organisms.”

Janine Benyus discusses a set of laws, strategies, and principles that resonate in the chapters of her book. These principles of nature include:

Nature runs on sunlight.

Nature uses only the energy it needs.

Nature fits form to function.

Nature recycles everything.

Nature rewards cooperation.

Nature banks on diversity.

Nature demands local expertise.

Nature curbs excesses from within.

Nature taps the power of limits.

Biomimicry is a good clear thesis of designing principles. To act and utilize nature as a model of design can promote the original sustainable intention. The abstraction of building and designing architecture with this method can resolve the ambiguous notion of built separation. Using the biomimicry theory one can develop a technological and natural waste stream that works through a closed-loop cycle. These properties then become regenerative parts to a whole that have an agreeable whole to whole relationship.

8.3 Swarm Theory

Swarming is a collective behavior exhibited by animals of similar size. They aggregate together forming a cloud or mass moving in directional patterns caused by outside sources. Swarming is performed by insects, birds, bats, fish, and other life forms.

I have observed fish swarms and watched the characteristics of how they form and function. It is most interesting the patterns and conditions in which the swarm moves. The fish all move in a sequential manner into a larger mass in hopes to create a threatening illusion to predators. When a current acts upon the swarms, the fish move fluently as a reaction. In the case of a predatory attack, the group of fish moves in a synchronized fashion to evade the predator.

The qualities and effects of the fish swarms are relatable to architectural conditions. The sun that penetrates the smaller and larger openings between the fish creates a spectacle and glimmering effect. The fish are constructed with a skin of scales that portray a variety of colors and textures which reflect magnificently in the sunlight. The swarm itself is a generated blob which I like to consider a spatial condition which is continually changing in response to outside factors. The thinner and thicker patches of fish in the swarm could suggest a more breathable or open/visible condition. The observance of these qualities could easily be implemented as principle concepts for building design.

Studies of swarm theories have suggested a mathematical computation that generates a swarm. Based on mathematical inputs the swarms are produced as adaptive algorithms. Using scripted programs, I believe it could be possible to generate a spatial quality based on a mathematical algorithm that reflects a swarming condition.

CHAPTER IX

ARCHITECTURAL PRECEDENT STUDIES

9.1 Precedent Study - 1: Composite Veneer

Project: Responsive Surface Structure

Designer: Steffen Reichert

9.1.1 Description

This material is a product of pine cone biologies. The texture functions conditionally. When the environment is humid or too warm the scales open to release the humidity or warm air and vice versa when it's cold. This is an example of a conditionally responsive skin and how that skin performs spatially.

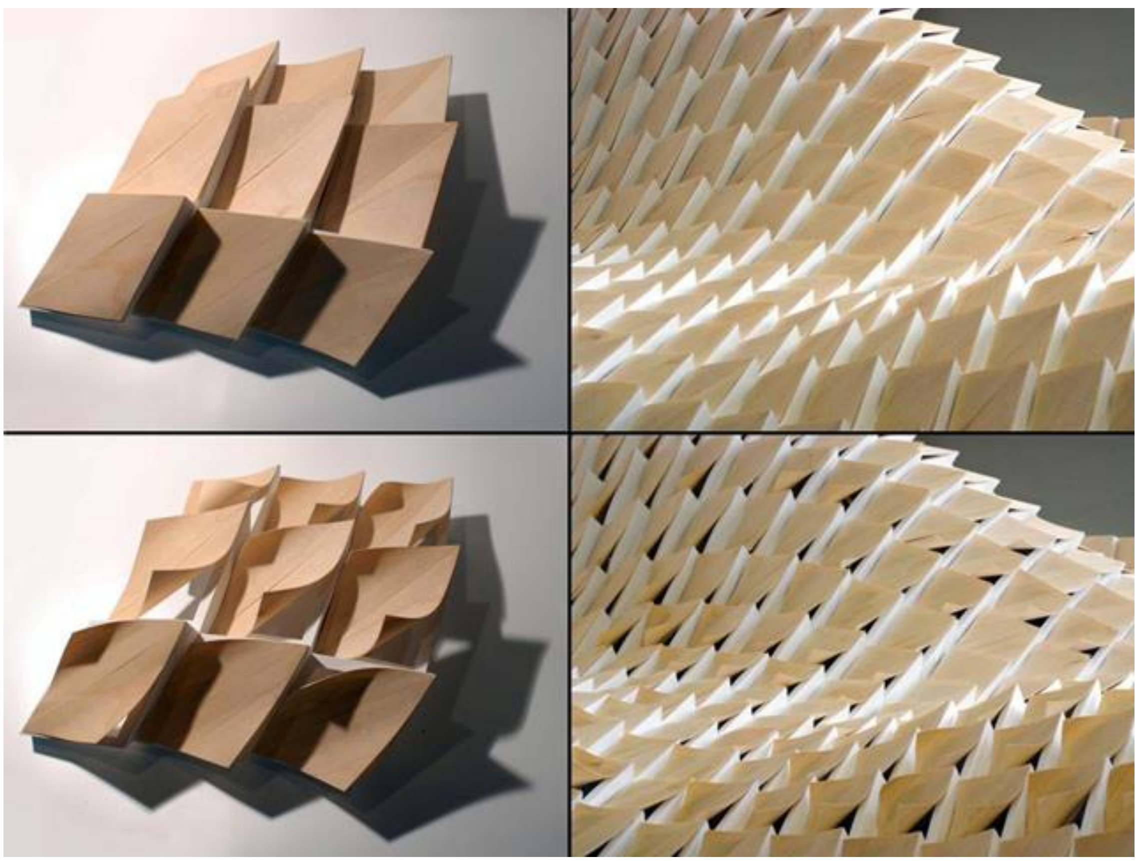

Figure 14 – Responsive Surface. Images of responsive surface reacting to the relative humidity. *Note.* Responsive Surface Structure. (2006-2007). Image retrieved January 19, 2013, from http://www.achimmenges.net/?p=4411

9.2 Precedent Study - 2: Architectural Composition

Architecture: Whitney Water Purification Facility and Park

Designer: Steven Holl

9.2.1 Description

The project consists of six sectors which comprise the six processes of water treatment. The facility contents are hidden underground. The landscape coincides with the material spatial configuration below. The administration building is formed as stainless steel silver rising like liquid from below.

Figure 15 – Whitney Water Purification Administration Building. *Note:* Steven Holl. (2005). Image retrieved January 19, 2013, from http://www.stevenholl.com/project-detail.php?type=infrastructure&id=45&page=0

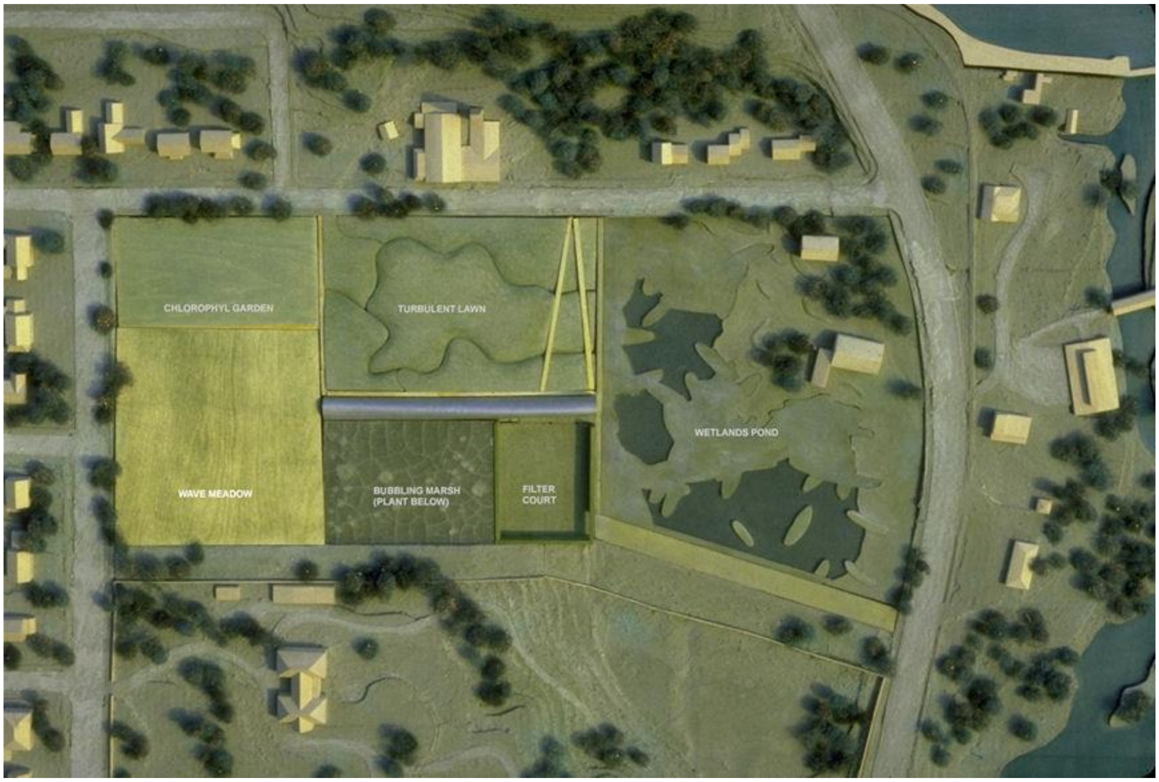

Figure 16 – Whitney Water Purification Facility and Park. *Note:* Steven Holl. (2005). Image retrieved January 19, 2013, from http://www.stevenholl.com/project-detail.php?type=infrastructure&id=45&page=0

Figure 17 – Whitney Water Purification Facility and Park. *Note:* Steven Holl. (2005). Image retrieved January 19, 2013, from http://www.stevenholl.com/project-detail.php?type=infrastructure&id=45&page=0

9.3 Precedent Study - 3: Architectural Composition

Architecture: Bioscience Innovation Center

Designer: SERVO

9.3.1 Description

SERVO explains, “The primary performative aspect of the hydrophile is the cultivation of biotopes on and through a variegated roofscape augmented with systems for percolating water through soil substrates. The material properties of ceramics with varying degrees of porosity and surface treatments are coupled with a morphology of protuberant forms in order to perform as hydrophilic and hydrophobic agents. The protuberant morphology of the roofscape directs the flow of water to irrigate organic matter—dirt.”

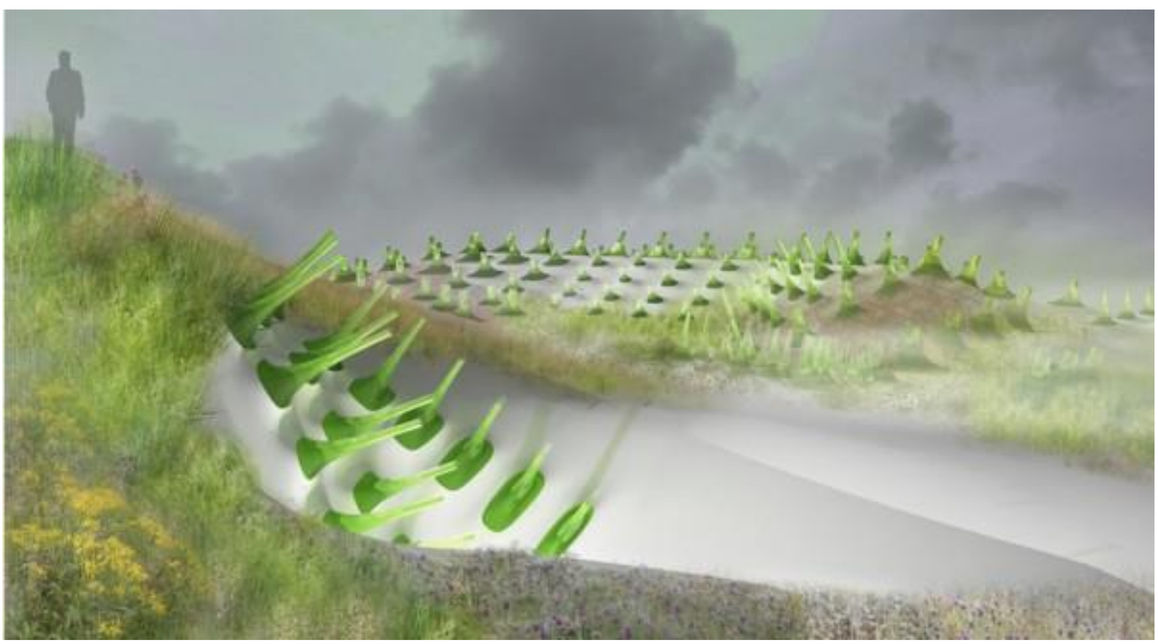

Figure 18 – Vegetated Roof and Water Collecting Devices. *Note:* SERVO. (2011). Image retrieved January 19, 2013, from http://www.evolo.us/architecture/bioscience-innovation-center-with-a-hydrodynamic-vegetated-roof-servo/

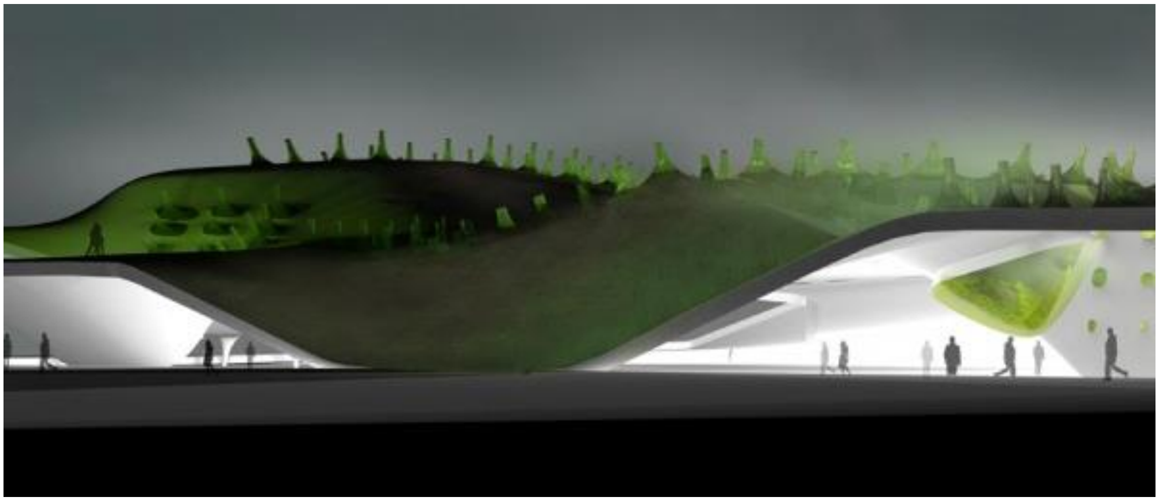

Figure 19 – Section through Bioscience Innovation Center. *Note:* SERVO. (2011). Image retrieved January 19, 2013, from http://www.evolo.us/architecture/bioscience-innovation-center-with-a-hydrodynamic-vegetated-roof-servo/

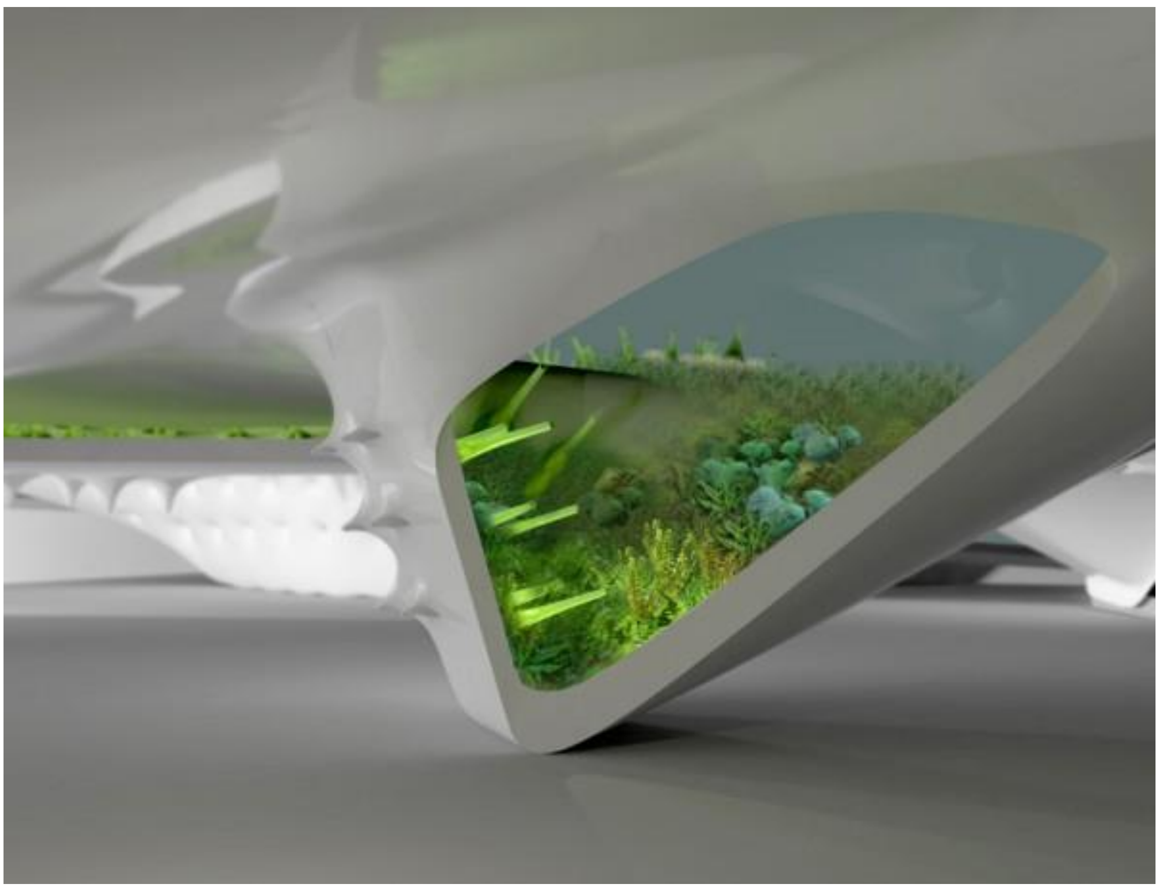

Figure 20 – Interior imagery of the project. *Note:* SERVO. (2011). Image retrieved January 19, 2013, from http://www.evolo.us/architecture/bioscience-innovation-center-with-a-hydrodynamic-vegetated-roof-servo/

9.4 Precedent - 4: Architectural Composition

Architecture: Elevated Brood Aquarium

Designer: Paul Nicholls

9.4.1 Description

This theoretical building was designed in 2011. The architecture portrays a very interesting way to connect a user with architecture and water. The composition of water is part of the architecture in this design. The design brings the user into new environmental array. This is a creative perspective on the opportunities of architectural works.

Figure 21 – Night image of Elevated Brood Aquarium. *Note.* Paul Nicholls. (2011). Image retrieved January 19, 2013, from http://www.biomimetic-architecture.com/2011/paul-nicholls-elevated-brood-aquarium/

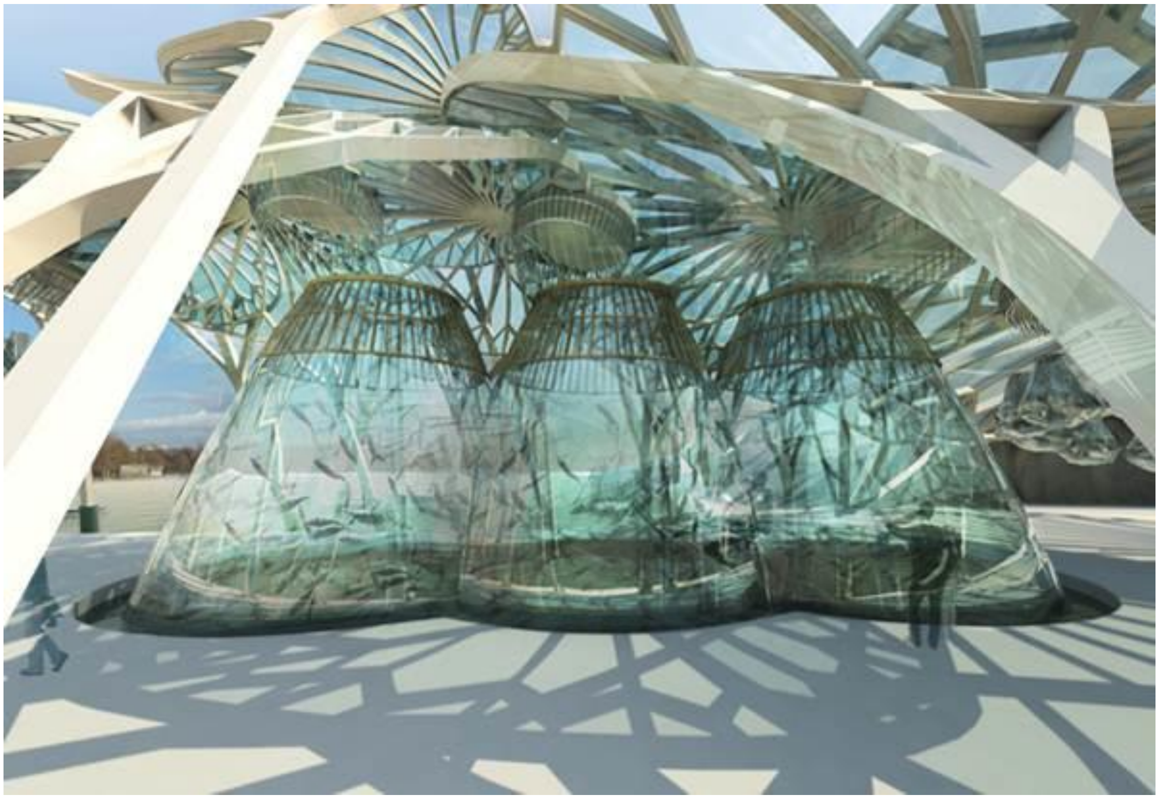

Figure 23 – Image of fishery tanks. *Note.* Paul Nicholls. (2011). Image retrieved January 19, 2013, from http://www.biomimetic-architecture.com/2011/paul-nicholls-elevated-brood-aquarium/

Figure 22 – Elevated Brood Aquarium. *Note.* Paul Nicholls. (2011). Image retrieved January 19, 2013, from http://www.biomimetic-architecture.com/2011/paul-nicholls-elevated-brood-aquarium/

CHAPTER X

RIVERSIDE BREWING FACILITY

10.1 The Riverside Brewing Facility

The Riverside Brewing Facility is a place where people can go to have fun but at the same time be educated about water allocation. People can go to the brewery to have a beer and socialize with other people. The brewhouse produces beer for consumption and for exporting. There is also a small restaurant space for visitors to grab a bite to eat while they sip on a nice pint. The interior spaces introduce the mechanical equipment used to generate electricity, make beer, and purify water. The building is set in a very prominent location so it maintains many of the exterior events of the site. The architecture is intended to be a subtle presence within the earth of the site. As the form boulders out, it mimics the geological activity that occurs around the site.

10.2 What's interesting about the building?

The building uses water in a closed loop system. It is extracting water from the Connecticut River and purifying it. The brewhouse utilizes much of the water for beer and for cleaning. Once the water is unusable for cleaning or other aspects it is then filtered and returned to the river. The excess wort from the brew process provides good nutrients for local farm animals. The brewing process is very energy intensive. To combat this I introduced water into large collection basin where the water is focused and set through a turbine which rotates to generate electric energy. By using a sustainable process, this hydroelectric generator produces vast amounts of energy and benefits not only the brewery but other energy suppliers as well. The structural design is formulated in a way that mimics the movement of water and the geologic layering. The experience of this building is like no other. The user crosses a bridge which dives under water to express the physical and emotional power of water. The walking experience through the building is an every changing liquid movement. The architectural conditions are intended to suggest a social connection between people, water, and architecture.

10.3 Inspiration

Visiting the site, I was able to interact with the river bed and get a closer look at the geologic foundations of the site. What I found was the astounding interaction of layered rock and water. The plates of mudstone and sandstone protruded from the earth and were carved and formed by the continual passing of water. Certain shapes and moments created pockets carved out of the stone. Where water is focused, it shapes paths within the stone to make what could be considered an architectural condition. Inspired by these events I took a more analytical approach to design the building as a movement of liquid.

Figure 24 – Geologic Phenomenon and Water. *Note:* This photo was taken by Ryan Luczkowiak March 23, 2013.

10.3.1 Digital Investigation

As part of my digital explorations I performed a site analysis which allowed me to manipulate the site topologies which exposed an interesting architectural condition. Formulating and expressing the characteristics of water was generated from conditions of the site. After studying the results of the investigation I then began to apply structural members and a light source to then produce a digital fabrication within a physical environment. The result of this investigation created a very conceivable architectural condition that would later be used as an interior effect of liquid movement.

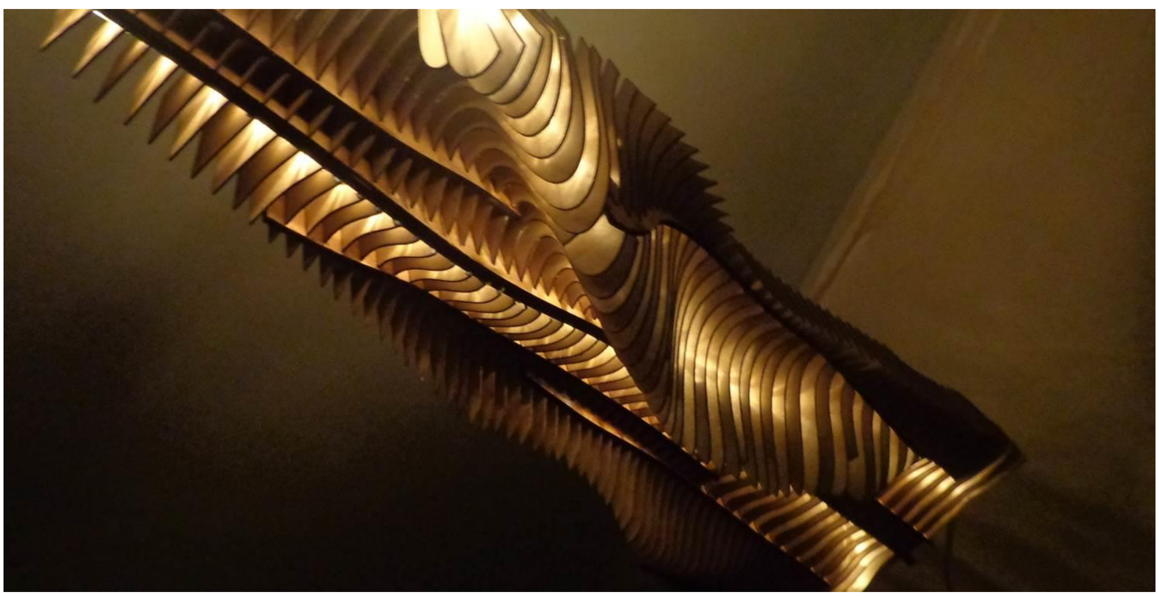

Figure 25 – Liquescent Light Fixture. This light fixture suggests an architectural condition which expresses a liquid movement. *Note:* Light fixture is designed, built, and photographed by Ryan Luczkowiak.

I began to thoroughly explore and understand the parametric capabilities of digital design and fabrication. Both Revit Architecture[7] and Rhinoceros 3D[8] contains parametric capabilities but is communicated differently. As an understanding tool I used functions of Rhinoceros 3D to explore the more liquescent forms and possibilities of architecture. In using Revit Architecture the program defines architectural conditions by default which gives the user an automated representation, taking away design ability. By having a free flow influence of the Rhinoceros digital language I was able to use and understand Revit architecture in a more fluid and parametric manor. The movements of digital fabrication are becoming a common practice. This investigation among different digital contexts has opened my thought process to a more in-depth approach to a design scenario. Understanding the logics of the software gives me an interchangeable ability to specify design intentions. In learning the programs I am no longer limited due to a lack of know how. With an understanding of the digital tools I was able to embark on a design influenced by liquid movement.

[7] Revit Architecture is a Building Information Modeling (BIM) software, produced by Autodesk. The software is used by architects, structural engineers, engineers, contractors, and trades alike. The user can create digital 3D models of buildings and components within those buildings and efficiently illustrate information about the building.

[8] Rhinoceros (Rhino) is a stand-alone, Nurbs-based 3D modeling software, developed by Robert McNeel & Associates. The software is used in a multiplicity of disciplines which specialize in free-form designs. Examples of its usage can vary from automotive design, architecture, multimedia and graphic design, marine design, and other forms of engineering.

Figure 26 – Parametric bridge design. This is the bridge designed for users access the brewery. The tunnel dives under water and is designed specifically to resist the immense pressure of the water. *Note:* This image is fabricated by Ryan Luczkowiak

10.3.2 Initial Sketching and Modeling

Returning back to the site map I looked at a more physical movement of the site. One of the ideas was to move the landscape and carve out a means of egress which in this concept mimicked the presence of liquid movement through earth. Taking and studying the information I worked on a more conglomerated form which maintained the earthy values. In doing this I formed a boulder like object which protruded from the earth. Along with the many concept ideas I underwent a modeling process to think in three dimensions. These models gave me a clear understanding of how the forms would interact with the site amenities.

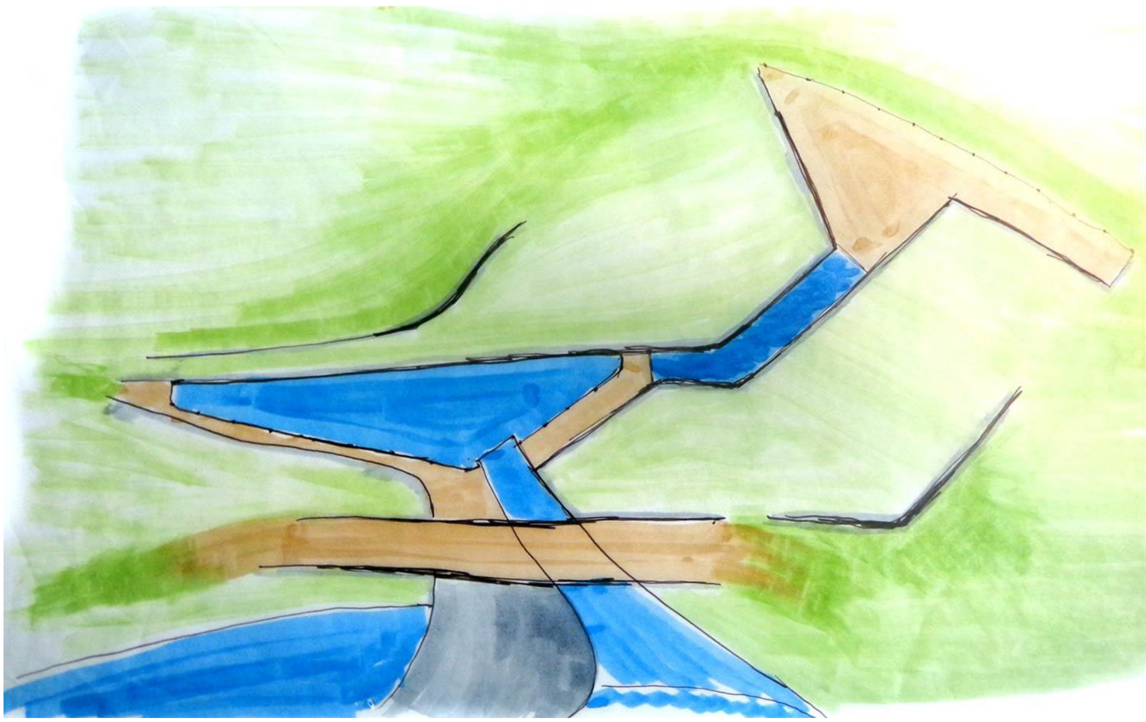

Figure 27 – Initial sketch of earth movement. *Note:* Sketch drawn by Ryan Luczkowiak.

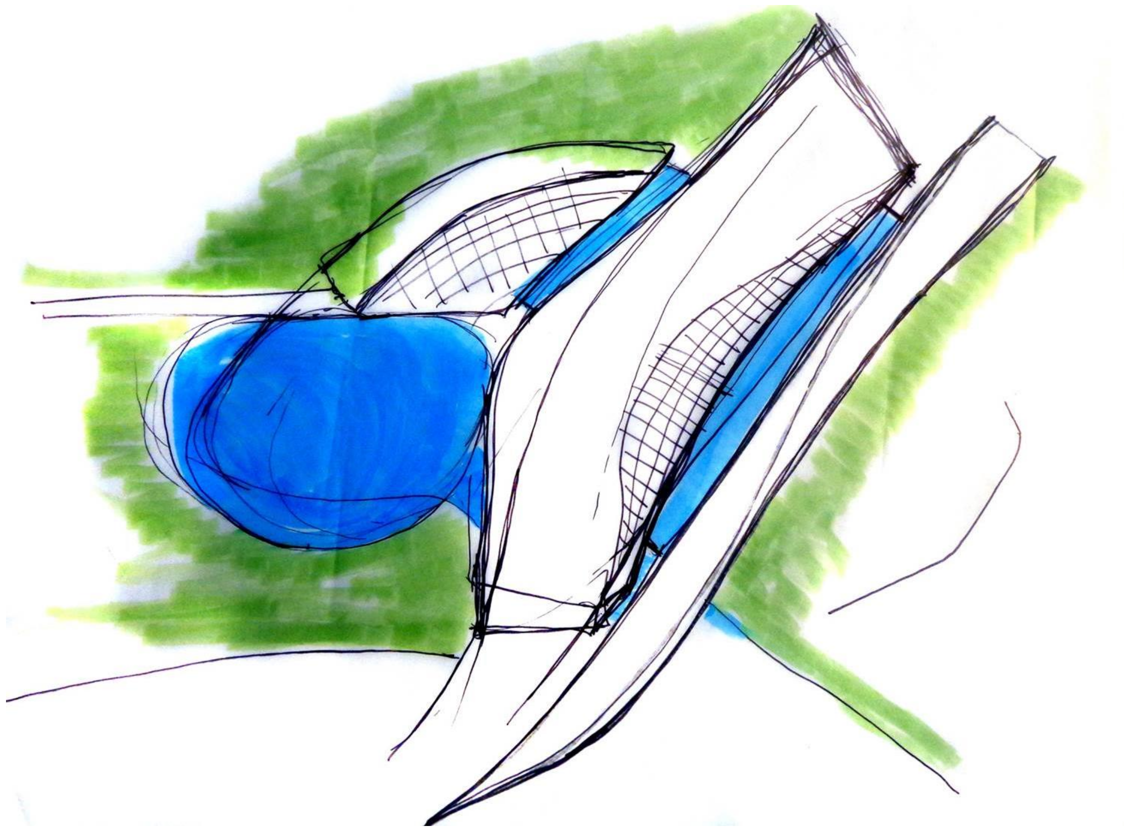

Figure 28 – Concept sketch involving a conglomerated program. *Note:* Sketch drawn by Ryan Luczkowiak.

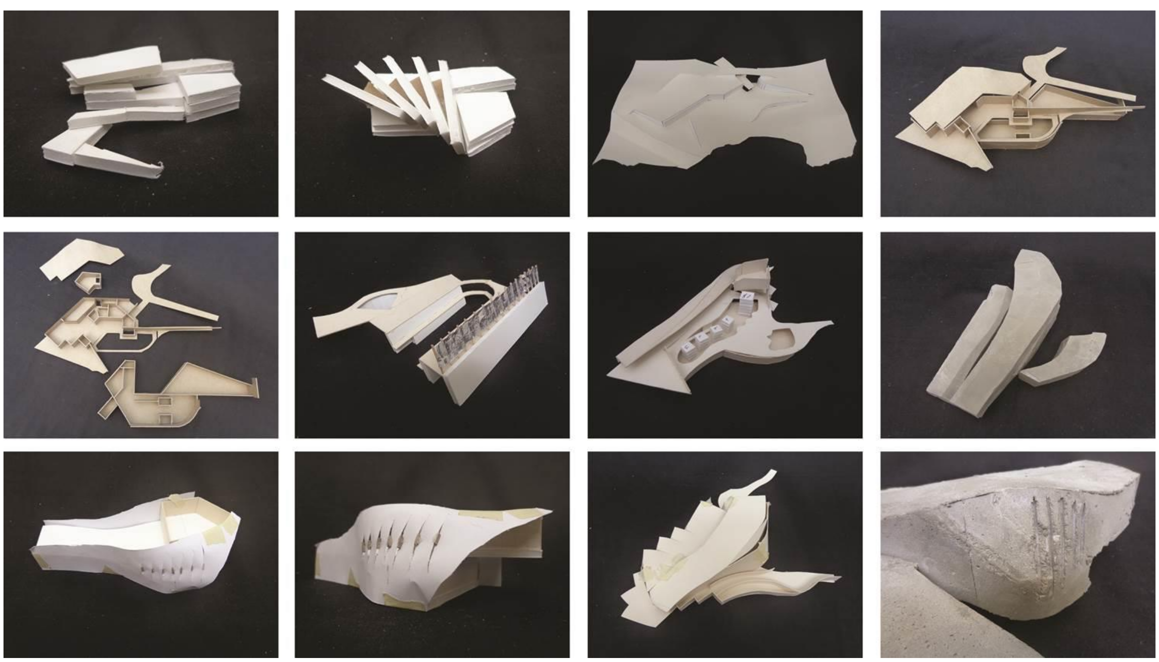

Figure 29 – Modeling Process. *Note:* Models built and photographed by Ryan Luczkowiak.

10.4 The Architectural Experience

To access the site the user must cross a bridge. The existing bridge is currently deemed unsafe for pedestrian activity. Part of this project was to design a new bridge that embraced the nature water. The proposed bridge was influenced by the motions of the flowing water. As the user descends down the ramp, the ramp slowly turns. Before entering the underwater tunnel the ramp path pauses to reflect on two experiences. The first event would be a nice visual of the canal, the old mill buildings, and the bike path. This scene is calm and relaxing. Turning in opposition of the water flow, facing the tunnel, the user looks into an immense rush of water. Seeing and hearing this titanic force of water, evokes an emotion which may be disconcerting. This moment is captured to express the different emotions that water can portray.

Entering the tunnel the mood changes into a mysterious adventure. This tunnel travels underwater, captivating the user in a new architectural experience. The structural design is collaborated by parametric hexagonal components. These components interlock providing a structure that resists the immense power and force of the passing water. Also to reinforce the hexagon structure, ribbed steel members attach to the hexagon components in a rhythmic pattern, creating a more rigid system. At the end of the tunnel the user may notice the polyhedra, which is the water intake system that filters debris and large particles out of the water for water purification.

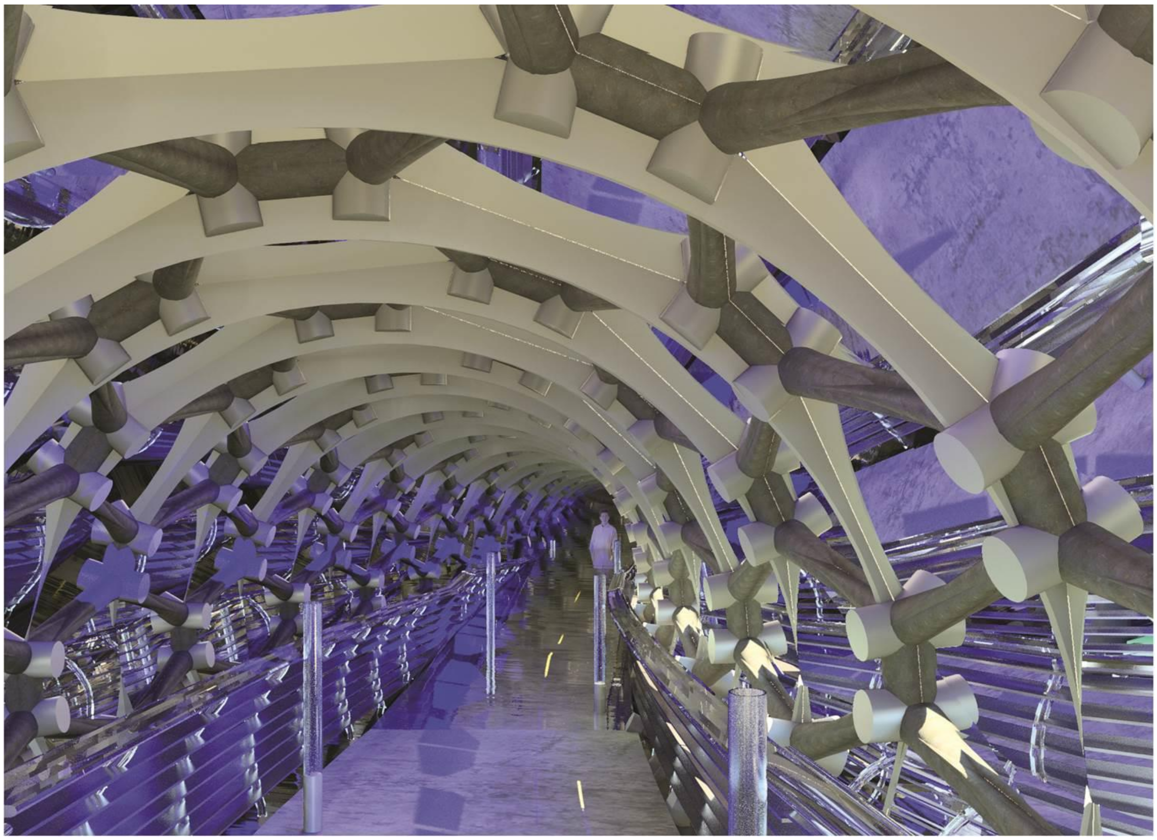

Figure 30 – Tunnel Experience. *Note:* This image is fabricated by Ryan Luczkowiak

Exiting the tunnel the user has a choice to continue straight which enters the brewery or to turn left putting the user onto a path that leads to the river. Upon entering the building, the user is opened to various windows that look into the equipment that purifies the river water into potable water. On the opposite side of the windows are large tanks that hold the purified water. The water is stored in three large tanks and then is distributed among the systems within the building.

Figure 31 – Entry Image. *Note:* This image is fabricated by Ryan Luczkowiak

The ceiling is a system of ribs which gestures to the movement of water. As the user passes through the spaces the ribs and lighting are ever changing. This gives an effect of movement. At the end of this hall there is a window that looks outside to see the Connecticut River. A door adjacent to the window takes the user to an outdoor space which functions as a social area, overlook, or other social gatherings. This overlook views the mountains, intersecting estuaries, the Turners Falls Bridge, the fish ladder, and the dams.

Figure 32 – Outside Space, Overlook. *Note:* This image is fabricated by Ryan Luczkowiak

Returning back inside the user is announced to the brewhouse and bar area. The two areas are adjacent to one another. The ceiling for the bar area is brought down to a lower intimate level. Enjoying a pint of beer the user has multiple choices on how to interact with the space. One can sit at the bar, stand and enjoy the brewhouse, or take a seat at a table in a more open area. The open area becomes a very public space during the daytime. In the evening, small warm lights bring the level of socialization down to a warmer personal level.

Figure 33 – Social Area. *Note:* This image was fabricated by Ryan Luczkowiak.

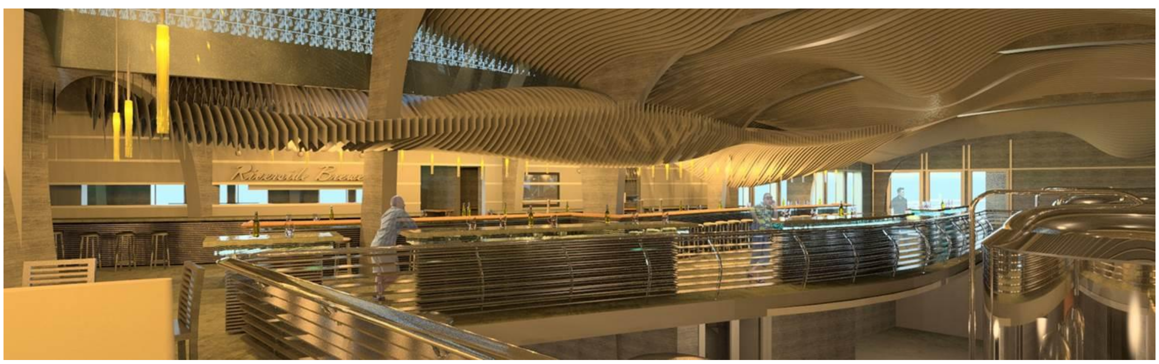

Figure 34 – Bar and Brewhouse. *Note:* This image is fabricated by Ryan Luczkowiak.

The user can exit one of two ways; one being the way we entered the building which exits back to the tunnel or through a hallway which leads to the west end exiting near the pathways that lead to the river. The west exit is also another interesting atmospheric experience. The lighting becomes much cooler and the space becomes closer. Just before the exit there is an opening in the floor. Looking down the user can see the generator which is producing the energy for the building.

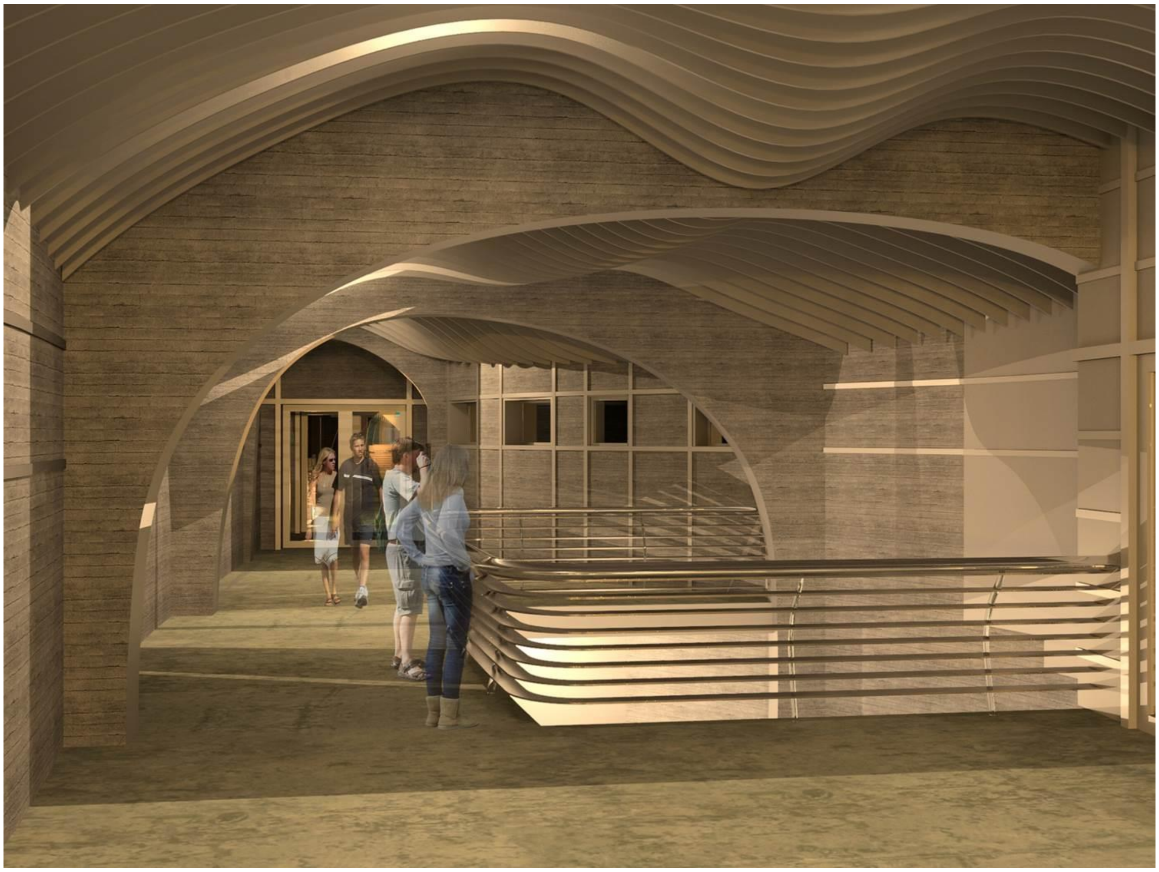

Figure 35 – Above Generator Space. *Note:* This image is fabricated by Ryan Luczkowiak

After exiting through, the user is presented to a very monumental scene. This scene portrays the water basin, the geologic form of the building, and the path that returns to the tunnel and bridge. It is an awe-inspiring scene. This is meant to be a scene of remembrance and an iconic reflection. The enjoyment and experience of water are meant to become very visible items. The illustration of water and its existence within our architectural and social life is intended to have an apparent communication through the users that experience this building.

Figure 36 – Night Rendering of Exterior, Water Basin. *Note:* This image is fabricated by Ryan Luczkowiak

10.5 Floor Plans & Sections

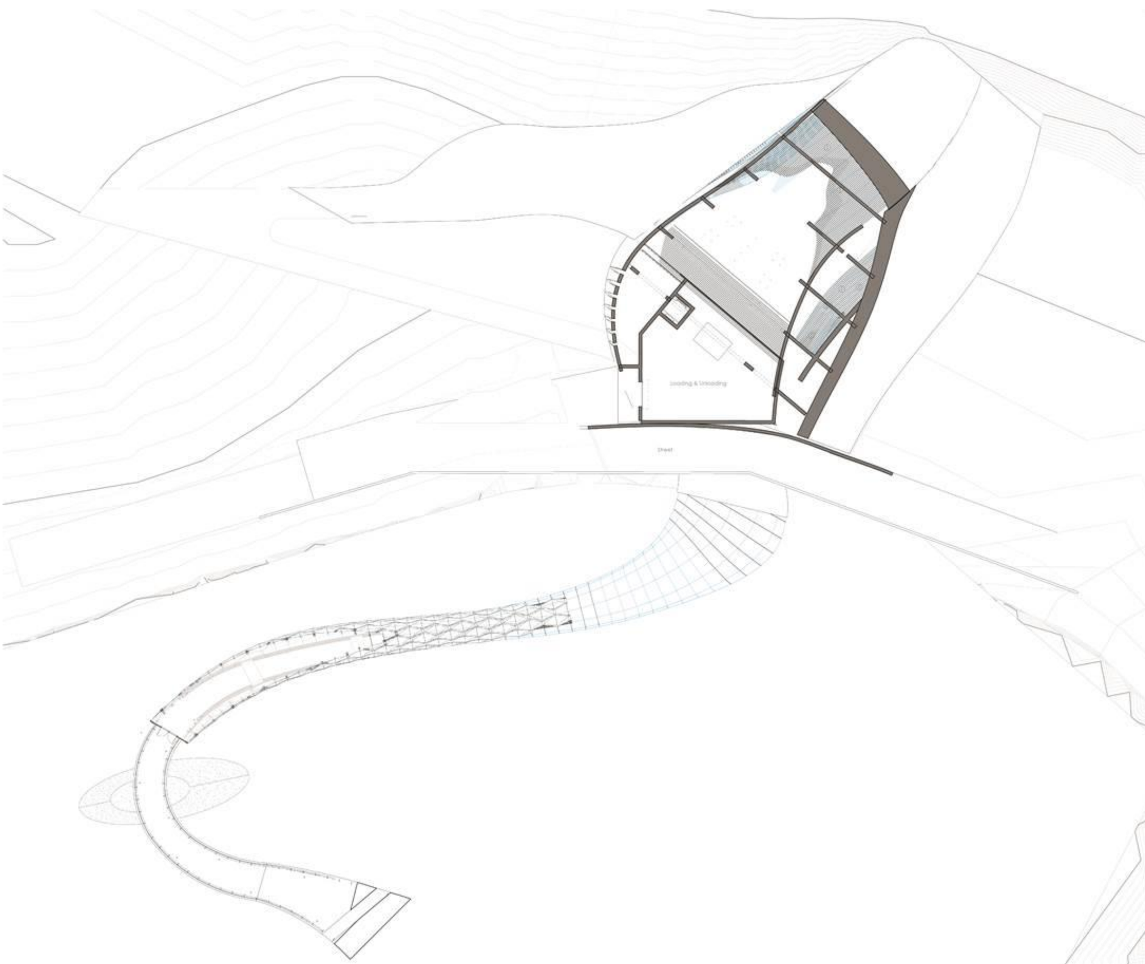

Figure 37 – Level 3 – Loading Dock. *Note:* Image generated by Ryan Luczkowiak.

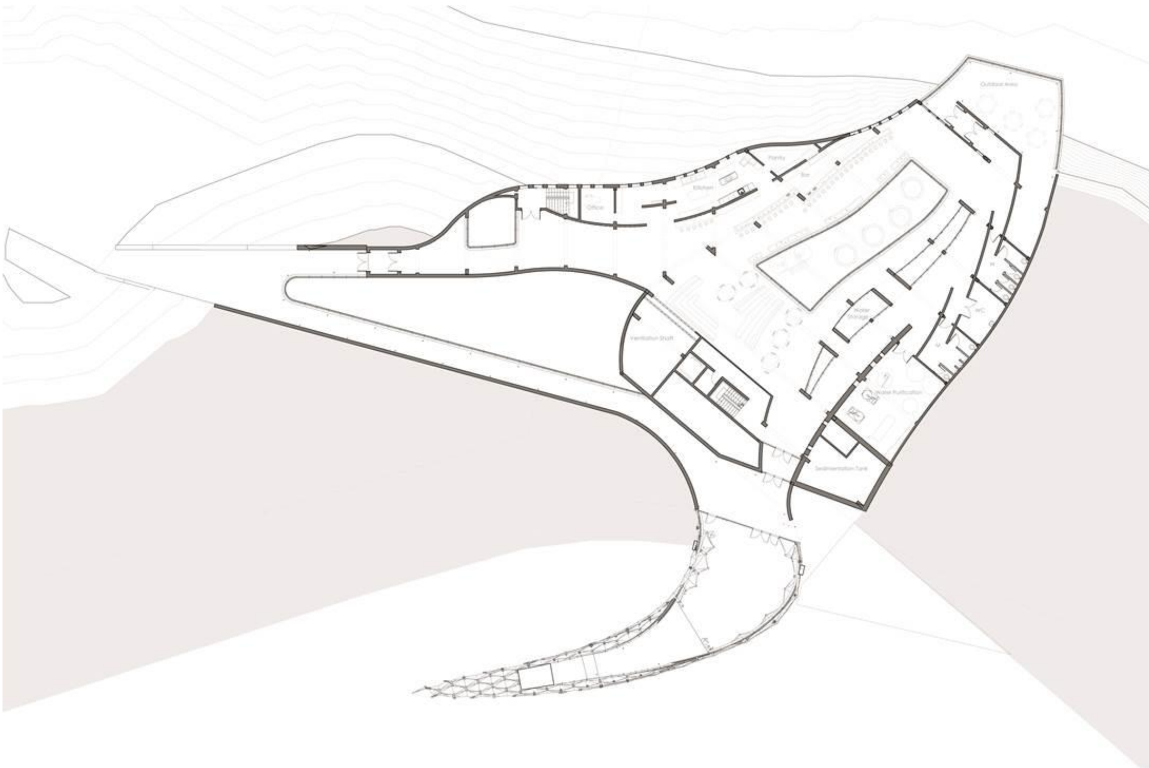

Figure 38 – Level 2 – Main Floor. *Note:* Image generated by Ryan Luczkowiak.

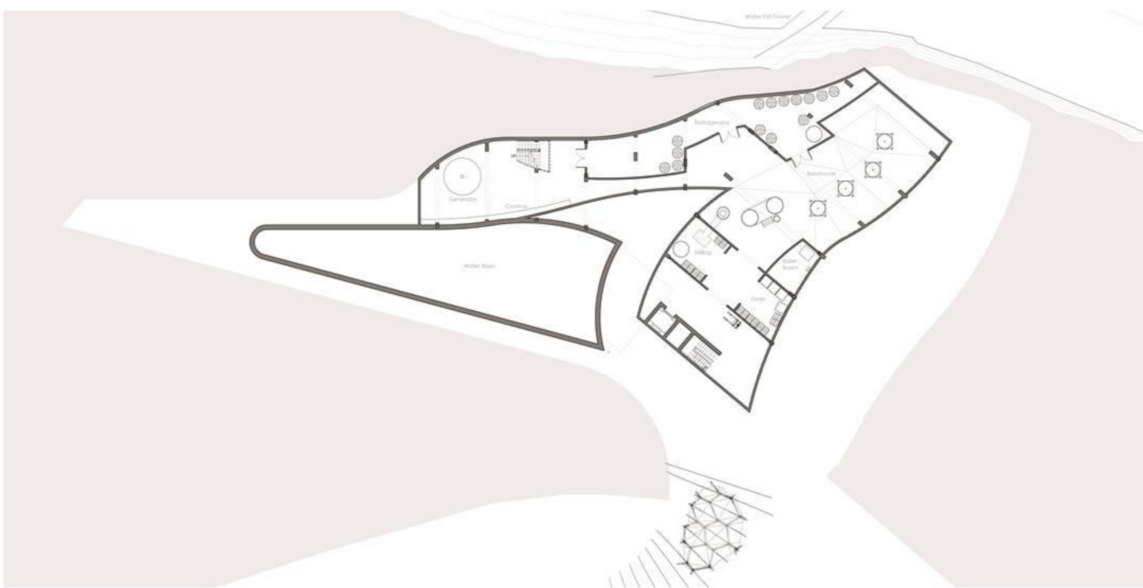

Figure 39 – Level 1 – Generator and Brewhouse. *Note:* Image generated by Ryan Luczkowiak.

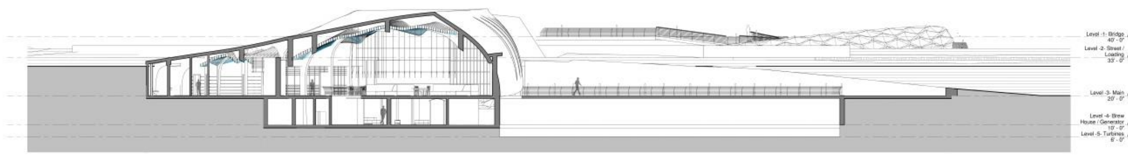

Figure 40 – Section 1. *Note:* Image generated by Ryan Luczkowiak.

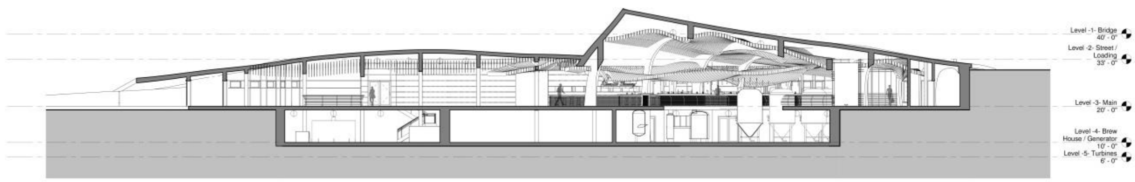

Figure 41 – Section 2. *Note:* Image generated by Ryan Luczkowiak.

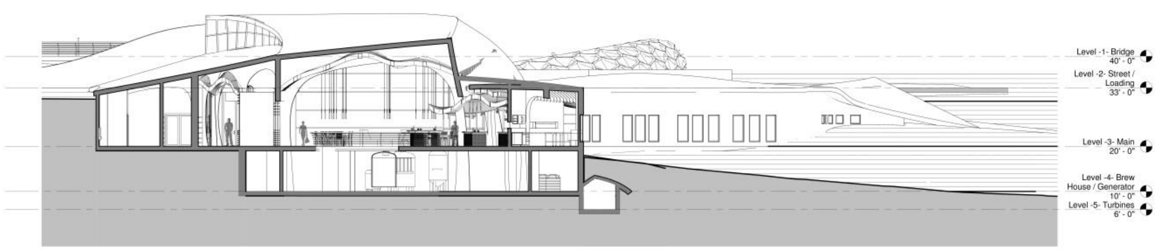

Figure 42 – Section 3. *Note:* Image generated by Ryan Luczkowiak.

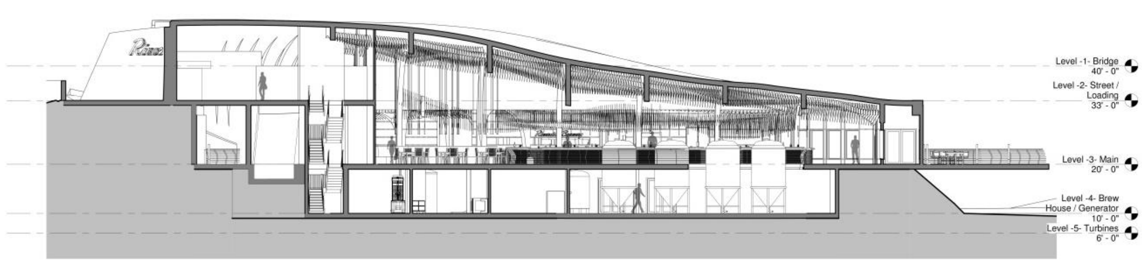

Figure 43 – Section 4. *Note:* Image generated by Ryan Luczkowiak.

CHAPTER XI

SYMBIOSIS

11.1 Symbiosis

The Metapolis Dictionary of Advanced Architecture

> "**Symbiosis:** is the mechanism by which two organisms mutually come together to enrich their development or simply their permanence. There are harmonious (pure) ones and hybrid (impure) ones. We are interested in the latter."

Taking in and understanding this ideology of social movement and applying a sustainable aspect to it is a big part in the societal shift. It may not be understood in the literal sense but the theologies of moving towards an environmentally stable ethic would be sufficed. It is to take these theories and allow them to grow into a common place. This common place could be generated architecturally. We as cultures and societies revolve around architectural influence. Creating this social movement through the use of architecture can be a tool in our advancement to become a more symbiotic culture with natural essences. Symbiosis is the interaction of two biological systems. An example of this is the Living Bridges of Cherrapunji located in India. The bridges consist of grown roots that reach across a water way, providing an accessible means of crossing the water way.The Living Bridges of Cherrapunji are a real literal sense of symbiosis. Adjusting to the social needs and accessibilities of today we can take these principles and apply them, technologically, in a natural artifice. The evolutionary quandary of sustainability has only begun its first stages in a potentially long continual life to come. A sentence from Alan Kay, quoted by Andres Edwards from The Sustainability Revolution Portrait of a Paradigm Shift, writes, "The best way to predict the future is to invent it."

Figure 44 – Living Bridges of Cherrapunji, India. *Note:* The Guardian. 2011. Image retrieved January 19, 2013, from http://www.guardian.co.uk/environment/picture/2011/sep/15/living-bridges-inda-big-picture

11.2 Closure

As we begin to invent possibilities of architecture we activate new social understandings. By digitally fabricating a condition of architecture we are introducing new forms of architectural communication. Through the process of investigation we are building logic out of these possibilities which lead to innovative results. Newer systems of thinking and design are become apparent in the workflow of architecture. It is clear the Bridges of Cerrapunji are an example of designing nature which has been passed down from generation to generation. A key element in this design was to allow nature to be the building function. It is the connection of our digital workflows and natural patterns that are apparent when designing a built nature. Through generations of teaching and discovering we can become producers of nature. This project became an investigation of water as part of our architectural and social patterns as much as it came to be an investigation of the digital and natural connection. Studying the movement and characteristics of water allowed me to illustrate an architecture that represents fluid natures of water. The digital architectural connections to our social natures have only been introduced. This thesis was a part of that search; to find a more symbiotic connection between people, water, and architecture.

APPENDIX I

PROGRAM ROOM DATA

Room No.	Room Name	Net S.F.	Max. Occupancy
1.A.	Vestibule	100	33 @ 3sf/person

Function	
Activities	Circulation, transition space
Access	ADA accessible, main entrance
Frequency	High traffic, daily

Relationships	
Adjacencies	Lobby
Proximity	Entrance
Floor Location	Level 3 – Main Floor

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Seasonal temperatures
Humidity	
Noise	Acts as acoustical buffer from inner activities
Ceiling Finish	High quality, durable
Wall Finish	High quality, durable
Floor Finish	Polished Concrete

Technology. Mechanical and Electrical	
A.V. Required	Yes
HVAC	Yes
Plumbing	Yes

Fire Protection
Yes

Furniture/Equipment
Door, Bench, Debris collector, Glass front

Comments
Transition space from outside to architectural conditions.

Room No.	Room Name	Net S.F.	Max. Occupancy
1.B.	Lobby	650	216 @ 3sf/person

Function	
Activities	Provides orientation and organization to building
Access	ADA accessible, main entrance
Frequency	High traffic, daily

Fire Protection
Yes

Relationships	
Adjacencies	Reception, vestibule, restaurant, event space, brewhouse
Proximity	Main entrance
Floor Location	Level – 3 Main Floor

Furniture/Equipment
Seating

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Regulated
Humidity	Regulated
Noise	Acoustic open to multiple spaces
Ceiling Finish	Ribbed panels
Wall Finish	Plank formed concrete
Floor Finish	Polished Concrete

Comments
This space will be the introduction space to the building.

Technology. Mechanical and Electrical	
A.V. Required	No
HVAC	Yes
Plumbing	No

Room No.	Room Name	Net S.F.	Max. Occupancy
1.C.	Reception	100	33 @ 3sf/person

Function	
Activities	
Access	ADA accessible
Frequency	

Fire Protection
Yes

Relationships	
Adjacencies	Lobby, social area, and bar
Proximity	
Floor Location	Level 3 – Main Floor

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Controlled
Humidity	Controlled
Noise	Medium
Ceiling Finish	Ribbed Panels
Wall Finish	
Floor Finish	Polished Concrete

Technology. Mechanical and Electrical	
A.V. Required	Yes
HVAC	No
Plumbing	No

Comments

Room No.	Room Name	Net S.F.	Max. Occupancy
1.D.	Restaurant	1200	400 @ 3sf/person

Function	
Activities	Eating, socializing, drinking beer
Access	ADA accessible
Frequency	

Fire Protection
Yes

Relationships	
Adjacencies	Bar, kitchen
Proximity	
Floor Location	Level 3 – Main Level

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting, cylinder wire lights
Temperature	Controlled
Humidity	Controlled
Noise	Medium
Ceiling Finish	Ribbed Panels
Wall Finish	
Floor Finish	Polished Concrete

Comments

Technology. Mechanical and Electrical	
A.V. Required	No
HVAC	Yes
Plumbing	Yes

Room No.	Room Name	Net S.F.	Max. Occupancy
1.E.	Restroom	600	200 @ 3sf/person

Function	
Activities	
Access	ADA accessible
Frequency	

Fire Protection
Yes

Relationships	
Adjacencies	Water closet
Proximity	
Floor Location	Level 3 – Main Floor

Furniture/Equipment
Toilets, sinks

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Controlled
Humidity	Controlled
Noise	Low
Ceiling Finish	RFP Board
Wall Finish	RFP Board
Floor Finish	Polished Concrete

Technology. Mechanical and Electrical	
A.V. Required	No
HVAC	Yes
Plumbing	Yes

Comments

Room No.	Room Name	Net S.F.	Max. Occupancy
1.F.	Event Space	1200	400 @ 3sf/person

Function	
Activities	
Access	ADA accessible
Frequency	

Fire Protection
Yes

Relationships	
Adjacencies	
Proximity	
Floor Location	

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Controlled
Humidity	Controlled
Noise	Medium
Ceiling Finish	
Wall Finish	
Floor Finish	

Comments

Technology. Mechanical and Electrical	
A.V. Required	Yes
HVAC	Yes
Plumbing	No

Room No.	Room Name	Net S.F.	Max. Occupancy
1.G.	Outdoor Space	1500	500 @ 3sf/person

Function	
Activities	
Access	ADA accessible
Frequency	

Fire Protection
N/A

Relationships	
Adjacencies	
Proximity	
Floor Location	Level 3 – Main Floor

Furniture/Equipment
Tables and chairs

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Seasonal
Humidity	Seasonal
Noise	Sound
Ceiling Finish	N/A
Wall Finish	N/A
Floor Finish	N/A

Comments

Technology. Mechanical and Electrical	
A.V. Required	No
HVAC	N/A
Plumbing	N/A

Room No.	Room Name	Net S.F.	Max. Occupancy
1.H.	Boardwalk	1000	333 @ 3sf/person

Function	
Activities	
Access	ADA accessible
Frequency	

Fire Protection
Yes

Relationships	
Adjacencies	
Proximity	
Floor Location	Level 1 – Bridge Level

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Seasonal
Humidity	Seasonal
Noise	
Ceiling Finish	
Wall Finish	
Floor Finish	

Comments

Technology. Mechanical and Electrical	
A.V. Required	Yes
HVAC	No
Plumbing	No

Room No.	Room Name	Net S.F.	Max. Occupancy
1.I.	Small Shop	650	216 @ 3sf/person
Function			
Activities			
Access	ADA accessible		
Frequency			

Fire Protection
Yes

Relationships	
Adjacencies	Lobby, brewhouse, restaurant
Proximity	
Floor Location	

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Controlled
Humidity	Controlled
Noise	Low
Ceiling Finish	
Wall Finish	
Floor Finish	Polished Concrete

Technology. Mechanical and Electrical	
A.V. Required	Yes
HVAC	Yes
Plumbing	No

Comments

Room No.	Room Name	Net S.F.	Max. Occupancy
2.A.	Water Intake	300	100 @ 3sf/person

Function	
Activities	Extraction of water
Access	Limited
Frequency	Constant

Fire Protection
Yes

Relationships	
Adjacencies	Hydro canal
Proximity	
Floor Location	From top of Level 2 down 12 feet

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Seasonal
Humidity	Seasonal
Noise	High
Ceiling Finish	N/A
Wall Finish	N/A
Floor Finish	Concrete

Technology. Mechanical and Electrical	
A.V. Required	Yes
HVAC	N/A
Plumbing	Yes

Comments

Room No.	Room Name	Net S.F.	Max. Occupancy
2.B.	Water Filtration	100	33 @ 3sf/person

Function	
Activities	Secondary filtration of water
Access	ADA accessible
Frequency	High use

Fire Protection
Yes

Relationships	
Adjacencies	Potable filtration, water storage, tube cleaning
Proximity	
Floor Location	Level 3 – Main Floor

Furniture/Equipment
Water Purification Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Controlled
Humidity	Controlled
Noise	Medium
Ceiling Finish	RFP Board
Wall Finish	RFP Board
Floor Finish	Polished Concrete

Comments

Technology. Mechanical and Electrical	
A.V. Required	No
HVAC	Yes
Plumbing	Yes

Room No.	Room Name	Net S.F.	Max. Occupancy
2.C.	Potable Filtration	150	50 @ 3sf/person

Function	
Activities	Final purification of water
Access	ADA accessible
Frequency	High use

Fire Protection
Yes

Relationships	
Adjacencies	Water filtration, water storage
Proximity	
Floor Location	Level 3 – Main Floor

Furniture/Equipment
Potable filtration equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Controlled
Humidity	Controlled
Noise	Medium
Ceiling Finish	RFP Board
Wall Finish	RFP Board
Floor Finish	Polished Concrete

Comments

Technology. Mechanical and Electrical	
A.V. Required	Yes
HVAC	Yes
Plumbing	Yes

Room No.	Room Name	Net S.F.	Max. Occupancy
2.D.	Storage	150	50 @ 3sf/person

Function	
Activities	
Access	ADA accessible
Frequency	

Fire Protection
Yes

Relationships	
Adjacencies	
Proximity	
Floor Location	Level 3 – Main Floor, Level 2 – Loading Dock, Level 4 – Brewhouse and Generator

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Controlled
Humidity	Controlled
Noise	Low
Ceiling Finish	
Wall Finish	
Floor Finish	Polished Concrete

Comments

Technology. Mechanical and Electrical	
A.V. Required	No
HVAC	Yes
Plumbing	No

Room No.	Room Name	Net S.F.	Max. Occupancy
2.E.	Water Storage	1000	333 @ 3sf/person

Function	
Activities	
Access	ADA accessible
Frequency	

Fire Protection
Yes

Relationships	
Adjacencies	Water filtration, brewhouse
Proximity	
Floor Location	Level 3 – Main Floor

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Controlled
Humidity	Controlled
Noise	Low
Ceiling Finish	RFP Board
Wall Finish	RFP Board
Floor Finish	Polished Concrete

Technology. Mechanical and Electrical	
A.V. Required	No
HVAC	No
Plumbing	Yes

Comments

Room No.	Room Name	Net S.F.	Max. Occupancy
2.F.	Tube Cleaning	100	33 @ 3sf/person

Function	
Activities	
Access	ADA accessible
Frequency	

Fire Protection
Yes

Relationships	
Adjacencies	Brewhouse, water filtration
Proximity	
Floor Location	Level 3 – Main Floor

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Controlled
Humidity	Controlled
Noise	Medium
Ceiling Finish	RFP Board
Wall Finish	RFP Board
Floor Finish	Polished Concrete

Comments

Technology. Mechanical and Electrical	
A.V. Required	No
HVAC	No
Plumbing	Yes

Room No.	Room Name	Net S.F.	Max. Occupancy
2.G	Brewhouse	1500	500 @ 3sf/person

Function	
Activities	
Access	ADA accessible
Frequency	

Fire Protection
Yes

Relationships	
Adjacencies	
Proximity	
Floor Location	Level 4 – Brewhouse and Generator

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Controlled
Humidity	Controlled
Noise	High
Ceiling Finish	RFP Board
Wall Finish	RFP Board
Floor Finish	Polished Concrete

Comments

Technology. Mechanical and Electrical	
A.V. Required	Yes
HVAC	Yes
Plumbing	Yes

Room No.	Room Name	Net S.F.	Max. Occupancy
2.H.	Milling Room	150	50 @ 3sf/person

Function	
Activities	
Access	ADA accessible
Frequency	

Fire Protection
Yes

Relationships	
Adjacencies	
Proximity	
Floor Location	Level 4 – Brewhouse and Generator

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Controlled
Humidity	Controlled
Noise	Medium
Ceiling Finish	
Wall Finish	
Floor Finish	Polished Concrete

Comments

Technology. Mechanical and Electrical	
A.V. Required	No
HVAC	Yes
Plumbing	No

Room No.	Room Name	Net S.F.	Max. Occupancy
2.I.	Bottling	50	16 @ 3sf/person

Function	
Activities	
Access	ADA accessible
Frequency	

Fire Protection
Yes

Relationships	
Adjacencies	
Proximity	
Floor Location	Level 4 – Brewhouse and Generator

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Controlled
Humidity	Controlled
Noise	Medium
Ceiling Finish	RFP Board
Wall Finish	RFP Board
Floor Finish	Polished Concrete

Comments

Technology. Mechanical and Electrical	
A.V. Required	No
HVAC	Yes
Plumbing	Yes

Room No.	Room Name	Net S.F.	Max. Occupancy
3.A	Loading Dock	200	66 @ 3sf/person
Function			
Activities	Loading and unloading equipment, materials, grains, and other beer contentsx		
Access	ADA accessible		
Frequency	Once per week		

Fire Protection
Yes

Relationships	
Adjacencies	Storage
Proximity	
Floor Location	Level 2 – Loading Dock

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Seasonal
Humidity	Seasonal
Noise	Low
Ceiling Finish	
Wall Finish	
Floor Finish	

Comments

Technology. Mechanical and Electrical	
A.V. Required	No
HVAC	No
Plumbing	No

Room No.	Room Name	Net S.F.	Max. Occupancy
3.B.	Grain Storage	300	100 @ 3sf/person

Function	
Activities	
Access	ADA accessible
Frequency	

Fire Protection
Yes

Relationships	
Adjacencies	
Proximity	
Floor Location	Level 2 – Loading Dock, Level 4 – Brewhouse and Generator

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Uncontrolled
Humidity	Uncontrolled
Noise	Low
Ceiling Finish	
Wall Finish	
Floor Finish	Concrete

Comments

Technology. Mechanical and Electrical	
A.V. Required	No
HVAC	No
Plumbing	No

Room No.	Room Name	Net S.F.	Max. Occupancy
3.C.	Conditioning Room	600	200 @ 3sf/person

Function	
Activities	
Access	ADA accessible
Frequency	

Fire Protection
Yes

Relationships	
Adjacencies	
Proximity	
Floor Location	Level 4 – Brewhouse and Generator

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Controlled
Humidity	Controlled
Noise	Low
Ceiling Finish	RFP Board
Wall Finish	RFP Board
Floor Finish	Polished Concrete

Comments

Technology. Mechanical and Electrical	
A.V. Required	No
HVAC	Yes
Plumbing	Yes

Room No.	Room Name	Net S.F.	Max. Occupancy
3.D.	Refrigerator	800	266 @ 3sf/person

Function	
Activities	Cooling of beer, bottled beer, and kegs
Access	ADA accessible
Frequency	

Fire Protection
Yes

Relationships	
Adjacencies	Conditioning Room
Proximity	
Floor Location	Level 4 – Brewhouse and Generator

Furniture/Equipment

Characteristics	
Lighting	Artificial lighting
Temperature	Controlled
Humidity	Controlled
Noise	Low
Ceiling Finish	PVC
Wall Finish	PVC
Floor Finish	PVC

Comments

Technology. Mechanical and Electrical	
A.V. Required	No
HVAC	Yes
Plumbing	Yes

Room No.	Room Name	Net S.F.	Max. Occupancy
3.E.	Generator	750	250 @ 3sf/person

Function	
Activities	Transfer of kinetic energy from water to electric energy.
Access	ADA accessible
Frequency	Constant

Fire Protection
Yes

Relationships	
Adjacencies	Turbines, control room, automation
Proximity	
Floor Location	Level 4 – Brewhouse and Generator

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Controlled
Humidity	Controlled
Noise	High
Ceiling Finish	
Wall Finish	Concrete
Floor Finish	Concrete

Technology. Mechanical and Electrical	
A.V. Required	Yes
HVAC	Yes
Plumbing	Yes

Comments

Room No.	Room Name	Net S.F.	Max. Occupancy
3.F.	Turbines	300	100 @ 3sf/person

Function	
Activities	Concentrated water forced through spinning turbines
Access	Limited
Frequency	Constent

Fire Protection
Yes

Relationships	
Adjacencies	Generator
Proximity	
Floor Location	Level 5 - Turbines

Furniture/Equipment
Hydro turbines

Characteristics	
Lighting	Artificial lighting
Temperature	Seasonal
Humidity	100%
Noise	High
Ceiling Finish	Concrete
Wall Finish	Concrete
Floor Finish	Concrete

Comments

Technology. Mechanical and Electrical	
A.V. Required	Yes
HVAC	Yes
Plumbing	Yes

Room No.	Room Name	Net S.F.	Max. Occupancy
3.G.	Automation & Protection	100	33 @ 3sf/person

Function	
Activities	
Access	ADA accessible
Frequency	

Fire Protection
Yes

Relationships	
Adjacencies	
Proximity	
Floor Location	Level 4 – Brewhouse and Generator

Furniture/Equipment

Characteristics	
Lighting	Artificial
Temperature	Controlled
Humidity	Controlled
Noise	Medium
Ceiling Finish	
Wall Finish	Concrete
Floor Finish	Polished Concrete

Comments

Technology. Mechanical and Electrical	
A.V. Required	Yes
HVAC	No
Plumbing	No

Room No.	Room Name	Net S.F.	Max. Occupancy
3.H.	Auxiliary Devices & Balance of Plant	150	50 @ 3sf/person

Function	
Activities	
Access	ADA accessible
Frequency	

Fire Protection
Yes

Relationships	
Adjacencies	
Proximity	
Floor Location	Level 4 – Brewhouse and Generator

Furniture/Equipment

Characteristics	
Lighting	Artificial lighting
Temperature	Controlled
Humidity	Controlled
Noise	Medium
Ceiling Finish	
Wall Finish	Concrete
Floor Finish	Polished Concrete

Technology. Mechanical and Electrical	
A.V. Required	Yes
HVAC	Yes
Plumbing	No

Comments

Room No.	Room Name	Net S.F.	Max. Occupancy
3.I.	Transformer Room	150	50 @ 3sf/person
Function			
Activities			
Access	ADA accessible		
Frequency			

Fire Protection
Yes

Relationships	
Adjacencies	
Proximity	
Floor Location	Level 4 – Brewhouse and Generator

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Controlled
Humidity	Controlled
Noise	Low
Ceiling Finish	
Wall Finish	Concrete
Floor Finish	Polished Concrete

Comments

Technology. Mechanical and Electrical	
A.V. Required	Yes
HVAC	Yes
Plumbing	No

Room No.	Room Name	Net S.F.	Max. Occupancy
3.J.	Mv/Hv Switchyard Substation	250	83 @ 3sf/person

Function	
Activities	
Access	ADA accessible
Frequency	

Fire Protection
Yes

Relationships	
Adjacencies	
Proximity	
Floor Location	Level 4 – Brewhouse and Generator

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	
Humidity	
Noise	
Ceiling Finish	
Wall Finish	
Floor Finish	Concrete

Comments

Technology. Mechanical and Electrical	
A.V. Required	Yes
HVAC	No
Plumbing	No

Room No.	Room Name	Net S.F.	Max. Occupancy
3.K.	Control Room	150	50 @ 3sf/person
Function			
Activities			
Access	ADA accessible		
Frequency			

Fire Protection
Yes

Relationships	
Adjacencies	
Proximity	
Floor Location	Level 4 – Brewhouse and Generator

Furniture/Equipment

Characteristics	
Lighting	Artificial lighting
Temperature	
Humidity	
Noise	
Ceiling Finish	
Wall Finish	
Floor Finish	Polished Concrete

Technology. Mechanical and Electrical	
A.V. Required	Yes
HVAC	Yes
Plumbing	No

Comments

Room No.	Room Name	Net S.F.	Max. Occupancy
4.A.	Kitchen	650	216 @ 3sf/person

Fire Protection
Yes

Function	
Activities	
Access	ADA accessible
Frequency	

Relationships	
Adjacencies	
Proximity	
Floor Location	Level 3 – Main Floor

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	
Humidity	
Noise	
Ceiling Finish	
Wall Finish	
Floor Finish	Polished Concrete

Comments

Technology. Mechanical and Electrical	
A.V. Required	No
HVAC	Yes
Plumbing	Yes

Room No.	Room Name	Net S.F.	Max. Occupancy
4.B.	Bar	200	66 @ 3sf/person

Function	
Activities	Consumption of beer, socialization
Access	ADA accessible
Frequency	

Fire Protection
Yes

Relationships	
Adjacencies	
Proximity	
Floor Location	Level 3 – Main Floor

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	
Humidity	
Noise	
Ceiling Finish	
Wall Finish	
Floor Finish	Polished Concrete

Comments

Technology. Mechanical and Electrical	
A.V. Required	Yes
HVAC	Yes
Plumbing	Yes

Room No.	Room Name	Net S.F.	Max. Occupancy
4.C	Staff Office	120	40 @ 3sf/person
Function			
Activities			
Access	ADA accessible		
Frequency			

Fire Protection
Yes

Relationships	
Adjacencies	
Proximity	
Floor Location	Level 3 – Main Floor

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	
Humidity	
Noise	
Ceiling Finish	
Wall Finish	
Floor Finish	Polished Concrete

Comments

Technology. Mechanical and Electrical	
A.V. Required	Yes
HVAC	Yes
Plumbing	No

Room No.	Room Name	Net S.F.	Max. Occupancy
4.D.	Service Desk	100	33 @ 3sf/person

Function	
Activities	
Access	ADA accessible
Frequency	

Fire Protection
Yes

Relationships	
Adjacencies	
Proximity	
Floor Location	Level 3 – Main Floor

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	
Humidity	
Noise	Low
Ceiling Finish	
Wall Finish	
Floor Finish	Polished Concrete

Comments

Technology. Mechanical and Electrical	
A.V. Required	Yes
HVAC	Yes
Plumbing	Np

Room No.	Room Name	Net S.F.	Max. Occupancy
5.A.	Restore Bridge	2400	800 @ 3sf/person

Function	
Activities	Traffic circulation
Access	ADA accessible
Frequency	

Fire Protection
N/A

Relationships	
Adjacencies	Road access
Proximity	
Floor Location	N/A

Furniture/Equipment

Characteristics	
Lighting	N/A
Temperature	Seasonal
Humidity	Seasonal
Noise	High level of water turbulence
Ceiling Finish	N/A
Wall Finish	N/A
Floor Finish	

Comments

Technology. Mechanical and Electrical	
A.V. Required	N/A
HVAC	N/A
Plumbing	N/A

Room No.	Room Name	Net S.F.	Max. Occupancy
5.B.	Road Access	N/A	N/A @ 3sf/person

Function	
Activities	
Access	ADA accessible
Frequency	

Fire Protection
N/A

Relationships	
Adjacencies	Bridge, parking, outdoor space
Proximity	
Floor Location	N/A

Furniture/Equipment

Characteristics	
Lighting	Natural lighting, artificial lighting
Temperature	Seasonal
Humidity	Seasonal
Noise	High level of water turbulence
Ceiling Finish	N/A
Wall Finish	N/A
Floor Finish	

Technology. Mechanical and Electrical	
A.V. Required	N/A
HVAC	N/A
Plumbing	N/A

Comments

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