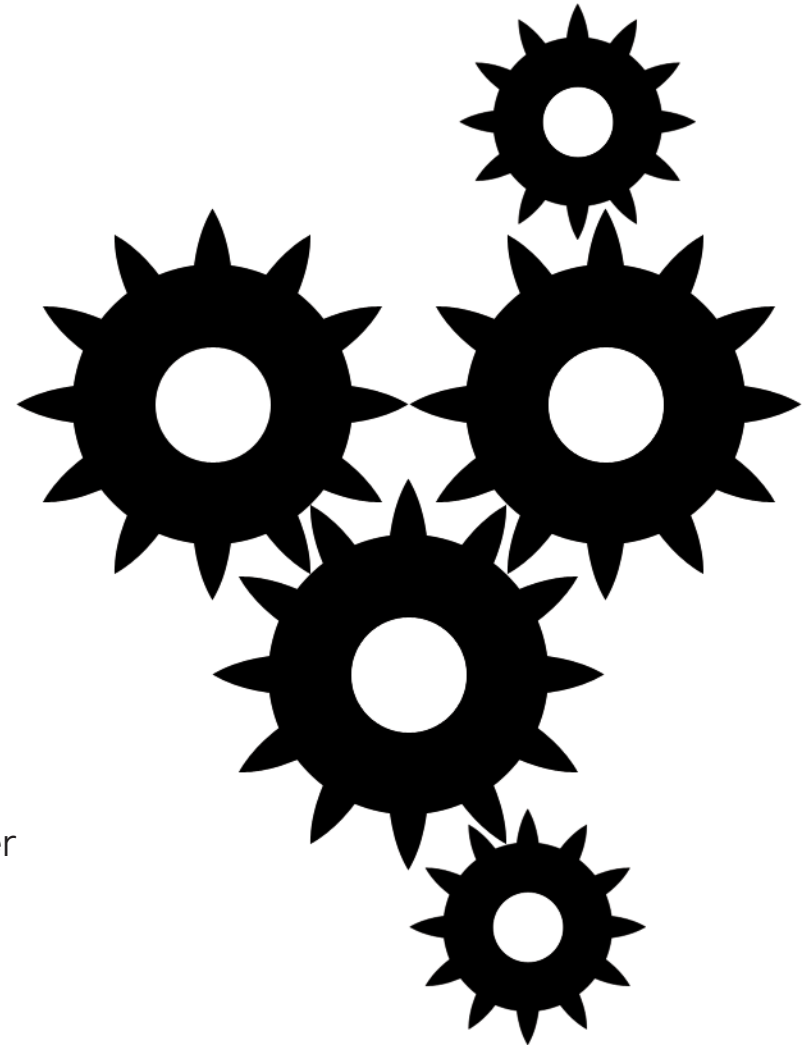
Manufacturing A New Way

By Scott Wullschleger



MANUFACTURING A NEW WAY

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

By

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

Pirmary Thesis Advisor

5/4/12

Thesis Committee Chair

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Abstract

This thesis project, titled Manufacturing: a new way, will examine manufacturing buildings, and the working conditions that exist there. The typology will be a brewery with a area of 60,000 square feet. The guiding idea is that through careful design, manufacturing buildings can be made safer, more productive, and more enjoyable to inhabit. The site is in downtown Minneapolis, Minnesota. It is a lot at the corner of North 3rd Street and 7th Avenue North, right in the heart of the warehouse district.

The manufacturing industry has been held to a minimal standard for many years. Through thoughtful design decisions, this project will help to redefine a new standard that will show good design can create an improved work environment that allows for increased productivity and a reduction of stress.

Keywords: Manufacturing, Safer, Productive, Enjoyable, Redefine, Standard, Design

Problem Statment

How can architecture be used in the manufacturing industry to not only create more humane working conditions but also boost productivity?

Typology: Manufacturing Building

The Claim: Because most manufacturing buildings are of the large warehouse variety, using an architect to design the building and spaces needed can allow for a more streamlined process, while also making for a better environment for the everyday user.

Statment of Intent

The Premise

The Actor: Architects have a specific set of skills which allow them to gain a deeper understanding of the manufacturing process.

The Action: Design has had limited influence for manufacturing buildings and holds the key to their improvement.

The Object: Manufacturing buildings have been regulated for safety since 1970 by the Occupational Health and Safety Administration (OSHA); however, while these regulations make for a safe work environment, they do not make for an enjoyable one. (OSHA, 2011)

Final Theoretical Premise/Unifying Idea: Using the skills that architects possess, manufacturing buildings can be brought to a new standard in which users can have both safe and enjoyable conditions.

The Project Justification: For quite some time the manufacturing industry has held itself to a lower standard of working conditions and kept its focus on profits. It has long been overlooked by our society, which means there is immense room for improvement.

The Narrative

Dim lighting, stale air, loud machines churning away, and dirt and debris all around - these were the conditions of the manufacturing industry for years. Conditions have since improved but not as much as one might expect.

The Surly Brewing Company has been in operation since late 2005. They are currently housed in a converted warehouse in Brooklyn Center, Minnesota. While the conditions are not nearly as bad as the one listed above, the space they have to work with is nowhere near the level one would expect from the reputation they have acquired in their short six years in existence. In February of 2011, the Surly Brewing Company announced plans to build a new brew pub style brewery facility to allow them to meet the demand for their full-bodied beers (Lussenhop, 2011a). The new facility would increase their production from 15,000 barrels a year to 100,000 barrels a year.

Because Surly beer is currently only being sold in the state of Minnesota, this expansion will allow them to start distributing to neighboring states. Where, though, should such a facility be located? Shifting the location into downtown Minneapolis from Brooklyn Center would give it a stronger name to be associated with, and make it more accessible to the people who love the beer.

Since the beginning, the Surly Brewing Company has had to deal with many political issues. The first one they encountered was when they wanted to build the initial brewery, but the city of Brooklyn Center prohibited breweries from being built in the city ("Surly started with,"). Overcoming this challenge happened quite easily for them. However, when they decided to expand, another legal issue came up. The size of the new desired brewery is too large to be technically classified as a brew pub, and in Minnesota it is illegal for breweries and liquor stores in general to sell and distribute alcohol. On May 24th, 2011 the "Surly Bill" was signed, allowing breweries producing less than 250,000 barrels a year to apply for a special license that will allow them to sell beer on Sundays (Lussenhop, 2011b).

This project to create a new brewery is already having fairly major implications on the state of Minnesota. Along with the political changes that have already happened, it will create some economic growth for the city of Minneapolis. Through its careful design, it will be able to be looked at as a model for other parts of the manufacturing industry on how care and design can help propel a company forward.

The Client

This brewery will be owned and operated by the Surly Brewing Company. The Surly Brewing Company currently has a brewing capacity of 15,000 barrels annually and is looking to upgrade to a new facility that would be capable of producing 100,000 barrels annually. The new brewpub style brewery would employ upwards of 150 people ("Cheers to passage," 2011). As this will be much larger than their current brewery, it will be important to get a good understanding of all the people involved in the process and all the need they have. Parking will become a larger necessity with the inclusion of the restaurant, as well as understanding which people are needed for the different processes.

Major Project Elements

Milling Room
Mashing Room
Lautering Room
Boiling Room
Whirlpool Room
Cooling Room
Fermenting Tank Storage
Maturing Tank Storage
Filtering
Packaging
Distribution Dock

The rooms/spaces needed for the brewing process will be the most important spaces to look at for this project. The needs in these spaces are quite different and will really help to define the building.

Administrative Offices
Tasting Room
Restaurant
Kitchen
Restrooms
Mechanical

While these elements are less important in answering the problem statement, they do play a very important role in the design. They will have to be carefully considered because several of them will be some of the highest traffic areas of the project.

Site

The Corner of North 3rd Street and 7th Avenue North is located in the heart of Minneapolis's warehouse district. This district is currently experiencing a revitalization. Many of the old buildings are being transformed into condos and offices with small shops, cafes, and restaurants at street level. The area sits just northwest of Minneapolis's main downtown, just off Target Field, the new stadium for the Twins baseball team. This site has great access to public transportation. The new Surly brewery would be right at home in this neighborhood, where industry meets daily living.

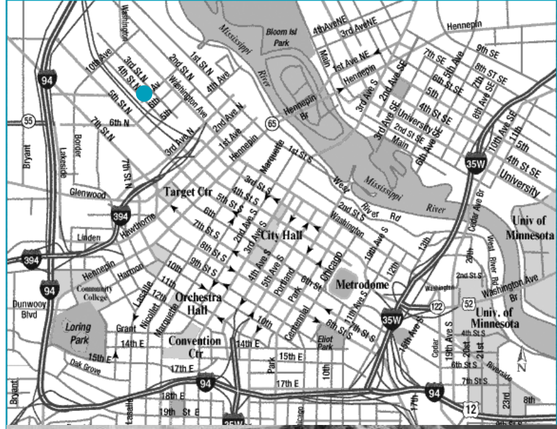


Figure 1

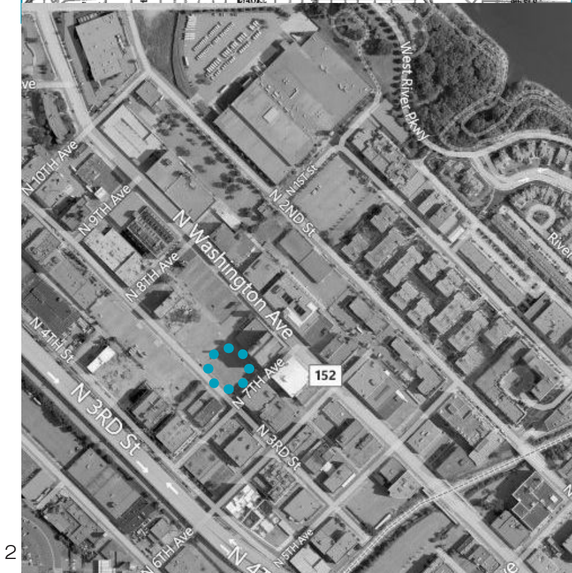


Figure 2

Project Emphasis

This project seeks to analyze the working conditions that can exist in the manufacturing industry. Strong design has solemnly been used in the creation of the spaces needed for production line style manufacturing. The Surly Brewing Company's current facility is a large open warehouse type building. Because there are many steps in the brewing process, it becomes important to look closely at each step, and then design the space around the process needs, as well as the needs of the brew team and any other people, such as tour groups, that will be using the space.

Plan For Proceeding

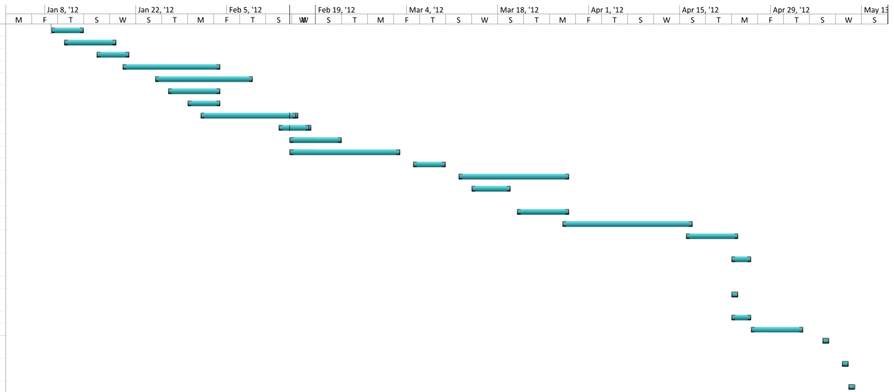
Research Direction
For this project, I will have to make sure I have a very firm grasp of the brewing process, and what is done by the users. Understanding the process will ensure that the spaces get designed properly for the brew team. It will also be important to know what types of conditions are needed for people to best perform the functions that are required of them.

Design Methodology
The research strategy I will be using is the mixed method, quantitative/qualitative approach. This will allow me to grasp the concepts being researched in a more wholistic manner. I feel it will be important for me to bounce back and forth between the types of data, which will help to create a more flowing design in the end.

Documentation
Because the majority of my process material often comes in the form of computer modeling, it will be important for me to maintain an organized account of my different steps and thoughts along the way. The sketches that are created will need to be well documented, as few as it may be, because they often give a great deal of insight into the design intention.

Schedule

ID	Task Name	Duration	Start	Finish
1	Context Analysis	5 days	Mon 1/9/12	Fri 1/13/12
2	Conceptual Analysis	6 days	Wed 1/11/12	Wed 1/18/12
3	Spatial Analysis	5 days	Mon 1/16/12	Fri 1/20/12
4	Floor Plan Development	11 days	Fri 1/20/12	Fri 2/3/12
5	Section Development	11 days	Wed 1/25/12	Wed 2/8/12
6	Materials Development	6 days	Fri 1/27/12	Fri 2/3/12
7	Envelope Development	5 days	Mon 1/30/12	Fri 2/3/12
8	Structural Development	11 days	Wed 2/1/12	Wed 2/15/12
9	ECS Passive Analysis	5 days	Mon 2/13/12	Fri 2/17/12
10	ECS Active Analysis	6 days	Wed 2/15/12	Wed 2/22/12
11	Context Development	13 days	Wed 2/15/12	Fri 3/2/12
12	Midterm Review	5 days	Mon 3/5/12	Fri 3/9/12
13	Project Revisions	13 days	Mon 3/12/12	Wed 3/28/12
14	Structural Redevelopment	4 days	Wed 3/14/12	Mon 3/19/12
15	Context Redevelopment	6 days	Wed 3/21/12	Wed 3/28/12
16	Presentation Layout	14 days	Wed 3/28/12	Mon 4/16/12
17	Plotting and Model Building	6 days	Mon 4/16/12	Mon 4/23/12
18	Preparation for Presentation	3 days	Mon 4/23/12	Wed 4/25/12
19	Project Documentation			
20	Exhibits Installed on the 5th Floor	1 day	Mon 4/23/12	Mon 4/23/12
21	Thesis Exhibit	3 days	Mon 4/23/12	Wed 4/25/12
22	Final Thesis Reviews	6 days	Thu 4/26/12	Thu 5/3/12
23	CD Due to Thesis Advisor	1 day	Mon 5/7/12	Mon 5/7/12
24	Final Thesis Document Due	1 day	Thu 5/10/12	Thu 5/10/12
25	Commencement	1 day	Fri 5/11/12	Fri 5/11/12



Previous Studio Experience

Second Year
- Fall 2008 - Darryl Booker
  - Tea House - Fargo, ND
  - Rowing Club - Minneapolis, MN
- Spring 2009 - Meghan Duda
  - Dance Studio - Fargo, ND
  - Dwelling - Fargo, ND

Third Year
- Fall 2009 - Steve Martens
  - Satellite School of the Far North - Kugluktuk, Nunavut, Canada
  - Velodrome - Thunder Bay, Ontario, Canada
- Spring 2010 - Ronald Ramsay
  - Shaker Barn Performance Center - New Lebanon, NY
  - 44 Congress Parkway - Chicago, IL

Fourth Year
- Fall 2010 - David Crutchfield
  - High Rise - San Francisco, CA
- Spring 2011 - Paul Gleye
  - Blois Design Charrette - Blois, France
  - Place Rihour - Lille, France

Fifth Year
- Fall 2011 - Mark Barnhouse
  - Water Resource Experiment Station

Theoretical Premise/ Unifying Idea Research

Introduction

Like most of the manufacturing industry, during the 1800s and into the early 1900s, some breweries were dirty, dangerous places to work. However, many breweries in those times were actually decent places to work with pay above average for industry work, and owners who treated their employees well. The typical work day was anywhere from 14 to 16 hours, with workers boarding on site and beer was often given freely throughout the day.

Productivity

Working conditions in the manufacturing industries have been a major topic of discussion for many decades now. However, the effects of these conditions on worker productivity is a more recent discussion that has started. Sweden's Quality of Work Life movement, which the U.S. quickly became involved in, was one of the first major pushes that looked into how working conditions affected productivity. Their goal was to study how pragmatic redesign of the workplace could eliminate work dissatisfaction and increase productivity (Karasek & Theorell, 1994).

Productivity can be influenced by many factors. Eighty-six percent of productivity problems are directly related to work environment. Of the factors that influence productivity, most of these fall under three main categories, general factors, organizational and technical factors, and human factors. General factors include things such as climate, fiscal and credit policies, and infrastructural facilities. Organizational and technical factors include degree of integration, percentage

of capacity, size and stability of production. Human factors are things like labor management relations, social and psychological conditions, wage incentives, physical fatigue, and trade union practices. From an architectural standpoint, the organizational and technical factors are the more easily manipulated elements; however, it is in how one analyzes these elements and manipulates them that will allow for the human factors to be addressed. Related to these factors, there are five measures that greatly affect productivity. A safe and healthy work environment is a must, which includes no hazards or undue risks. Workers must be given opportunities to effectively use their talents to acquire new skills and knowledge for advancement. Occasions to develop capabilities through problem solving and planning is another must. Maintaining a workplace free from prejudice and rigid classifications is very important, and lastly, ensuring that workers are left with time and energy at the end of their day for other aspects of their life (Taiwo, 2010).

It is important when looking at effects on productivity to understand the different elements. The elements fall under three different environments: technical environment, human environment, and organizational environment. Technical environment includes tools, equipment, technological infrastructure, and physical and technical elements. Human environment includes such things as peers, teams, interactional issues, and management. The elements within the human environment enhance the opportunity to share knowledge. An organizational environment includes systems, procedures, practices, and values and philosophies. These are the elements that are controlled by

management. Another important aspect to consider is the overall work environment and whether it is conducive or toxic. A conducive environment will allow for a pleasurable experience and reinforce self-actualizing behaviors. A toxic environment will create an unpleasant experience which can deactualize employee behavior leading to negative traits. A toxic environment can take a sensible, responsible employee and cause them to be irrational and irresponsible as a survival strategy (Taiwo, 2010).

Effects of Physical Conditions

In an analysis done in 2006, specific conditions and the effects they had were studied. The conditions looked at were inclement weather, extreme hot/cold, chemical smells, noise, poor lighting, vibration, and dust. Direct and indirect effects were found in regards to employee performance including low productivity, poor quality, and physical and emotional stress, all of which lead to higher costs. Another major finding was related to worker energy consumption. The energy a worker exerts mostly goes into waste activities. These activities include things like static efforts, such as pushing, pulling, and lifting. Some of the causes included inefficient equipment and improper methods. These waste activities were a large part of decreased productivity (Kahya, 2007).

It is all these different factors and elements that determine the level of stress created and placed in the worker. The level of stress one is under can cause a fluctuation in their productivity. It was found that people born over the last 30 years are 30 times more likely to experience depression than their

grandparents, and since 1980 worker's compensation cases related to stress have tripled. Stress, especially work related stress, has become a large factor in our society today. Careful design can be used to ease these stresses and minimize their impact on day to day life. The Surly Brewing Company has done an excellent job from a managerial standpoint, and this can be seen in their low employee turnover rate (Karasek & Theorell, 1994).

When looking at working conditions, there are five major physical characteristics one must analyze. Those five characteristics include noise, vibrations, lighting, air quality, and work space. Noise can often be a problem in manufacturing settings. Machines can be a source of noise pollution and may be at levels high enough to require hearing protection to be worn. Usually hearing protection is required for noise levels exceeding 85 decibels. As a point of reference, a noisy restaurant is generally around 70 decibels. In a brewery, the bottling line is a major source of noise pollution.

Vibrations generally are not viewed as causing health problems; however, they are a problem for areas that need precision. Vibrations from some machines may need to be addressed to ensure that all machines are working properly and to maintain consistency among batches of beer. Vibrations also need to be dealt with for structural reasons. Constant vibrations can be a risk factor that may lead to structural failure and the potential collapse of the building. When it comes to design, lighting can have a major impact on the other choices that one makes. With lighting design one must look at both natural and artificial lighting. In analyzing these

types of lighting one has to consider the materials that are highly reflective or one runs the risk of having problems with glare. Reflective materials can also work to one's advantage by allowing light to penetrate further into the building or just further illuminate a space. Contrast must also be considered when using multiple light sources. A general rule for contrast is not to exceed a ratio of 1: 10 and to avoid back-lighting. The quality of light is important for good working conditions as well. Different types of light have different qualities, such as incandescent lamps having a more warm light and smooth color spectrum compared to fluorescent lamps that have a more medium to cool light and a color spectrum consisting of dense peaks.

Maintaining air quality in a brewery could be an intensive task. There are a lot of processes involving heating and cooling. Humidity and condensation could be huge problems for some of the largest spaces, as well as radiating sources with the boilers or from the mash tun and lauter tun, where the ingredients are mixed and initially heated. As anyone who has ever been near a brewery knows, there are many aromas that come from a brewery. The process of cooking the malts and hops gives off a number of aromas that must be controlled. Treating the brewing rooms like laboratory spaces with special exhaust systems will be necessary in controlling these smells.

The last characteristic, work space, deals with understanding the users of the spaces and knowing their needs. These spaces will be used by many people and trying to ensure that they all have a pleasant experience while working is crucial to this project. It is all about designing the

physical environment in such a way that it aids in creating a good psychological environment.

When the manufacturing industry looks at ways to increase production or improve quality, they tend to look into two things. The first is the people and keeping them motivated to do a good job. This is often one of the cheapest ways to increase production; however, this is often a short-term fix for anything that may get solved. The second is looking for new equipment. This can get to be very costly, but can sometimes be worth the extra costs. They will often look for equipment that is either quicker or more precise, and they usually hope for both. New machines, however, do not always perform as they are expected to, especially if it is being added to an existing machine. What needs to be realized is these two methods are not the only way to look at the problems. Modifying the physical environment to create situations for people that are not simply adequate but as close to ideal as possible will allow for maximum performance. It is from this point of view that modifying management styles and adjusting the interpersonal relationships can really start to thrive. Some companies are understanding this and applying it to their office settings. Companies like Google and Pixar have encouraged their employees to make their work space their own. Applying this concept to a manufacturing setting is more difficult but still possible.

The Process of Brewing Beer

One of the most important things for this project is having a firm understanding of the brewing process. The

first part of the brewing process is knowing the ingredients. A majority of beers are made up of four ingredients, malt, hops, water, and yeast. At one point, Germany created a law saying these four ingredients were the only things allowed in beer (Publishers & Goldhammer, 2008). This purity law has since been expanded to allow different types of malts and some sugars to be used. In the rest of the world, many different herbs and other additives are used to alter flavors. Many of the larger brewers use adjuncts like corn and rice to mass produce beer at much cheaper costs. Budwieser does this with all their beers.

To start the brewing process, the malt and hot water are added into a large vessel known as the mash tun. During this stage, the starches are released from the malt and natural enzymes convert these starches into sugars that will later be fermented. The scientific name for this process is *saccharification* and after this process is complete one is left with a warm sugary liquid known as wort. There are two things that are sometimes done at the end of the mashing stage, the first of which is known as a mashout. During the mashout, the temperature of the wort is raised to around 75°C at which point the enzymes deactivate. The second process involves adding a small amout of water to the grains to extract any additional sugars. This process is known as sparging (Publishers & Goldhammer, 2008).

At the end of the mashing process, the lautering process begins. This is the process of filtering the spent grains from the wort. This sometimes is built into the bottom of the mash tuns; however, sometimes a separate lauter tun is used. The wort is then drained into the kettle where the next step in the process begins (Publishers & Goldhammer, 2008).

Once the wort is in the kettle it is boiled with hops and any herbs or sugars. This is the stage where the majority of the beer's final flavor, color, and aroma are decided. The boiling process acts to sterilize the wort. Hops come in many different varieties and change the aroma and bitterness of the beer. A lot of the distinct flavors of beer come from the hops used which is why this process is so important. While the hops can change the color of the beer to some degree, most of the color is determined by the varieties of malt that are used (Publishers & Goldhammer, 2008).

After the wort has been boiled with hops it is sent through a whirlpool, where more of the debris from the grains and hops is removed. The whirlpool is often quite large and has a flat bottom or possibly a slight slope of one or two degrees. A hopback can be used just prior to cooling, and this process involves the addition of hops in a sealed chamber, that forces some of the stronger hop aromas ,which would normally ventilate off the hot wort, to stay with the wort as it enters the cooling stage (Publishers & Goldhammer, 2008).

Before the fermentation can start, the wort must be brought down to a temperature of about 20-26°C. Failure to lower the temperature would kill off the yeast and fermentation would fail to happen. A heat exchange is often used to quickly lower the wort's temperature. A heat exchange consists of two intertwined coils, one for the wort to travel through and the other usually contains water. As the coils move around each other the heat transfers from the liquid in one coil to the liquid in the other. The hot water that exits the coil can be stored in hot water tanks to be added

to the next batch of malts. Once the wort is lowered to the right temperature, it is ready to move into the fermentation stage (Publishers & Goldhammer, 2008).

Modern day fermentation tanks are often cylindro-conical in shape, where the top is cylindrical in shape with a cone at the bottom. This cone allows for yeast to settle and be purged from the system through a valve. For top fermenting yeasts, the beer that exits the fermentation chambers is simply drawn from the bottom. The fermentation process involves the yeast metabolizing the sugars extracted from the malt and turning it into alcohol and carbon-dioxide. From here the beer can be stored in large vessels or it can move directly to the bottling line (Publishers & Goldhammer, 2008).

Summary

This research starts to examine the issues that will be addressed by this thesis. It hit on the key factors that create a good working environment. It also briefly went through the process in which beer is made. It will be in how these areas of knowledge are combined that will start to develop the knowledge needed for a successful design.

Productivity

In this first section, the factors that address productivity were discussed. The first of these factors was general factors, which covered things, like climate, fiscal and credit policies, and infrastructural facilities. Next was organizational and techincal factors ,which includes degree of integration, percentage of capacity, and size and stability of production. Finally was human factors, this included labor management relations, social and psychological conditions, wage incentives, physical fatigue, and trade union practices. It also discussed the five measures that affect productivity, as well as the elements that affect productivity.

Effects of Physical Conditions

This section started with a look at an analysis covering the effects of physical conditions, including inclement weather, extreme hot/cold, chemical smells, noise, poor lighting, vibration, and dust. If the conditions are poor, heightened levels of stress can lead to lower productivity. Stress is common these days, but, through design, some of these stresses can be avoided. The five major physical characteristics including noise, vibrations, lighting, air quality, and work space were looked at in more depth. Through the manipulation of the characteristics, high levels of productivity can be maintained and an enjoyable work environment can be created.

The Process of Brewing Beer

Lastly, the brewing process was discussed. This process starts with extracting starches from malt and changing them to sugar through active enzymes. Lautering then takes place, where the new liquid, known as wort, is separated from the spent grain. Boiling follows, where the hops are added, giving much of the distinct tastes and aromas. Boiling is followed by whirlpooling, where the wort is filtered further. Cooling then happens, where the wort passes through a heat exchange dropping the temperature, bringing us to fermentation, where yeast is added, which changes the sugars to alcohol and carbon-dioxide. The liquid is now beer and is ready to be bottled or stored.

Historical Research

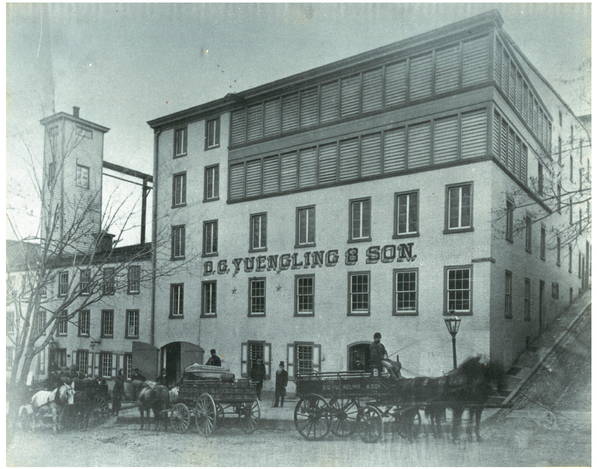


Figure 3

Brewing in the U.S.

Brewing in the United States began almost the instant the colonists touched foot on solid ground. Colonists in Virginia started brewing ale using corn as early as 1587. In 1607, the first shipment of beer arrived from England in the Virginia Colony. Five years later, the first known brewery was established by Adrian Block and Hans Christiansen at the southern tip of what is now Manhattan (Wieren & Bull, 1995).

The brewing industry was one of the major economical driving forces at the birth of this nation. In 1789, Massachusetts passed an Act encouraging people to both manufacture and consume beer and ale. In New Hampshire, to help encourage people to open breweries, a law was passed making breweries exempt from property taxes. By 1810 there were 132 operating breweries producing 185,000 barrels of beer. The population at this time was 7 million (Wieren & Bull, 1995).

In 1829 the country's oldest operating brewery, the Yuengling Brewery, is established in Pottsville, Pennsylvania and continues to be family owned to this day. 1844 marks the opening of a Milwaukee brewery, started by Jacob Best which would become Pabst Brewing Company. Milwaukee would slowly become one of the brewing capitols of the world, as more German immigrants made their way to this part of the country (Wieren & Bull, 1995).

Figure 4

A brewery was started in 1852 by George Schneider in St. Louis, Missouri, and would be the seed that would lead to the biggest name in brewing in the world, Anheuser-Busch. In 1873 under ownership of Adolphus Busch, the Anheuser Brewery would start bottling beer for large scale shipment. In that same year a record number of operating breweries, 4131, would produce 9 million barrels of beer (Wieren & Bull, 1995).

The industrial revolution would prove to be a double edged sword for the brewing industry. As technology improved, there was no longer a need for so many breweries to supply the country with the beer it demanded. By 1910 the number of breweries would drop to around 1500, less than half the number that had existed 37 years earlier (Wieren & Bull, 1995).

In 1919, the 18th amendment was ratified calling for the national prohibition of alcohol. The production of beer went underground, still producing numbers as high as 86 million gallons of near beer, beer containing 3.2% alcohol, in 1932. On April 7th, 1933, the 21st amendment was ratified appealing the 18th amendment, officially ending prohibition. By 1934, 756 breweries were back in operation (Wieren & Bull, 1995).

The trend of the industrial revolution continued after prohibition ended; many breweries were consolidating or shutting down. The low point would be in 1983 when only 80 breweries were in operation under 51 brewing companies. Of the companies brewing beer, six were producing 92% of all U.S. beer production. Those companies were Anheuser-Busch, Miller, Heileman, Stroh, Coors, and Pabst. However, six years earlier in Sonoma, California the start of a new trend appeared with the first "Micro Brewery" (Wieren & Bull, 1995).

Since 1977, the people of the U.S. have been reconnecting with their beer roots, and micro breweries have been popping up all around the country. Several have taken a strong hold in the brewing world, like Samuel Adams, Sierra Nevada Brewing Company, Bells Brewing Company, and New Belgium Brewing Company. In Minnesota, companies like the Schell's Brewing Company, which actually started over 150 years ago and is still operating, and Summit Brewing Company have made a large name for themselves; however, one company has really re-established a passion for beer with the people of Minnesota, the Surly Brewing Company (Wieren & Bull, 1995).

Figure 5

Brewing in the Twin Cities

St. Paul was one of the first settlements in the Minnesota Territory. When the territory of Minnesota was being settled, a wave of German immigrants made their way to St. Paul and established the start of the brewing history of the new German style of beers with lagers, a style of beer which uses a bottom settling yeast giving it its distinct clear appearance. Minnesota and Iowa, were the first places where breweries produced lagers instead of ales (Hoverson, 2007).

Anthony Yoerg opened Minnesota's first commercial brewery in 1849. According to the 1850 census, Ramsey Country, where St. Paul and the Yoerg Brewery were located, was home to only two dozen Germans, but, within a decade, that number grew to over 16,000. As the German immigrants flowed in, the demand for lager continued to increase. By 1860 the Yoerg Brewery was only the tenth largest out of twenty-some breweries (Hoverson, 2007).

By the end of the civil war, tastes were starting to change and more ales were being drank. Ales were being favored by breweries for their quicker fermentation rates, and they did not require the cool temperatures for storage that lagers required. In 1865, the Drewry and Greig ale brewery of St. Paul sold as many as 212 barrels in winter months, with the slowest month selling 72 barrels. People were enjoying the full bodied flavors of the ales in the winter months and the cool refreshing taste of the lagers in the hot summer months. The demand for ales did not stay consistent though. In the 1882, the Minneapolis city directory listed Patrick J. Gilbride as an ale brewery; however, over the next decade the same address would change between a saloon and an ale brewery several times and would at one point be listed as a confectioner (Hoverson, 2007).

In the late 1800s, the major Milwaukee and St. Louis brewers would start shipping their beers up to Minnesota in an attempt to edge their way into the high demand market. The Minneapolis Brewing and Malting Company, later known simply as the Minneapolis Brewing Company, would use its already strong name in the market to keep the people drinking locally produced beer. The Minneapolis Brewing Company was the original brewer of Grain Belt Premium, one of Minnesota's most prominent beers on the market. While the Minneapolis Brewing Company is no longer in existence, their flagship beer is still being brewed by the August Schell's Brewing Company out of New Ulm; however, the famous Grain Belt sign still stands at the location where the Minneapolis Brewing Company once operated (Hoverson, 2007).

Figure 6

Figure 7

By this time the architecture of the breweries of Minnesota were taking on a unique look from the other buildings of the area. Originally, breweries were almost indistinguishable from the other buildings. Now they were starting to grow taller to use gravity to aid in the brewing process. The malt and other grains would be stored at the top of the building, allowing them to drop into the mash tun followed by the brew kettle and so on. Many of the original breweries were made of wood, but fires were common, and, with the new wealth that existed in the brewing community, the wood started to be replaced by bricks, which created a safer environment for the brewers (Hoverson, 2007).

Minnesota saw the downfall of many of its breweries during prohibition but would be one of the leaders in the recovery of the brewing industry upon the repeal of prohibition. Production in Minnesota breweries increased from 1.7 million barrels in 1934 to 2.7 million barrels in 1939. After World War II, many of the famous Twin Cities brands would be sent to breweries around the country. Hamm's, Grain Belt, and Schmitt's would all find themselves in markets across the country in the attempt to expand into areas with a lack of strong local breweries (Hoverson, 2007).

The Hamm's brand would find itself changing ownership in the mid-1960s. Molson Breweries out of Montreal attempted to buy the brand, but the merger would have violated antitrust laws. The brand would eventually be bought by Heublein, a food firm out of Hartford, Connecticut. That company would end up losing money after a brief period of success with the brand, and the Hamm's brand ended up being sold to the Olympia Brewing Company of Washington in 1975. Pabst, in Milwaukee, ended up buying the brand in 1983, but the

Figure 8

Figure 9

Hamm's brewery was sold to Stroh's Brewing to avoid antitrust action. The Hamm's brewery found itself brewing the Stroh's brand and Hamm's was being brewed at the Pabst brewery in Milwaukee (Hoverson, 2007).

In the mid-80s, Minnesota would see its first new brewery since WWII, with the opening of the Summit Brewing Company in St. Paul. They would become the pioneers of micro brewing in Minnesota. In 2006 a new player would enter the game serving "beer for a glass, from a can." The Surly Brewing Company chose a different direction, which was to be the only brewery company to offer its beer in 16 ounce cans (Hoverson, 2007).

Figure 10

The Surly Brewing Company

The Surly Brewing Company is operating out of Brooklyn Center, a suburb northwest of downtown Minneapolis. It was started by owner Omar Ansari in 2006, but the seed was planted 12 years earlier, when Omar recieved a homebrew kit as a gift. Over the years he would continue to brew beer with friends, and with the birth of his first child, rather than a traditional birth announcement, he opted for an EPA, extra pale ale, which he brewed and sent to friends and family. In 2004, Omar upgraded his brew-kit and created his pilot brewery in his garage. He then enrolled at the American Brewer's Guild and completed an apprenticeship at New Holland Brewing in Michigan. Shortly thereafter, he ran into someone from his past, Todd Haug the head brewer at Minneapolis's Rock Bottom Brewing. After a bit of convincing, Omar made Todd the head brewer for the Surly Brewing Company. By the end of 2005, they had successfully transformed the family business's 5,000 square foot industrial space into a brewery. In 2006 they had the official opening of the Surly Brewing Company in Brooklyn Center ("Surly started with,").

Case Studies

Gantenbein Winery, Switzerland
Gramazio and Kholer Architects

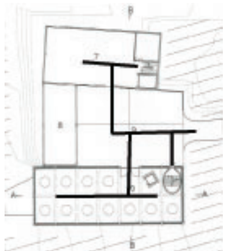
Faustino Winery, Spain Foster + Partners

Ysios Winery, Spain Santiago Calatrava

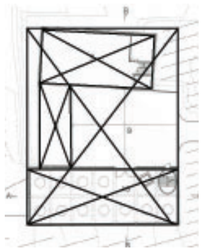
Figure 11

Gantenbein Winery, Switzerland
Gramazio and Kholer Architects

Circulation



Geometry

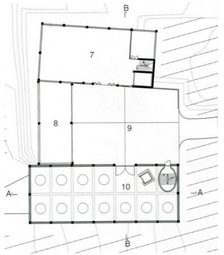


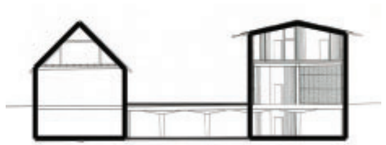
Hierarchy

The Gantenbein Winery in Fläsch, Switzerland consists of three small buildings on a 15.5 acre vineyard. The new addition has a custom brick façade made up of panels of angled bricks with open vertical joints. The building is meant to look like a basket full of grapes, and the gaps between the bricks allow sunlight to penetrate into the fermentation room. The addition consists of: a large fermentation room, which is an extension to the current cellar that is partially dug into the ground; a hall at courtyard level, where the grapes are crushed; and a rooftop terrace for tastings and receptions.

This small addition was built in response to this small Winery's growing success since its opening in 1982. The building's façade was created using state of the art computer programs and robotics to assemble the panels. To get the feel of grapes that naturally fell into a basket, the architects used software to mimic oversized grapes falling into their structure and analyzed the results and applied the results to the façades. There are 72 panels overall and a total of 20,000 bricks used to create the desired effect.

Structure





Massing

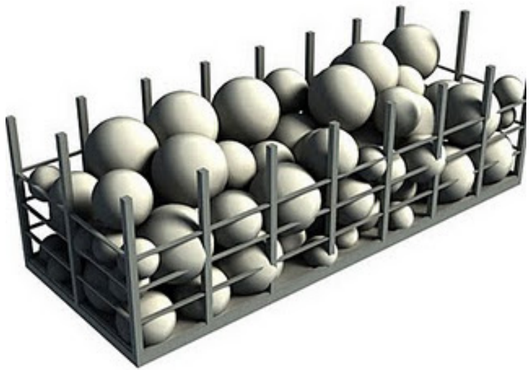


Figure 12

This Winery takes a more traditional view; it is open to nature rather than being hermetically sealed and extremely controlled. It is a very simple building for having used such complex techniques in its creation. It was designed to be a very efficient and utilize the space well, allowing it to have a smaller impact on the natural environment. Because the spaces, like the hall where the grapes are crushed, are only used at certain points of the year when the weather warmer, there is no need for complex heating and cooling systems. The fermentation cellar is a similar case. With it being dug partially into the ground, it maintains a more consistent temperature making those systems unnecessary.

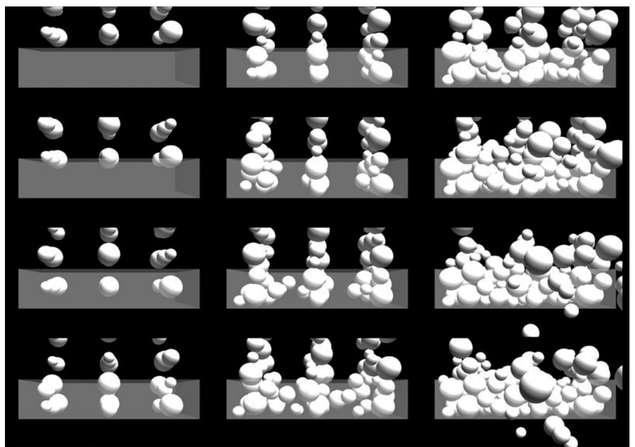
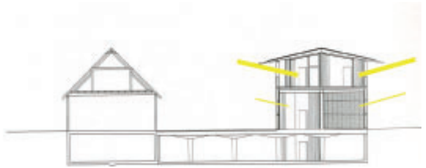
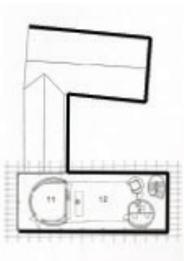


Figure 13



Natural Light

Figure 14



Plan to Section

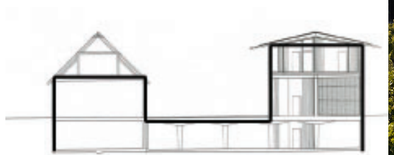


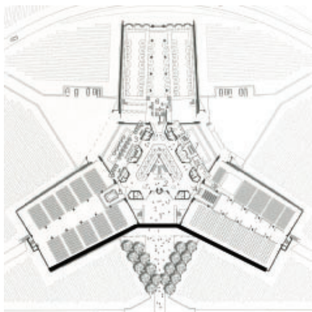
Figure 15

Figure 16

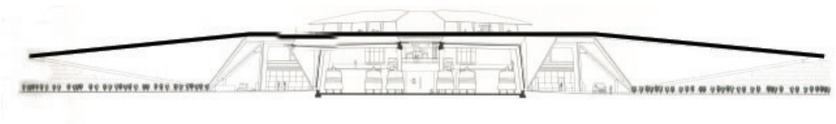
Faustino Winery, Spain Foster + Partners

Figure 17

The Faustino Winery by Foster and Partners in Gumiel de Izan, Spain was completed in 2010. It is a large winery at 12,500 square meters. The design uses a trefoil plan in which the three wings that extend out house the major portions of the process. The fermentation wing is open to the outdoors to allow for natural ventilation of carbon dioxide that is produced. The other two wings, the bottle and barrel aging wings, are partially dug into the ground, which is supposed to create a better environment for the aging process. The building also has a road built going up the roofs of the two wings that are partially underground. This road is how the grapes are delivered after being harvested, and they get placed directly into the hopper to be processed and crushed.



Plan to Section

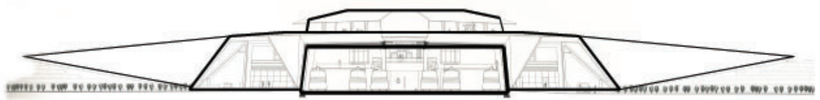


The center hub of the building houses the processing of the grapes, a gallery space, and all the administrative spaces. The hub is also set up with viewing areas into each wing, allowing visitors to get the full scope of the process from the one central area. In addition, there is a public area designed to show off the region's tradition of winemaking. The envelope of the building is covered in corten shingles and the color is quite complimentary to the vineyards natural tones.

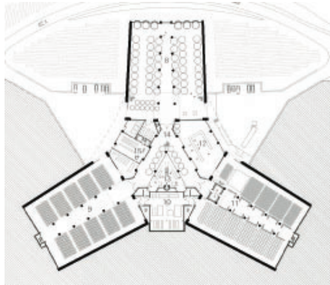
Like the Gantenbein Winery, the Faustino Winery is designed based around passive strategies and designed to allow the winemaking process be as fluid as possible. This project differs however, because of its size and the way tourism was planned into the process, allowing people to come witness how wine is produced, while at the same time not disrupt the process.

Figure 18

Natural Lighting



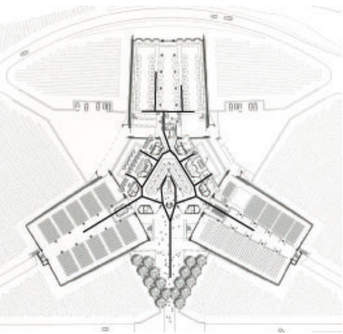
Massing



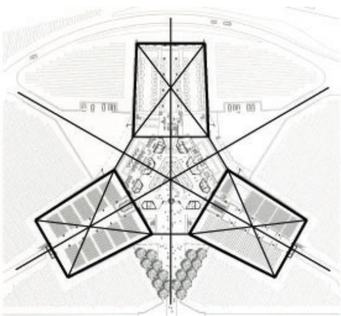
Structure

Figure 19

Curculation



Geometry



Hierarchy

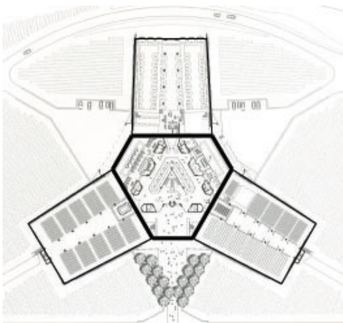


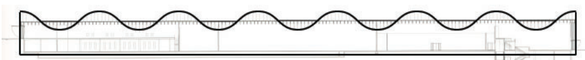
Figure 20

Ysios Winery, Spain Santiago Calatrava

Figure 21

The Ysios Winery by Santiago Calatrava is located in Laguardia, Spain. It is an 8,000 square meter building sitting on a 72,000 square meter site. One of the most noticeable key features of this design is the sine curve of the roof and walls. This sine pattern is broken only once at the center hump, where the roof extends an extra 33 feet in the air. This element houses a dining area for visitors on the second floor and acts as the entrance on the main level.

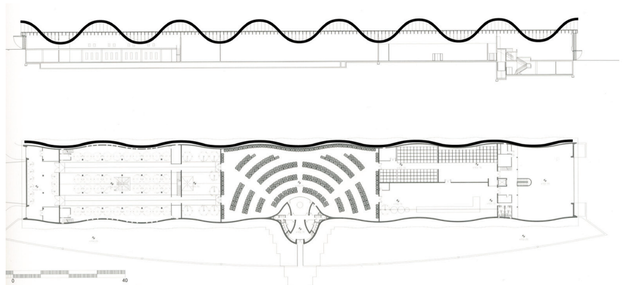
The floor plan uses a linear design that follows the winemaking process along that axis. The grapes enter at one end and wine exits after 640 feet of building. This project had a very limited budget of just $6 million or $70 a square foot. To help keep costs low, they created a simple design that would use a minimal amount of material. The sine curve of the walls helps keep them strong while also allowing them to stay relatively thin. The roof is made of laminated wood beams made of Scandinavian fir and span 85 feet.



Massing

This project, like the Faustino Winery, was designed around functionality. It was designed to minimize the distance the product would travel in the process of becoming wine. However, unlike the Faustino Winery, the Ysios Winery was not also designed around tourism. Where the Faustino Winery had special areas for groups to view the winemaking process, tour groups in the Ysios Winery are up close to everything happening. This allows people to get closer to the process, but this means they also runs the risk of disrupting the process. This design also does not utilize passive strategies as much.

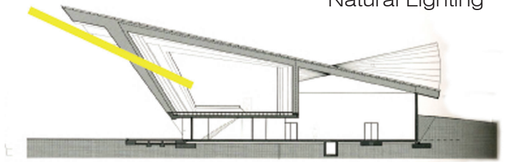
Structure



Plan to Section

Figure 22

Natural Lighting



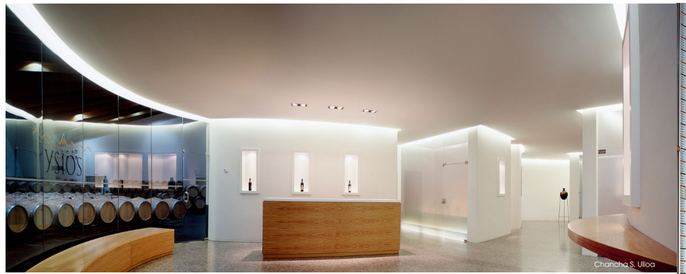
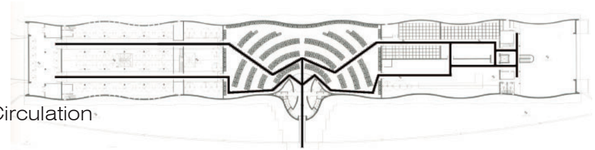
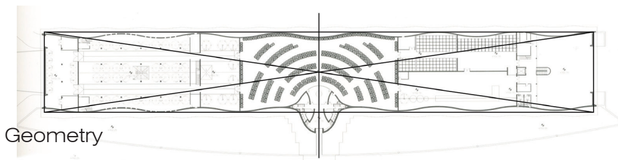


Figure 23



Circulation



Geometry

Hierarchy

Figure 24

Figure 25

Figure 26

Summary

Introduction

The Gantenbein, Faustino, and Ysios wineries all help start to uncover some of the issues one has to account for with this type of facility. Breweries and wineries deal with many of the same issues from processing to the shear volumes that must be stored to the way guests of the facility interact with the spaces.

Gantenbein Winery

One of the most important things to take away from this case study was its inclusion of passive systems. While the effect from the highly engineered panels creates a very nice aesthetic appeal, the way the small openings let in light and allow for the natural ventilation of carbon-dioxide makes those panels worth the effort that was put into them. The decision to dig the storage partially into the ground to draw from the Earth's naturally consistent temperature was also an important design strategy.

Faustino Winery

This winery was a highly process-driven design. It is designed to apply the least amount of effort to get the grapes transformed into wine. Their top feed gravity system is similar to the systems breweries often use. Like the Gantenbein Winery, the Faustino Winery is built partially into the ground to help maintain a consistent temperature. It also is designed to naturally ventilate the carbon-dioxide out of the building. The integration of tourism into this design provides a good example of how the inclusion of tourism does not have to disrupt the flow of the manufacturing process. Its central hub design allows people to view the different storage areas and the fermentation area, while moving around the central processing area.

Ysios Winery

What this case study demonstrates is the ability to create a strong design through several small gestures on a limited budget. This building is very simple and a straight-forward design that uses a linear progression to move from grape to wine. The one thing this design was lacking was the use of natural systems. Where the other designs benefited from natural light and ventilation, this design has little in terms of natural light and there was no mention of any natural venting strategies.

Conclusion

While the brewing process does differ quite a bit from the winemaking process, the overall processes are very similar. Each of these case studies offered a great deal of knowledge, shedding light onto the types of issues one faces when designing a building which is used by a good number of people in many different ways.

Project Goals

Academic

I feel one of the most important things is for this project to show the skills and knowledge I have learned while attending North Dakota State University. I would also like to create a project different from what is normally seen at the thesis show. I would like to have an end product that stands out as an exceptional piece of work that I can proudly know is placed in the Digital Repository for future generations to see.

Professional

For this project I feel it is important that its final product be something that is plausible and to a level of detail that, when viewed in my portfolio by potential future employers, it shows that I am able to keep my dreams in the realm of possibilities. With this being the final project before graduation, having an end product that reflects all the skills I possess is imperative.

Personal

On a personal level, I feel it is important to make sure I am enjoying myself while I design. I always design better when I am enjoying what I am doing. I also feel it is important to show how alcohol does not have to be a negative aspect of a community, and it can, in fact, be used as a point of gathering and pride.

Site Analysis

Narrative

The warehouse district in Minneapolis is in the middle of a transformation. My site at the corner of North 3rd Street and 7th Avenue North is right at the heart of it. The area is home to many older brick buildings, many of which either have been renovated or are in the process of being renovated. Small shops and cafes are starting to make their way into the streetscape with condos and offices filling many of the upper levels. Directly to the Southwest of the site are a series of three new condominium complexes, the first of which was completed in 2008.

Washington Avenue, the main arterial street running through the district, sits at the other end of the block along 7th Avenue. Bus line 14 runs along this main road bringing people directly into the central part of downtown. A mere six blocks to the south one finds Target Field, the new Minnesota Twins baseball stadium; the corresponding rail station and the new light rail system, which runs all the way from Target Field, past the Minneapolis/St. Paul International airport, south to the Mall of America in Bloomington.

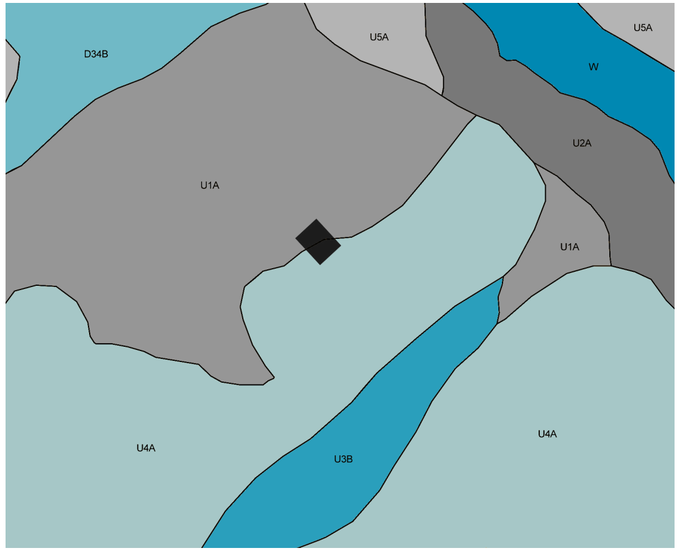
The area has unique character with the combination of old renovated buildings mixed in with modern new development. North 3rd Street is truly unique to the area as it is one of the few remaining brick roads; however, it has seen better days and may be in need of refurbishment in the near future.

This site is a prime location, having lower buildings to the south, allowing for an abundance of natural light to flood the site. The lower buildings also offer the potential of a rooftop terrace, which would overlook the skyline of downtown Minneapolis. The buildings that fill the warehouse district are relatively low; the highest building in the district sits at only nine stories tall. The shorter height means the area has less of a wind tunnel effect one might find in the main part of downtown, and this creates a more pleasant atmosphere.

One thing the site is lacking is vegetation. The only vegetation visible from the site is the small bit of landscaping around the condominiums nearby. A small park does exist along the Mississippi River five blocks from the site; however, the inclusion of a small green space with a water feature for the public to enjoy could be highly beneficial to the area.

Here one can see some of the distress at the site with this old brick road. It is in a state of disrepair, but with some attention it could add a lot to this unique downtown neighborhood.

Washington Avenue is the main arterial road cutting through the center of the warehouse district. Bus line 14 runs along this street which goes heads into the main central business district.

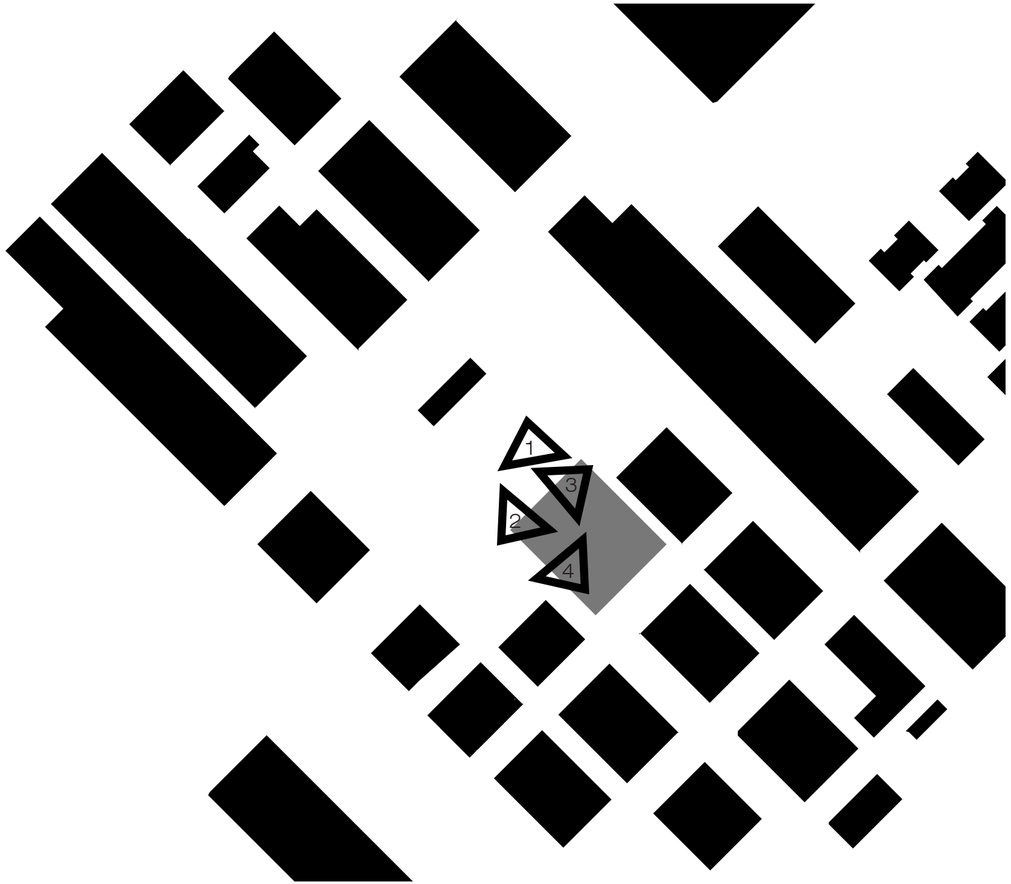


Soils and Slope

The U1A and U4A classified soils that exist on the site full under the category of urban land and have a slope of 0-2% and drain excessively. They are not prone to flooding or ponding and have a depth to the water table of more than 80 inches. There is also more than 80 inches to restrictive features.

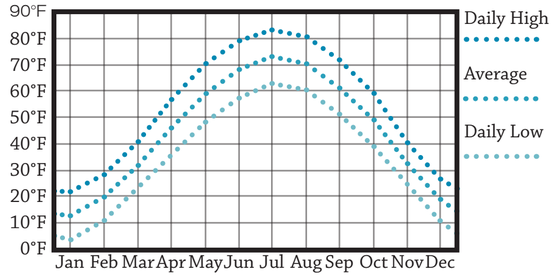
Hennepin County, Minnesota (MN053)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
D34B	Urban land-Hubbard complex, 0 to 8 percent slopes	26.3	5.5%
L52C	Urban land-Lester complex, 2 to 18 percent slopes	0.8	0.2%
U1A	Urban land-Udorthents, wet substratum, complex, 0 to 2 percent slopes	137.9	29.0%
U2A	Udorthents, wet substratum, 0 to 2 percent slopes	33.3	7.0%
U3B	Udorthents (cut and fill land), 0 to 6 percent slopes	31.5	6.6%
U4A	Urban land-Udipsamments (cut and fill land) complex, 0 to 2 percent slopes	212.1	44.5%
U5A	Urban land-Udorthents, wet substratum, complex, 0 to 2 percent slopes, rarely flooded	14.5	3.1%
W	Water	19.6	4.1%
Totals for Area of Interest		**476.1**	**100.0%**

To the north and west are a number of new condominium buildings, as well as a number of buildings still waiting to be renovated. It is also in these general directions where one finds a number of open sites ready to be developed. These are the areas that, depending on how they get developed, have the potential to strengthen this neighborhood that has seen so much growth over the past five to ten years.

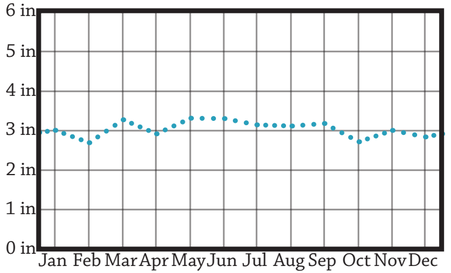


To the south and east there are a number of the older buildings in the warehouse district. The Minneapolis skyline peaking out hints at the potential for a rooftop terrace with a wonderful view. Just two blocks east, on North 2nd Street, one finds many of the small shops and restaurants in the area.

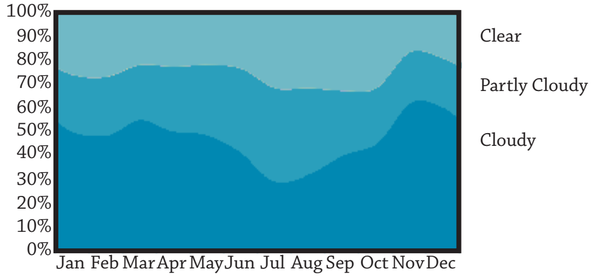
Average Temperatures



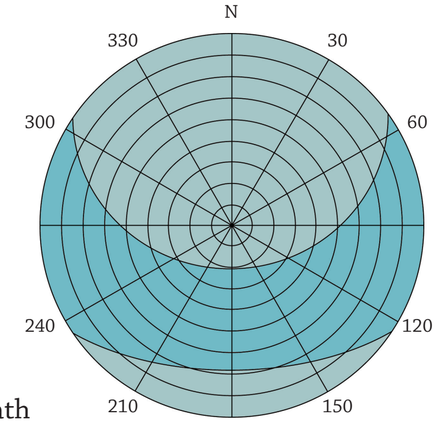
Precipitation



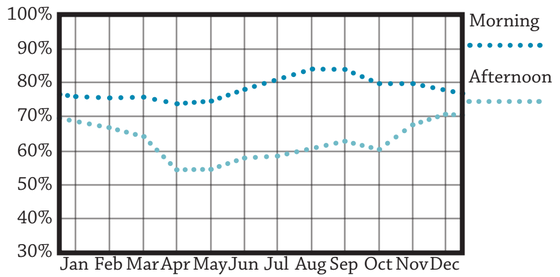
Cloudy Days



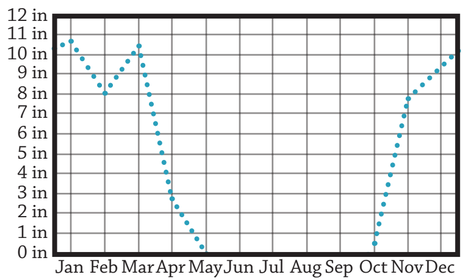
Sun Path



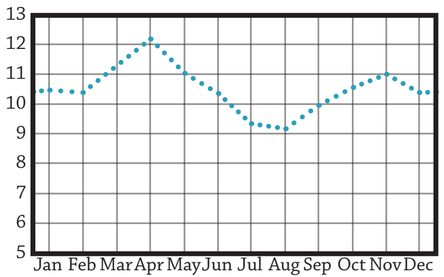
Humidity



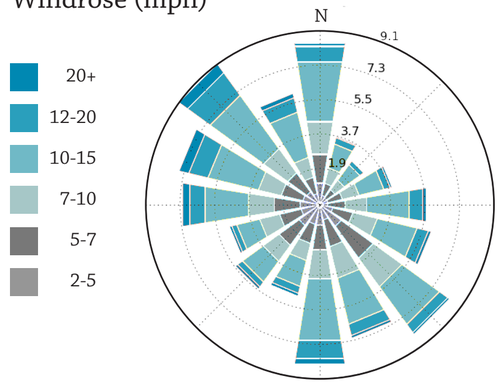
Snowfall



Wind Speed (mph)

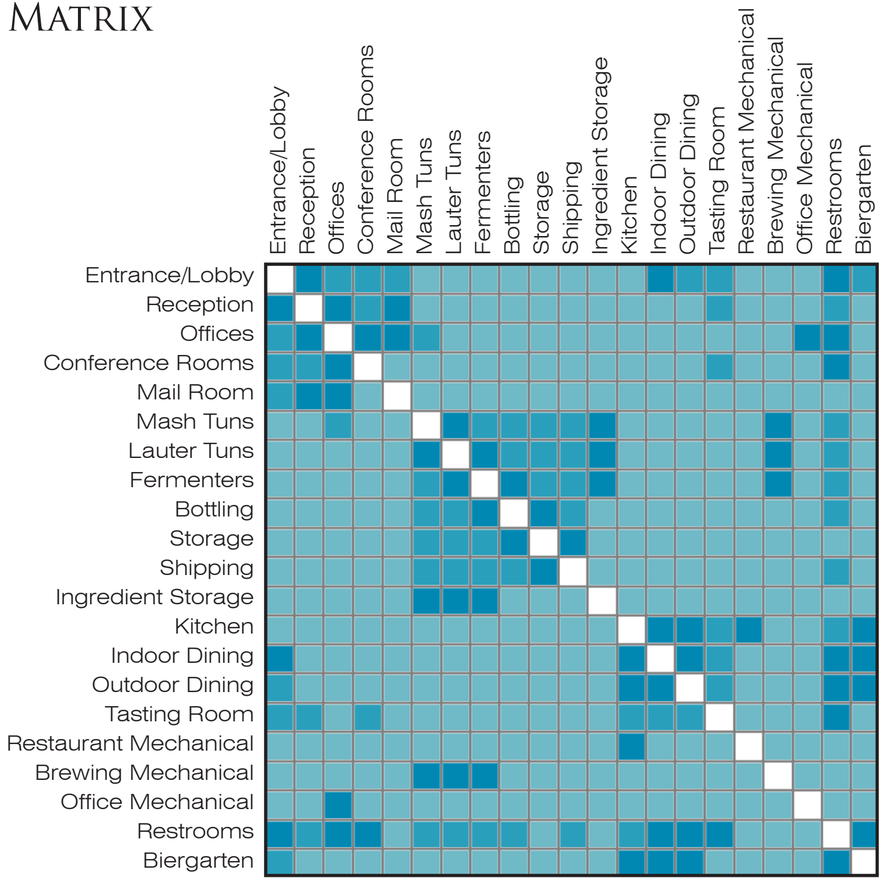


Windrose (mph)

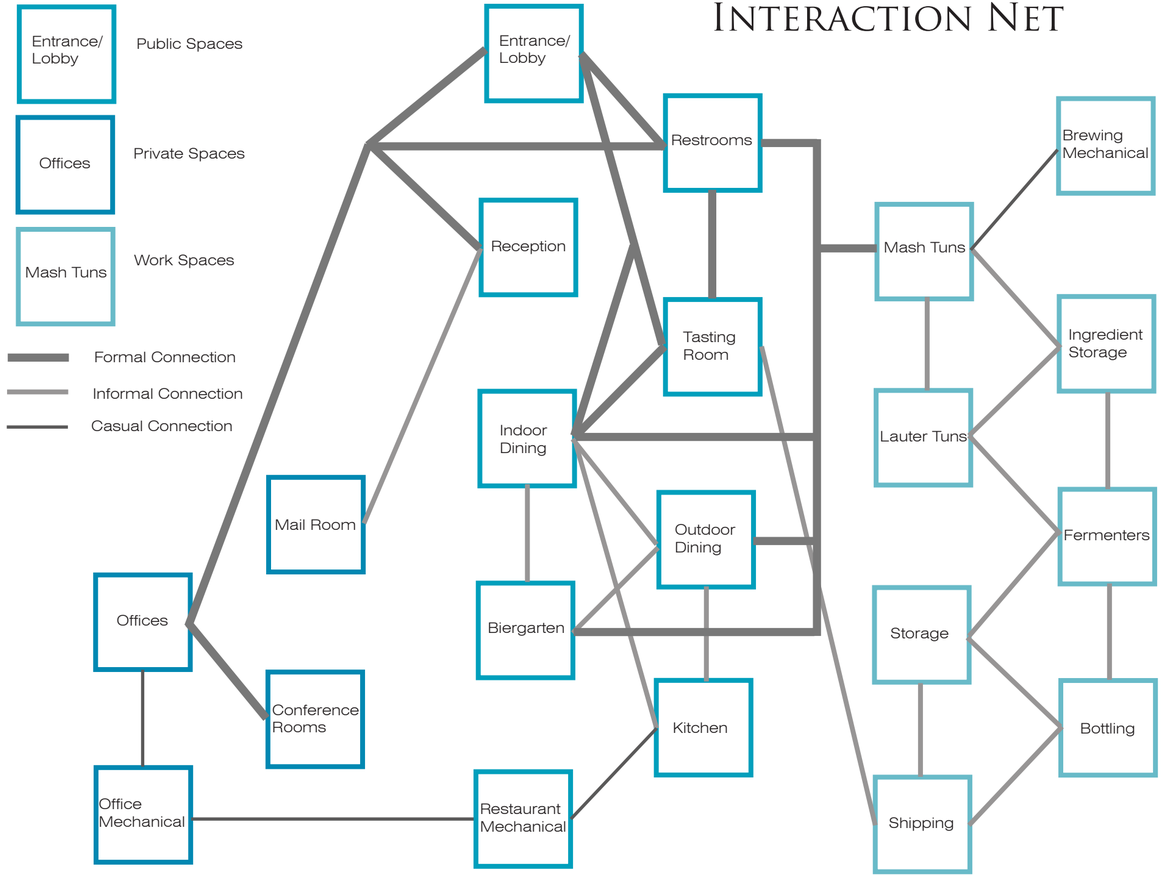


Interaction Matrix

- Essential
- Desirable
- Not Necessary



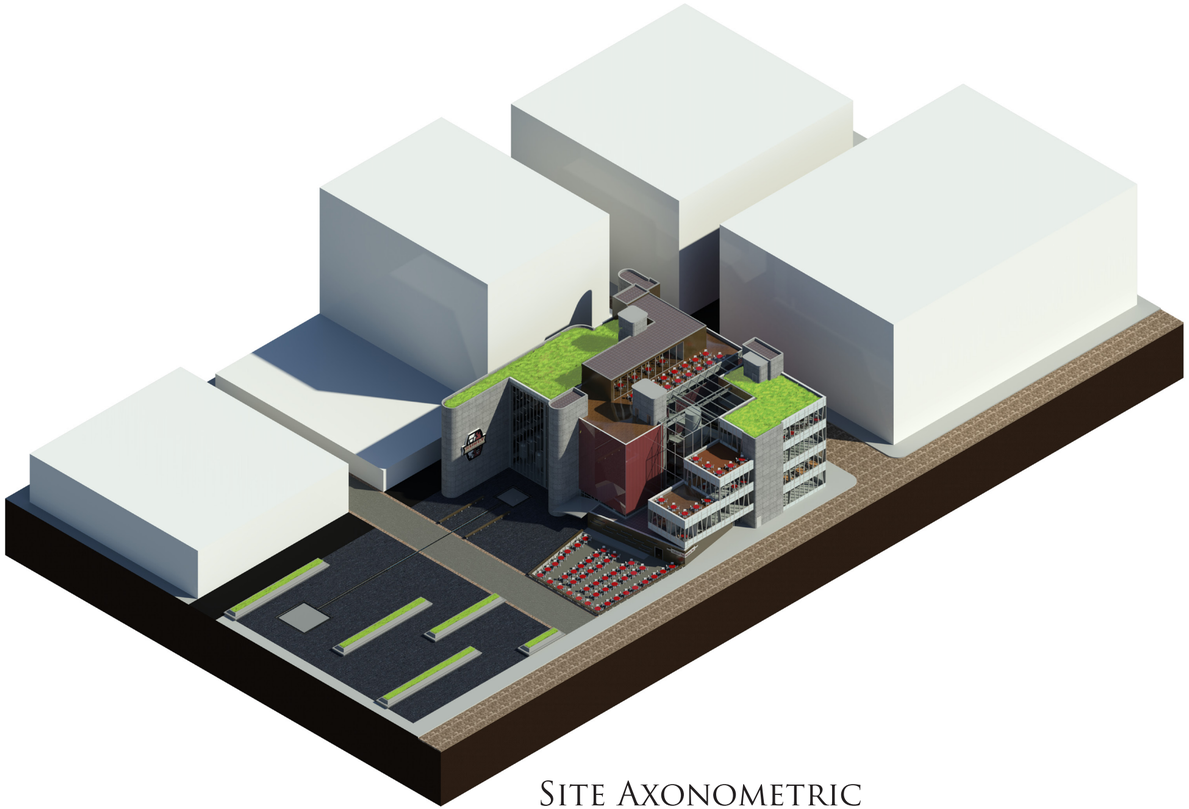
Interaction Net



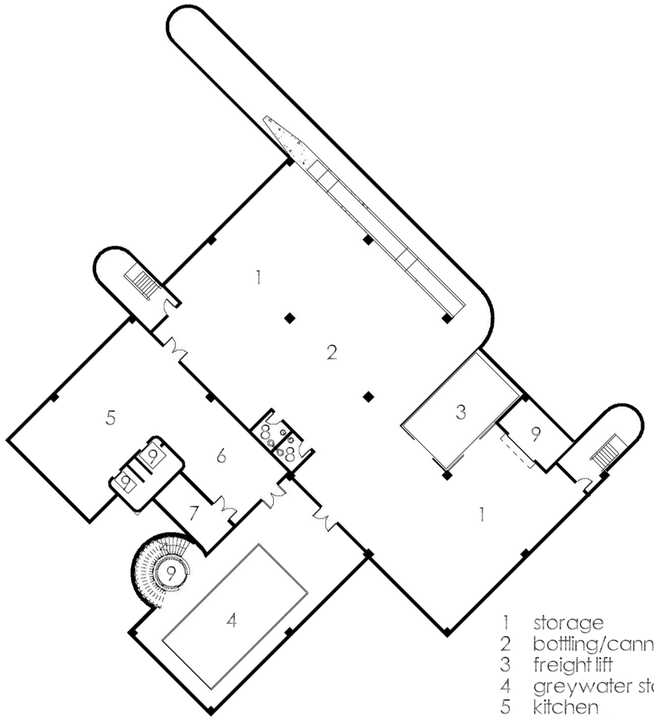
Program

	Brewing
1000 sf	Ingredient Storage
500 sf	Milling
2500 sf	Mashing
2500 sf	Boiling
5000 sf	Fermenting
2000 sf	Bottling
5000 sf	Storage
1000 sf	Shipping
500 sf	Tasting Room
500 sf	Mechanical
200 sf	Restrooms
	Administrative
75 sf	Reception
1000 sf	Offices
500 sf	Conference Rooms
150 sf	Mail/Storage
200 sf	Restrooms
500 sf	Mechanical (Shared with Restaurant)
	Restaurant
3000 sf	Indoor Dining
1000 sf	Outdoor Dining
1500 sf	Kitchen
500 sf	Storage
350 sf	Restrooms
29475 sf	**Total**

Final Brewery Design

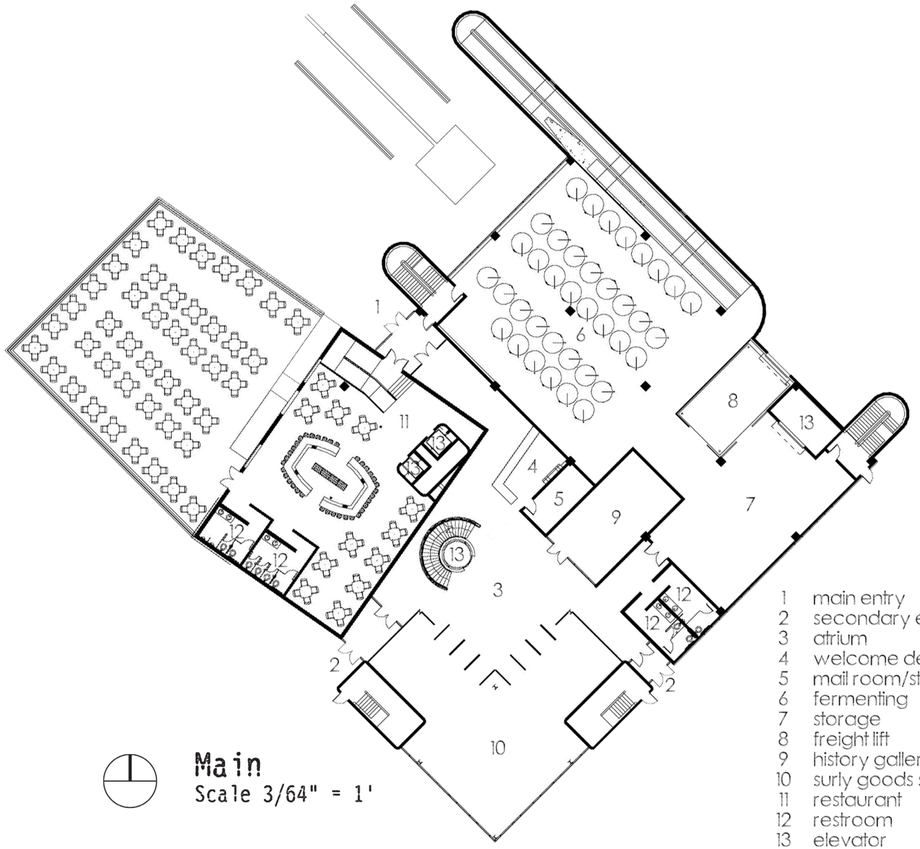


Site Axonometric



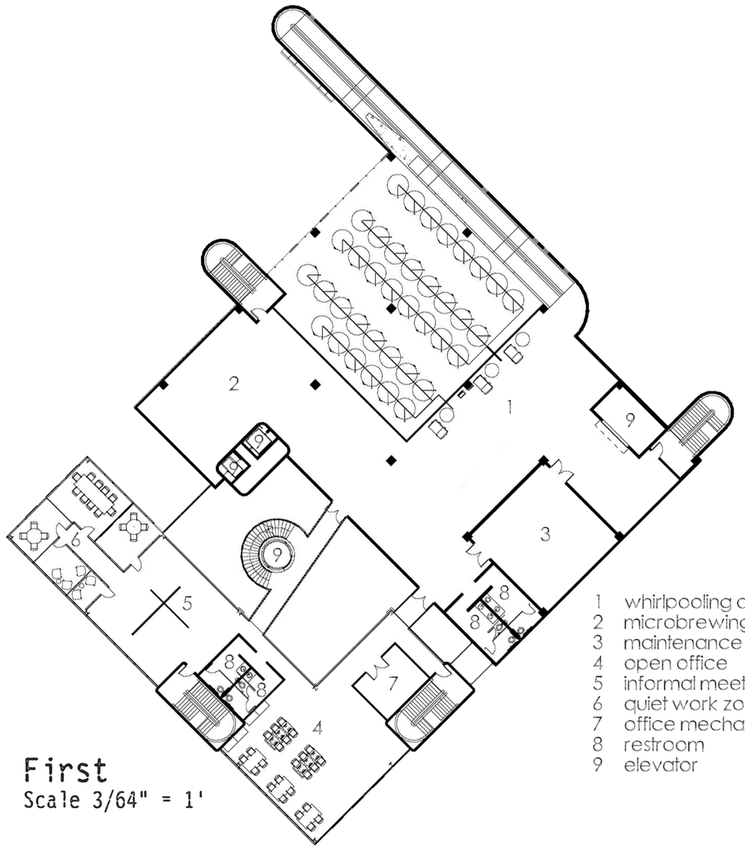
1 storage
2 bottling/canning/kegging
3 freight lift
4 greywater storage
5 kitchen
6 kitchen storage
7 restaurant mechanical
8 restroom
9 elevator

Basement
Scale 3/64" = 1'



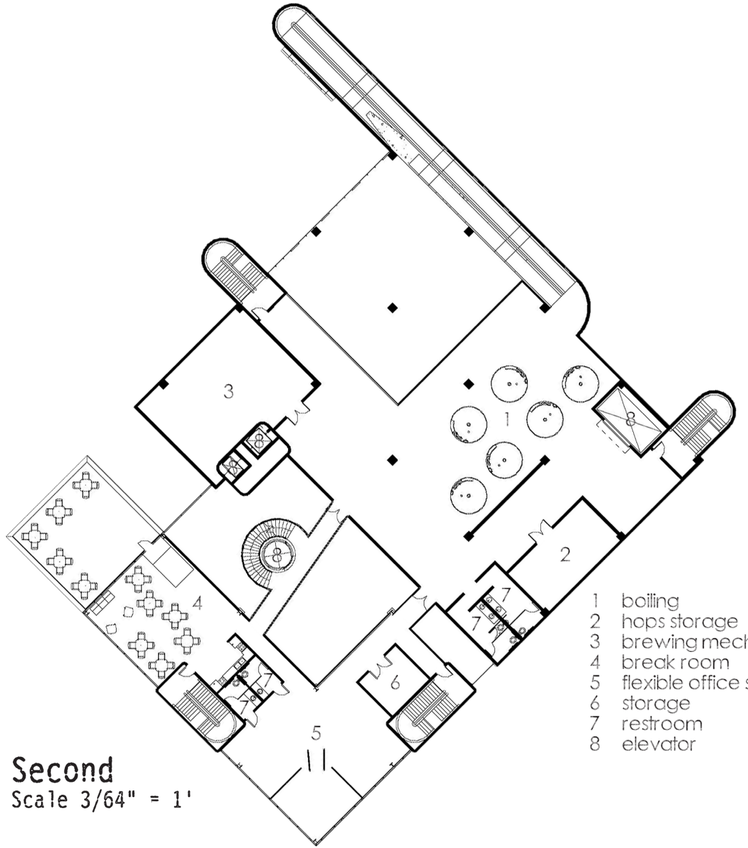
1 main entry
2 secondary entry
3 atrium
4 welcome desk
5 mail room/storage
6 fermenting
7 storage
8 freight lift
9 history gallery
10 surly goods shop
11 restaurant
12 restroom
13 elevator

Main
Scale 3/64" = 1'



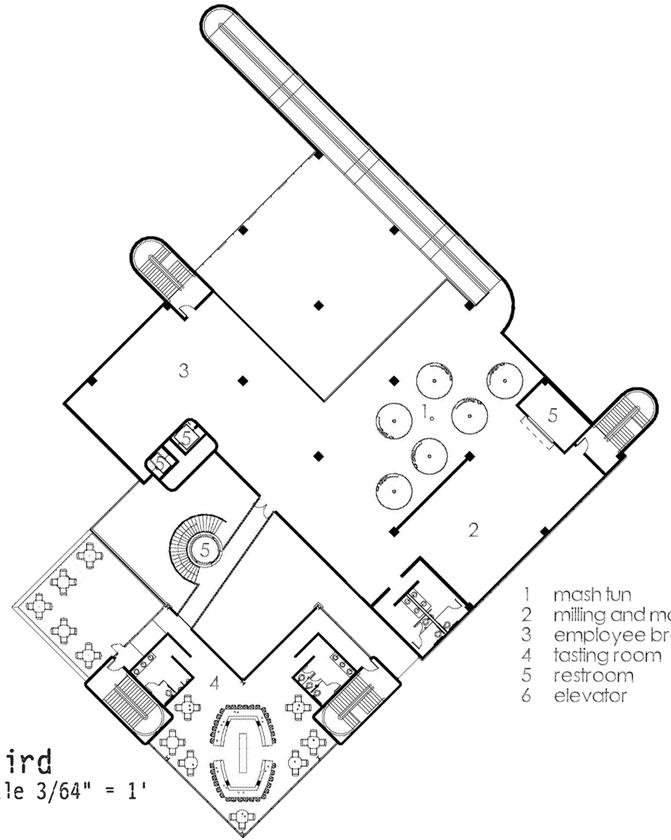
First
Scale 3/64" = 1'

1 whirlpooling and chilling
2 microbrewing testing
3 maintenance storage
4 open office
5 informal meeting/gathering
6 quiet work zone
7 office mechanical
8 restroom
9 elevator



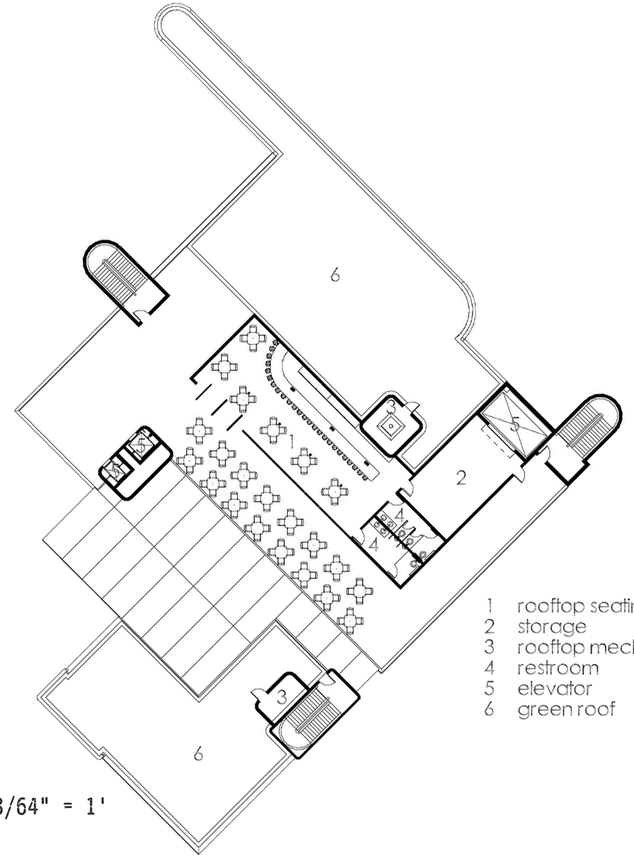
Second
Scale 3/64" = 1'

1 boiling
2 hops storage
3 brewing mechanical
4 break room
5 flexible office space
6 storage
7 restroom
8 elevator



1 mash tun
2 milling and malt storage
3 employee brewing/activity space
4 tasting room
5 restroom
6 elevator

Third
Scale 3/64" = 1'



1 rooftop seating and bar
2 storage
3 rooftop mechanical
4 restroom
5 elevator
6 green roof

Roof
Scale 3/64" = 1'

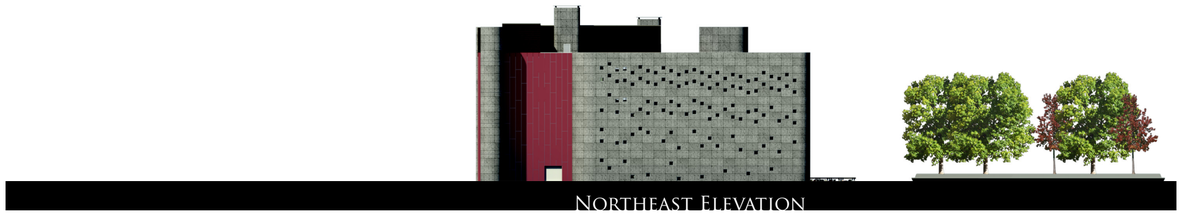
Brewing Space

Tasting Room

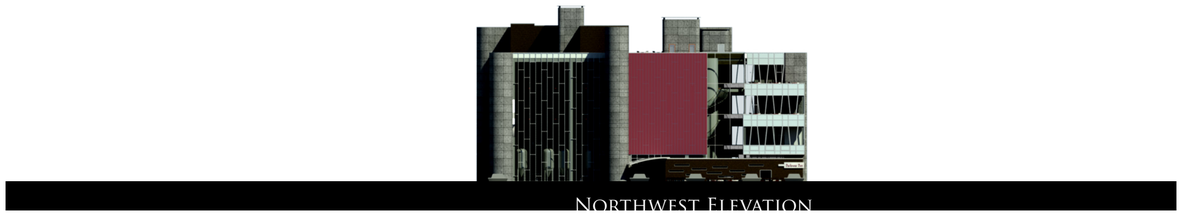
Section Perspective

Southwest Elevation

Southeast Elevation



Northeast Elevation



Northwest Elevation

Office Section Persective Detail

daylighting	1
natural ventilation	2
greywater collection	3
recessed shades	4
photo voltaic spandrel glass	5
steel frame construction	6
lightweight concrete on steel decking	7
raised wood exterior decking	8
drop down ceilings	9
air ducts	10

Plaza Perspective

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Photos

Site

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An education isn't how much you have committed to memory, or even how much you know. It's being able to differentiate between what you know and what you don't.

-Anatole France