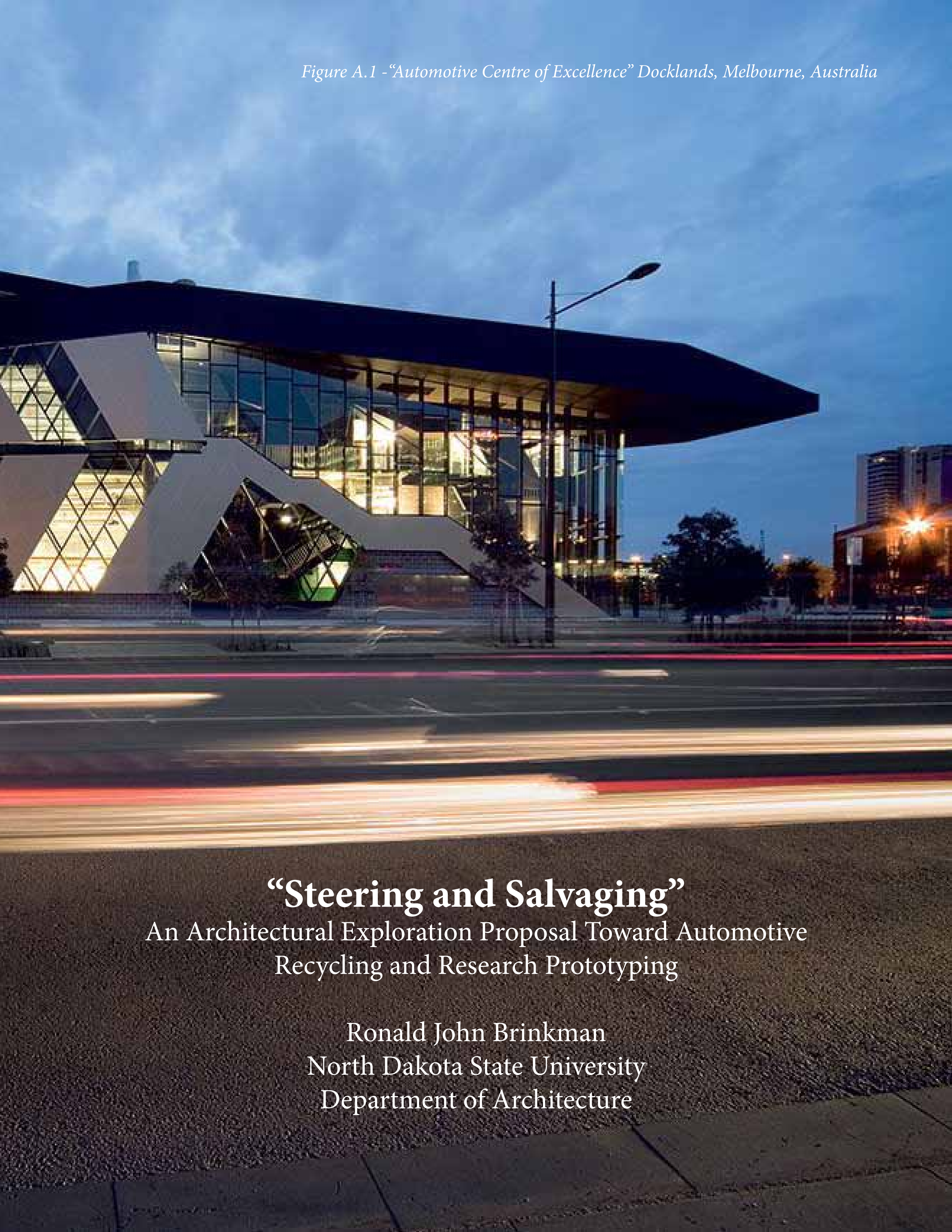

Figure A.1 - "Automotive Centre of Excellence" Docklands, Melbourne, Australia

"Steering and Salvaging"

An Architectural Exploration Proposal Toward Automotive Recycling and Research Prototyping

Ronald John Brinkman
North Dakota State University
Department of Architecture

Title and Signatures

“Steering and Salvaging”

An Architectural Exploration Proposal Toward an Automotive Recycling and Research Prototyping Center

For
The Department of Architecture of North Dakota State University

By

Ronald John Brinkman

Primary Thesis Advisor

Thesis Committee Chair

May 14, 2015 4:55 PM

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Chapter 1 - Proposal

Abstract

Automotive design and recycling are essential industries in today's efforts fighting unsustainability. Yet these industries are too often excluded from one another. I am proposing to design an urban environment automotive recycling and prototyping center. I am proposing this facility in the Northern American heartland of St. Paul, MN, where the vehicles are prone to exceptional environmental wear and tear. A research facility of this manner has potential to unlock countless recycling strategies in regards to the automotive industry. I propose to explore and present a life cycle sustainable, architectural solution for the creation of an Automotive recycling and prototyping research facility. My goal is to facilitate automotive design for recycling. To activate these gritty sustainability practices, architects must focus the redesigning modern automotive research facilities and integrating them with automotive recycling processes.

Narrative of Theory

Cars, cars, cars, more and more falling apart cars. Many are scrapped, chopped, mixed, matched and squandered for decades before their life cycles are closed.

With a thoroughly motor-head Midwestern upbringing, I've had no shortage of scouring vehicle graveyards for the missing pieces to reassembling my Frankenstein cars. I've grown up learning how cars are cycled, recycled, dismantled and rebuilt throughout their lives.
At some stage through my years of hands on roadster research, it has become increasingly obvious that vehicle designers and recyclers are disconnected.

As we continue to transition into a short term materialistic culture, how can we manage to sustainably maintain our recycling strategies? Traditionally this takes the form of the hand-me down vehicles or the junk yard repairs. Current automotive recycling methodologies provide an effective solution toward reducing environmental damages. This is an admirable and necessary challenge.

I believe that as the necessity of vehicles increases throughout developing nations, the bounty of automotive recycling facilities will overfill. I believe that it our societal duty to investigate alternative roadster recycling processes and research new sustainable vehicle solutions.

I propose to explore and present a sustainable, cost effective architectural solution for the creation of an Automotive recycling and prototyping research facility in the harsh Minnesotan environment.

Project Typologies

This project finds a typological middle ground between a scientific/educational research center and industrial automotive recycling facility. This facility's creation pushes the boundaries of industrial sustainability research, and architectural design innovation.

I intend to draw design strategies primarily from an educational research vernacular. This type of project typology will require research classrooms and workshops for an active educational approach.

Logistically, I believe incorporating elements from other industrial vernaculars will add to the function and efficiency of this project. Taking architectural research from industrial recycling facilities or other specialized research facilities will be necessary to complete the project.

Typologies
Educational and research prototyping facility
Industrial Dismantling and Automotive recycling facility


Figure 2.1


Figure 2.2

Typological Research

Case Studies Introduction Summary

1) Automotive Centre of Excellence (ACE), Kangan Institute

What/Where:	Educational Research Facility in Melbourne, Australia
Focuses:	Multi-phase Design, Circulation and Spatial Study, Site Context Cohesive Design

2) New Martini Hospital

What/Where:	Medical Facility in Goningen, Netherlands
Focuses:	Life cycle Construction and Deconstruction, Adaptive Construction and Repurposing

3) Veolia Materials Recovery Center

What/Where:	Recycling Facility in Haraldrud, Oslo, Norway
Focuses:	Passive Design Strategies, Inexpensive Construction Strategies, Strong User/Client Design Strategies

4) Hugo Auto and Truck

What/Where:	Automotive Dismantling Recycling Facility in Hugo, MN
Focuses:	Dismantling Facilities, Automotive Recycling Vernacular, Regionally Identical Climate, Automotive Recycling Design Strategies

Figure 3.1

Case Study 1 - ACE

Project Details

Name: Automotive Centre of Excellence (Phases 1 and 2)
Kangan Institute

Location: Docklands, Melbourne, Australia

Typology: Automotive technology research and educational center

Timeline: Phase 1 completed - 2007
Phase 2 completed - 2012

Architects: Phase 1 - Lyons Architecture
Phase 2 - Gray Puksand

Scale: Phase 1 - 5000 square meters
Phase 2 - 14000 square meters

Features: Adaptable education and research programing, Urban Environment, Multi-Phase planning design, High tech materiality and skins

Program: High-Bay workshop, specialist workrooms, classrooms, offices, flexible research and development spaces.

Figure 3.1

Figure 3.2

Case Study 1 - ACE

Commonalities

Industrial Design
Natural Light
Site Rejuvenation
Sustainable Design

Uniqueness

Automotive Program
Educational Setting
High tech materiality
Machine Metaphor
Multi Phase Design

Site Responses

Cultural regrowth, and gentrification.
Symbolizes surrounding "train sheds" vernacular.
Repurposing industrial region of urban environment.

Key Concepts

This project is an ongoing research and development education center revolutionary for the Australian motor industry. The multi-phase design and construction process has allowed for ease of gentrification of the traditionally industrial Docklands neighborhood of Melbourne. Additionally, to ease this transition, the buildings have been derived from the "industrial train shed" vernacular, forcing form, spacial and material designs to cohere with the surroundings. Being a successful automotive research institute, a "machine metaphor" has also been instituted into the campus.

Figure 3.3

Case Study 1 - ACE

Figure 3.4

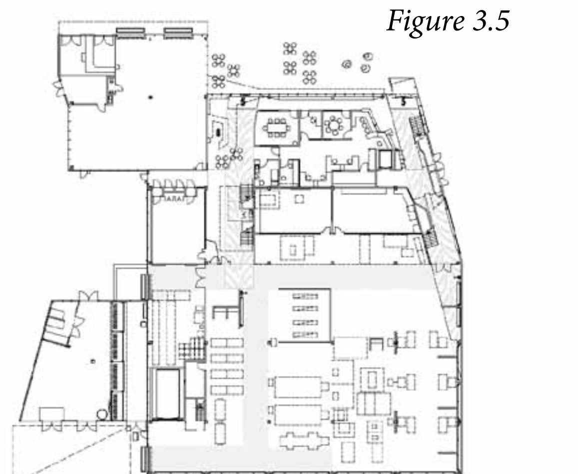


Figure 3.5

Figure 3.6

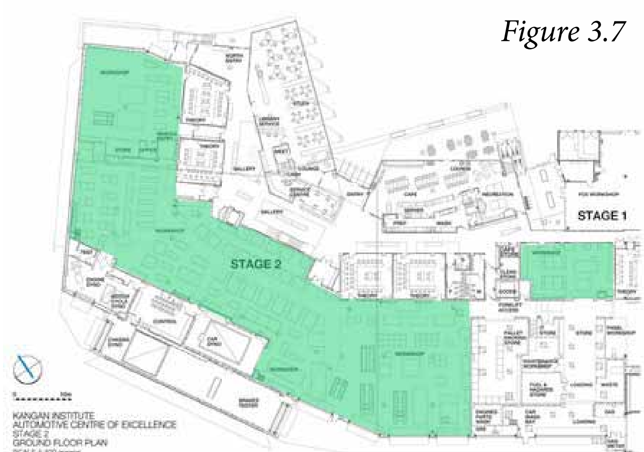


Figure 3.7

Form Design
Gabled roof designed to mimic the surrounding "big shed" vernacular from the railways, promotes cohesive urban environment design.

Phase 1 Design
Initial design creates small scale educational facility to begin neighborhood gentrification. Focuses on high tech workshop spaces for hands on educational approach.

Materiality
Utilizes high tech semi-permeable skins throughout the facades, driving the 5-star green rating that the facility recently received. Tapering facade with glass inlets also promotes natural light.

Phase 2 Design
"The new facility was required to accommodate courses and workshops from different campus locations with many processes and practices occurring on the same site for the first time" (WBD, 2012, Kangan).

Case Study 1 - ACE

Section - Circulation

Vertical circulation was key to the phase 1 design allowing for better circulation hierarchy.

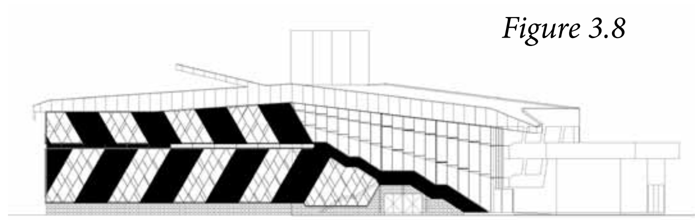


Figure 3.8

Multi-phase Planning

"The ACE will consolidate all of Kangan Institute's automotive training on one site which, together with new state-of-the-art technology and equipment, will ensure it is a unique centre of automotive learning, research and development" (ACEAuto.com, 2014).

Figure 3.9

Educational

"The old notion of the workshop does not exist in this facility, rather the components of the automotive industry are located in an environment more akin to a laboratory" (WBD, 2012, Kangan).

Figure 3.10

Figure 3.11

Conclusions

This case strongly reinforces the need and opportunity to design an automotive research and development facility. Being primarily an educational facility instead of a commercial facility as I anticipated, this sways my opinions toward facilitating my program toward educational. They do not focus on any recycling, however this is an excellent example of how to architecturally communicate the program of the building.

Case Study 2 - Martini

Project Details

Name: The New Martini Hospital
Location: Groningen, Netherlands
Typology: Hospital and Medical Research Facility
Timeline: Completed 2007
Architects: Burger Grunstra Architecten
Scale: 58000 square meters
Features: IFD (Industrial, Flexible, Demountable) strategy, deconstruction building type, adaptable floor planning, cohesive design strategies, multi-phase planning, building life cycle planning, colorful design.
Program: Flexible medical facilities, exam rooms, research spaces, offices. Potential housing or other future programing.

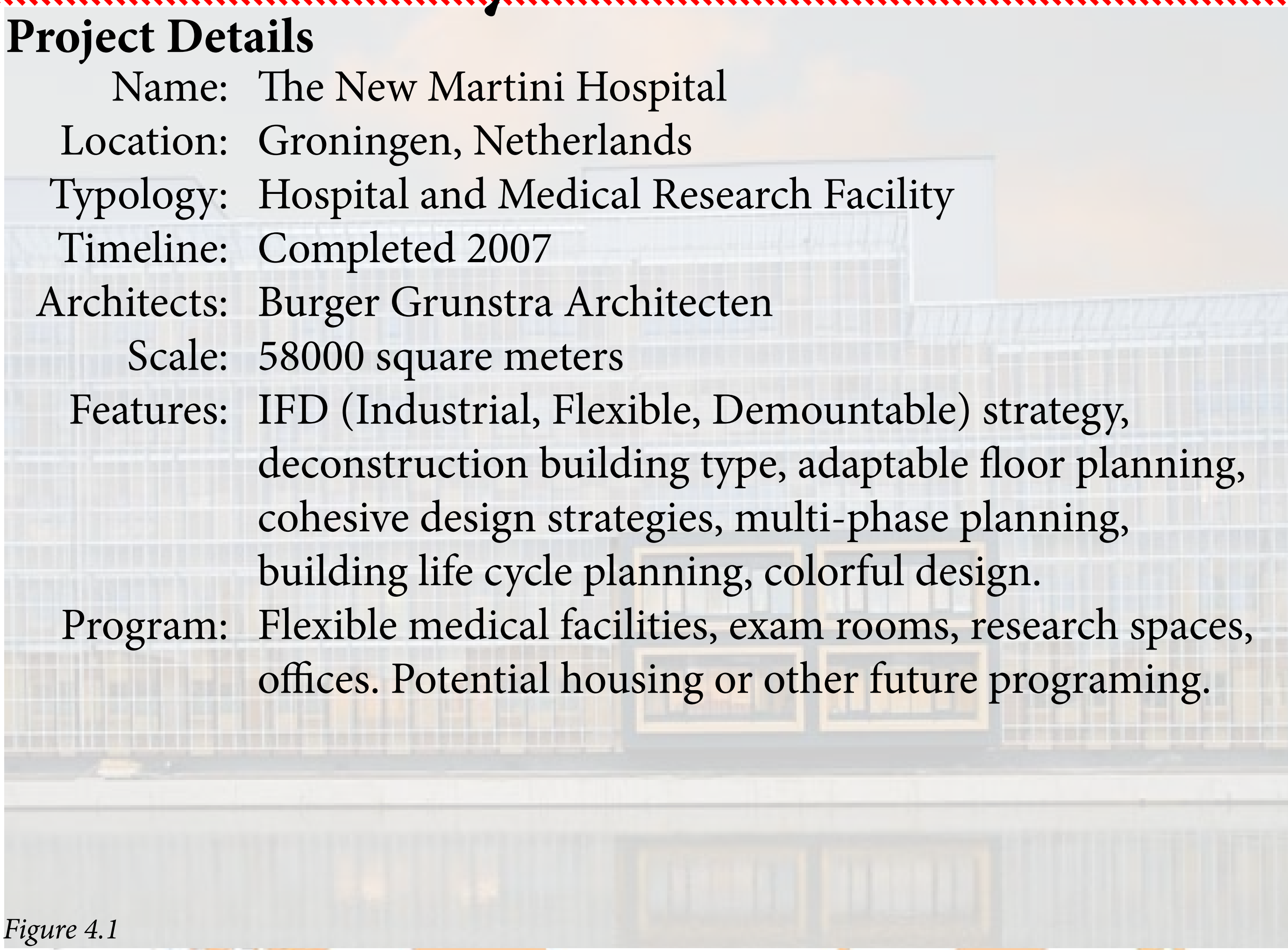


Figure 4.1

Figure 4.2

Case Study 2 - Martini

Commonalities

Industrial Design
Natural Lighting
Site Rejuvenation
Sustainable Design

Uniqueness

Medical Program
Research Setting
Colorful design
Chromosomes Metaphor
Adaptable Floor Plans
Deconstruction

Site Responses

Flexible medical campus.
Multi-phase planning
Adaptable layout designs.
Life cycle planning.
Deconstruction

Key Concepts

This revolutionary Dutch hospital offers unique strategies for the ever adapting medical field. By implementing deconstructive design, adaptable layouts and life cycle planning, this facility offers the opportunity to perform functionally excellent for the client.

Materiality

"An important difference between The New Martini Hospital and regular Dutch hospitals is the use of a narrower 16m width. This allows the possibility for much more natural daylight penetration" (WBD, 2008, Martini). "Even the curved façade behind the glass climatic curtain wall is made up of removable panels which can be changed to suite the functions it encloses" (WBD, 2008, Martini). The entire building is prefabricated demountable and adaptable.

Figure 4.3

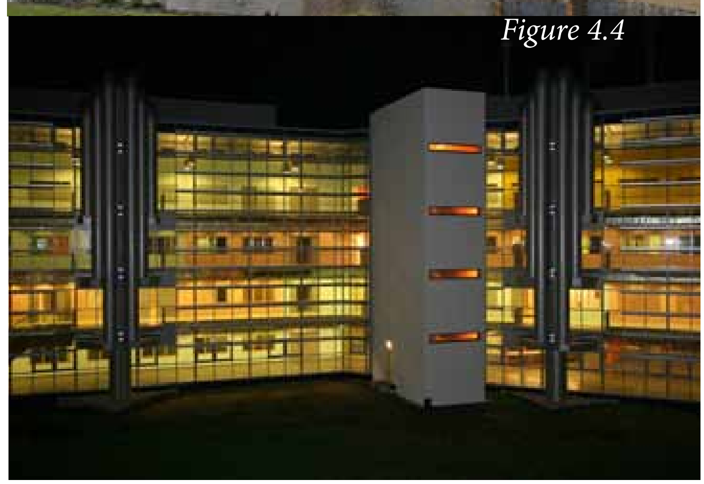
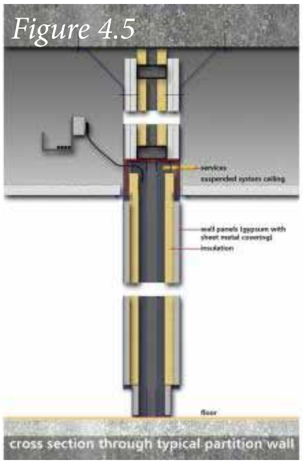


Figure 4.4

Case Study 2 - Martini



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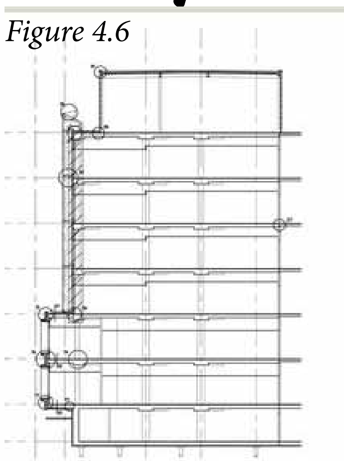


Figure 4.6

Figure 4.7

Adaptable Design

"Almost all spaces are equipped with a demountable system wall which includes at regular intervals a metal built-in rail. In this built-in provision there is a click-in possibility for sockets for the use of wall plugs, data connections and medical gases" (Thaidens, 2007).

Life cycle Planning

Having a 40 year life cycle plan for the hospital, and adaptable floor plans, allows for easy building program changes for the hospital campus.

Conclusions

This project approaches sustainability in a new light by focusing on the building's functional life cycle and adaptable design. By designing with entirely prefabricated, flexible, adaptable and detachable elements, the function of the hospital is changeable. The average Dutch hospital has a 20 year life cycle, but most all structures exist longer than this. Making this building adaptable, it can take the function of offices, housing or another function for end of its life. Otherwise, all elements of the building are deconstructable and recyclable for future construction. This offers a challenging opportunity for my thesis to implement deconstructable design strategies. This project directs me toward attacking sustainability challenges from a construction life cycle plan.

Case Study 3 - Veolia MRC

Project Details

Name: Veolia Materials Recovery Center
Location: Haraldrud, Oslo, Norway
Typology: Recycling Center
Timeline: Completed 2007
Architects: Arkitectkontoret GASA A/S
Scale: 28000 square meter
Features: Sustainable design, high traffic recycling capacity, creative industrial design, colorful design
Program: Recycling facility, green roof, offices, sorting area, loading and unloading spaces.

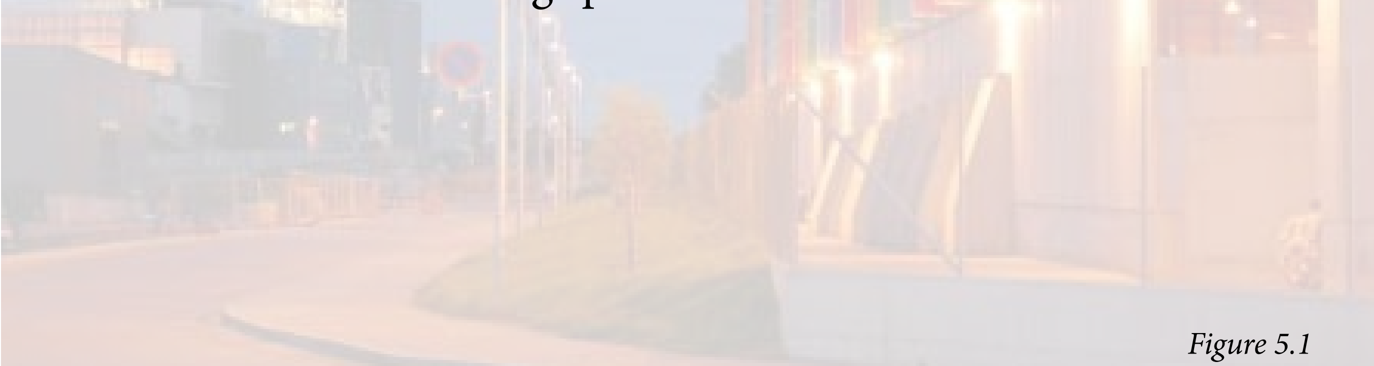


Figure 5.1

Figure 5.2

Case Study 3 - Veolia MRC

Commonalities	Uniqueness	Site Responses
Industrial Design	Fixed construction cost	Inexpensive
Natural Light	Design simplicity	Deconstruction
Site Rejuvenation	Recycling facility	Utilitarian function
Sustainable Design	High traffic abilities	Passive systems
	Worker Considerations	Green roof

Key Concepts

This passively designed recycling center offers a utilitarian solution for the extensive waste loads of a metropolitan area. This project's inexpensiveness and passive simplicity are the driving force for the success of this facility.

Figure 5.3

Figure 5.4

Materiality

The concrete base wall "has the strength to endure the push and scratch of heavy duty machinery and the flexibility to adapt to future changes in production layout" (Urbarama.com, 2009, *Veolia)*. The corrugated steel upper walls offer an inexpensive adaptable solution.

Employee Friendly

Exterior and rooftop seating, along with top line wardrobe, showering and break spaces begin to consider and prioritize the quality the blue collar workers at the facility.

Case Study 3 - Veolia MRC


Figure 5.5

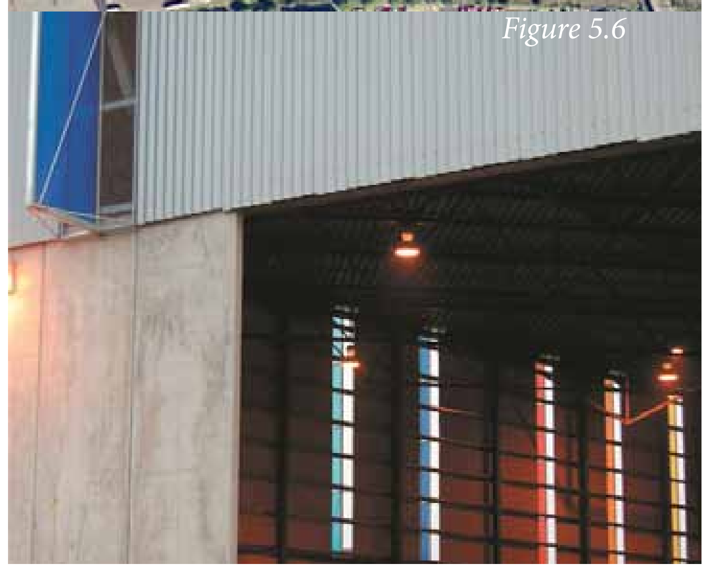


Figure 5.6

Passive Design

This project sports the largest green roof in Norway, which minimizes water runoff and temperature fluctuations. Additionally, the exterior colored louvers promote natural ventilation and natural light of the spaces, reducing the need of mechanical systems.

Construction Costs

This project was awarded with a 15 million euro construction cost during the competition. By capping the construction cost prior to design, an energy efficient, utilitarian, passive and beautiful solution was possible.

Conclusions

This competition awarded project offered a marvelously eloquent solution to the recycling conundrum we're presented with in today's society. Simplicity and efficiency are essential to design. This project intrigues me to consider designing with an anticipated cost cap. I believe this project solves many of the issues towards recycling. However, this reinforces my project emphasis: innovation of new design must more closely connect to the recycling process. Connecting a prototyping element to a recycling facility can offer the opportunity for innovation in the industry.

Case Study 4 - Hugo Auto

Project Details

Name:	Hugo Auto and Truck Parts
Location:	Hugo, MN, USA
Typology:	Automotive Salvage Yard
Timeline:	1980's to Present
Architects:	Various
Scale:	2700 square feet and 2000 square feet plus storage
Features:	Dismantling Facilities, Automotive Recycling Vernacular, Regionally Identical Climate, Automotive Recycling Design Strategies
Program:	Dismantling Facilities, Sales Facilities, Storage Facilities, Vehicle and Parts Storage, Existing Recycling Processes.

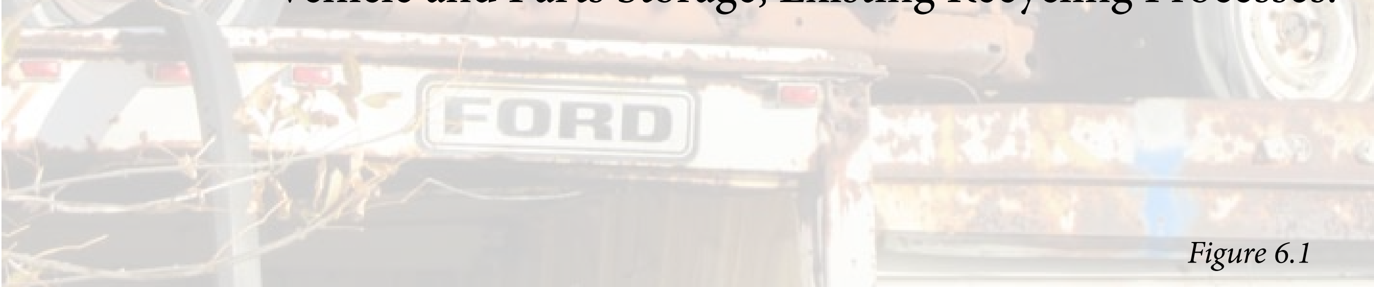


Figure 6.1

Figure 6.2

Case Study 4 - Hugo Auto

Key Concepts

This regional Automotive shop, sales and recycling business offered the opportunity to begin research into the regional automotive recycling industry. As a business, functionality and cost efficiency within the design are essential to it's success.

Functionality

Function is the primary driver of the structures and flow design of the spaces involved. An intimate knowledge of codes and industry regulations are essential to ensuring the safety and plausibility of designing for this function.

Figure 6.3

The Business of Automotive Recycling

This business revolves around cycling through products to profitably reuse the greatest quantity of inventory. This is the intermediate stage of the vehicle life cycle and reproposes as many valuable pieces as possible before recycling further.

Figure 6.4

Conclusion

Having toured the facilities and spoken with the business owners, I have started to gain an intimate knowledge of the region's automotive recycling processes. This has been vital toward choosing my site location, as my interviews revealed that most automotive scrap metal waste for the region gravitate toward the Mississippi River area in S. St. Paul. This is an unsurpassed opportunity that must be capitalized upon.

Typological Research

Case Study Series Analysis

I propose to explore and present a sustainable, cost effective architectural solution for the creation of an Automotive recycling and prototyping research facility in the harsh Minnesota environment. The purpose of this project is to facilitate research for automotive life cycle innovations and recycling strategies. To achieve this unparalleled architectural exploration, I have drawn typological research from a variety of sources and vernaculars.

I've chosen the Australian Automotive Centre of Excellence for inspiration toward programming. This project touches on high tech automotive prototyping facilities and their needs. It gives insight into the opportunities for circulatory and spatial investigations for the potential architectural programming. Lastly, this case connects metaphorical references toward machinery and design process.

I chose the New Martini Hospital project in Holland, to study architectural opportunities for life cycling building construction, adaptable programming, and deconstructivism. I was very interested to find how they provide solutions that consider the entirety of the building's existence. By creating a structure entirely from interchangeable, dismantlable prefabricated elements, it provides opportunities for reprogramable layouts. This offers a core architectural opportunity element to my recycling and reuse based premise.

Thirdly, I chose the Oslo Veolia Materials Recovery Facility. This case offers insight into large scale industrial recycling process and the possible architectural opportunities. I was very intrigued to find how passive systems and simple inexpensive materiality were crucial to this study's success. This case also provided design insight toward utilitarian designs.

Lastly, I chose the Automotive Dismantling and Recycling Facilities in Hugo, Minnesota. This allowed me to see an existing regional automotive recycling business. This has given me great insight into the local industry processes and begin understanding possible design considerations for an educational facility to revolutionize the industry. I have also been able to gain insight into local strategies for designing these facilities.

All of these projects are industrial, and sustainable projects implementing design solutions to rejuvenate undervalued sites within their communities. Individually, they focus on the educational programming, life cycle construction and industrial design combining into an excellent research pool for my proposal. Using these design philosophies, I have an opportunity to hone my theoretical premise toward facilitating automotive recycling innovations in an building.

Sustainably, I chose the Dutch and Norwegian facilities that mimic our Midwestern climates. This allows me to study passive build systems within similar climate context. Each of the European buildings implement many passive energy solutions. The Melbourne facility is also a Green 5 star facility (LEED Platinum Australian Equivalent) giving me opportunity to study modern active mechanical systems like geothermal and solar. However, being a warmer coastal climate, the sustainability strategies vary in comparison to the Midwest.

By focusing on industrial rejuvenating projects like these, I believe that I'm reinforcing my "design to recycle" theoretical premise. I intend on implementing several of the life cycle planning and design strategies that I've researched into my designs further reinforcing my premise.

Major Project Elements

Priority Spaces
Major Automotive Storage
Large Indoor Dismantling Space
Researching Spaces
Prototyping Spaces
Showroom Presentation Space
Workshops
Classrooms

Ulterior Spaces
Educational oversight area
Break rooms
Green seating areas

Functionality Spaces
Offices
Employee Workrooms
Conference Rooms
Parking
Maintenance
Mechanical Systems
Storage
Docking, Unloading


Figure 7.1

Conclusions
I hope to find a healthy balance between functional and priority spaces needed for this facility. I believe that by focusing on the long term users, and their spatial needs, a profitable and successful architectural proposal may be achieved.

Client/User Description

Short Term Users
Students
Potential Investors
Delivery staff
Consultants/ Advisors

Long Term Users/Clients
Owners/ Investors
Administrators
Engineers
Professors
Maintenance
Inventory trafficking

Users Design Focus

I am proposing the opportunity to design an educational and research building to facilitate automotive design for recycling. A wide variety of individuals and organizations will undoubtedly be involved with a facility aspiring to this. However, educational research is the primary goal of my thesis, so students, professors, engineers and researchers will be the primary design users. Associated with this requires seasonally busy and unused times along with a separation of users (as seen above). By designing for researching, I can hone the spatial programming to adhere their requirements.


Figure 7.2

Site Information

Location
1 Ridder Circle
St. Paul, MN 55107

Site Choice decisions

Minnesota Metropolitan Area
- Deteriorating automotive industry in need of revitalization
- Abundance of knowledgeable tradesmen and engineers
- Exceptionally harsh automotive conditions
- Capable of generating lots of "automotive waste"
- Opportunity for automotive design for recycling education

1 Ridder Circle, St. Paul, MN
- Beautiful northern view of Mississippi river and bluffs
- Repurposing currently industrial area
- Land parcel for sale
- Proximity to major regional automotive scrap waste recycling
- Proximity to downtown urban area and local transportations

Figure 8.1

Site Information

Figure 8.2

Figure 8.3

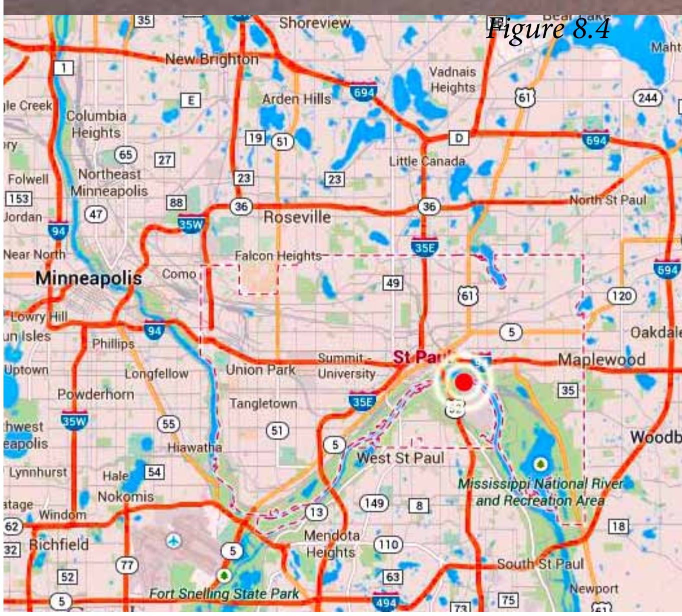


Figure 8.4

Figure 8.5

Project Emphasis

The core of my thesis gravitates around the idea reconnecting automotive design with automotive recycling. As vehicles progress toward becoming increasingly designed into plastics, the industry becomes disconnected from their recyclability. I wish to connect the recycling and prototyping processes within the automotive industry by facilitating automotive design for recycling.

Programmatically this demands a focus on understanding the industry basics and backgrounds. This will require thorough regional knowledge on the automotive design and recycling processes.

Architecturally this demands the equivalent recycling challenge. Emphasizing life cycle recyclability, architectural deconstruction and plan adaptability will be essential to my proposal. By prioritizing life cycle design strategies, I believe that my theoretical premise is essentially reinforced and primary to my proposal.

Emphasis on urban site reuse and analysis, regarding sustainable site design considerations, will also reinforce my premise. Lastly, my construction estimating background drives me to consider construction cost effectiveness as an economically sustainable thesis element which could be strongly reinforcing.

Research Priorities

Construction Life cycle Sustainability Automotive Recycling and Prototyping Industry Analysis
Adaptive Re-use and deconstructivism
Land Reuse and Repurposing
Urban Site Analysis
Construction Cost Effectiveness

Goals of the Thesis Project

Academic Goals

Masters of Architecture Degree - Finish the NDSU Architectural Masters degree program and graduate.

Present a Graduate Worthy Design Thesis Proposal - I hope to present a worthy and educational design thesis proposal, stimulating audience participation and inspiring interest in architectural design sustainability.

Develop a Sustainable Solution Facilitating Automotive Design toward Recycling - I hope to propose a building vernacular that is all to uncommon and architecturally ignored in society today. It is my goal to design a proposal which inspires further industrial, architectural and sustainable research and designing.

Develop a Constructible Design - Propose a design with sufficient construction details and information to support a constructible design. In addition to this, I hope to implement potential multi-phase design solutions, when scope of my thesis is pushed beyond its boundaries.

Explore and Research Architectural Deconstructivism - I hope to research and develop potential dissassemblable and deconstructable building systems.

Explore Economical Sustainable Designs - I hope to research and explore the possibility of designing not only a life cycle construction sustainable design, but also an economically sustainable one. This aspect is kept out of much of our education, but as a graduate student with a construction estimation background, I feel obligated to entertain the idea economic sustainability.

Goals of the Thesis Project

Professional Goals

Build Connections with Potential Employers - I hope through various professional interviews to start and build professional relationships leading to potential employment.

Graduate Education Experience - By accepting graduate courses and challenges, I hope to achieve high level educational experiences and knowledge. I wish to push my personal boundaries of research and design to capitalize upon my learning abilities, carrying throughout my design lifetime.

Personal Goals

Strive for Excellence - It is my personal duty throughout all efforts in my life to strive for nothing short of excellence. Putting complete heart and soul into all my efforts is the only opportunity to achieve personal excellence and satisfaction.

Learn to Learn - Upon being frustrated with a grade school assignment in my youth and claiming "school is stupid" I was taught my favorite fatherly advice. "School is not stupid. Learning is not stupid. Learning is a lifetime. School is not simply to learn math or science or English. School is to learn to learn, which takes a lifetime to understand." My graduate thesis is the next learning hurdle in my lifetime of education.

Plan for Proceeding

Definition of Research Direction

My goal is to facilitate automotive design for recycling. A better understanding of the automotive design and recycling systems will be essential to presenting design opportunities for this facilitation. I intend on researching the Automotive Design and Recycling industry processes to better grasp the design necessities and opportunities involved. I hope to achieve a better industry understanding by hands on interviewing of industry professionals.

Being a primarily educational research facility, focusing on research for this vernacular will be essential. By educating myself in the university research facility vernacular, I'm confident that automotive recycling design opportunities will emerge.

Historically, the car recycling industry has been a necessity driven field demanding acceptable solutions to growing industrial issues. It will be essential to research the regional automotive recycling processes.

Having some knowledge of this prior, my site choice has been driven by the industrial metal recycling facilities, essential to the process, are in proximity. Further research will be important for more options. Additionally, this is an opportunity for industrial site revitalization, land re-use and urban site analysis.

Lastly, programmatic research will be the lifeline of this project. By gaining insight into my project emphasis's, I hope to offer practical and beautiful design solutions. Emphasizing on adaptive reuse, deconstructivism and cost effectiveness will also be further researched for design opportunities.

Plan for Proceeding

Design Methodology

Design is a multi fold process with great variations in research and design implementation. Qualitative and quantitative processes will be essential toward the development of the thesis. I hope by interviewing professionals and industry experts, that potential design solutions will be arrived at. Traditional design iteration strategies including parti modeling and form making, computerized spatial development (Revit) and 3-D modeling will be bounced in between and analyzed upon. I hope to meet with my advisor and in small studio groups weekly for opportunity to bring further design opportunities and strategies.

Documentation of the Design Process

Strategically documenting my thesis research and design processes will be essential to an effective thesis. I will be conducting weekly research and programmatic design analysis to chronologically present my thesis process. I will be photographing, recording and analyzing (when applicable) all physical models and drawings during and upon completion. Saving and copying all digital models, renderings and walkthroughs will be essential to the final presentation. All thesis information, research and design solutions will be presented in the form of a digital thesis book. The final presentation will condense, analyze and present the strongest research and design solutions to represent the core of the thesis premise for the audience. Lastly the board presentation will represent the strongest design graphics and concepts for broad viewership toward any onlookers.

Plan for Proceeding

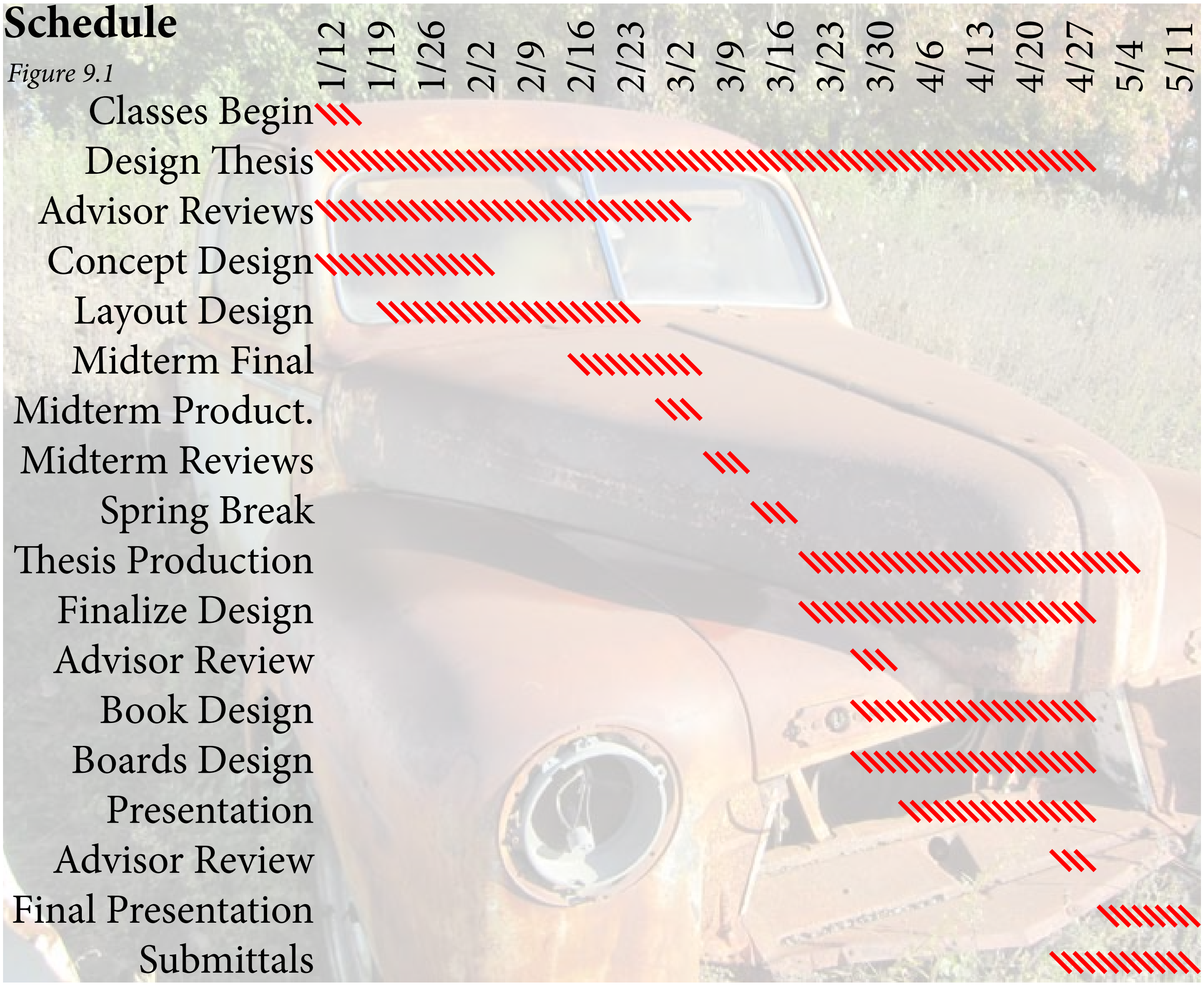
Work Plan

Fall: Primary and Secondary Research (recorded at weekly intervals) establishing the thesis premise argument will allow for reinforcing design programming. Analysis of research and formation of the thesis premise foundation will be essential to driving the spring's design opportunities.

Spring: Establishment and formation of spatial and conceptual form. Development of and refinement of building form. Analysis of potential design strategies. Final production of proposal.

Schedule

Figure 9.1



Chapter 2 - Programming

Theory Research Analysis Introduction

"We recycle everything from newspapers to automobiles, and yet we continue to pile obsolete building materials into landfills. Recent national and grass-roots initiatives open the door for reuse to have a greater role in sustainable design," WB Yeats (Volner, 2012). I propose to explore and present a life-cycle sustainable, architectural solution for the creation of an Automotive recycling and prototyping research facility. My goal is to facilitate automotive design for recycling. This typology demands an intimate belief that waste is detrimental to all future industry. Everything from automobiles to architecture must find ways to encourage the deterioration of waste. "The automobile is the most recycled consumer product in the world — 95 percent of all vehicles are reclaimed. The rate far exceeds the numbers for recycling giants such as newspaper (74 percent), aluminum cans (51 percent) and glass (22 percent). Still, as much as 25 percent of each car ends up in landfills." (Hewitt, 2007). "The fact that the U.S. demolition industry takes down 200,000 buildings every year explains why activities related to the built environment generate 30 to 40 percent of all waste" (Knecht, 2004). From cars to buildings, headlights to HVAC, or motors to building materials, recycling is essential to all future industry. I hope to semantically, economically, and ecologically persuade the importance of architectural solutions for the creation "recyclable design".

Semantically

It is necessary to establish a common understanding of recycling terminology for any recycling persuasion. "Although various research efforts on the recovery of buildings, components and their material have been undertaken, there is still no common understanding of terms such as 'recycling', 'recovery', and 'reuse' in construction" (Shultmann, 2007). I consider "recycling" to be the system of which to dispose, without disregarding. In a world where the easiest and often cheapest option to dispose of anything is a landfill, it is truly remarkable to experience society striving to value the invaluable with the creation of the "recycling system." We must focus on more descriptive terms with specific uses if any understanding of recycling is to be made. Repairing, Refurbishing, Remanufacturing and Cannibalization of material products each outline a crucial step in the recycling process (Shultmann, 2007).

Repairing is to return used products to working order by fixing and/or replacing broken parts, whereas the quality is usually less than the quality of new products.

Refurbishing raises the quality of used products up to a specified level by disassembling the products into modules, inspecting them and, if necessary, replacing them and reassembling inspected modules into refurbished products.

Remanufacturing is to bring used products up to specified quality standards which are as rigorous as those for new products.

Cannibalization is the used products are selectively disassembled and potentially reusable parts are inspected and used in the repair, refurbishing, and remanufacturing of other products and components (Shultmann, 2007).

Understanding basic recycling process is key to establishing a recycling research facility typology such as mine. Each process possess a unique and timely position in the recycling system of closing product waste loops.

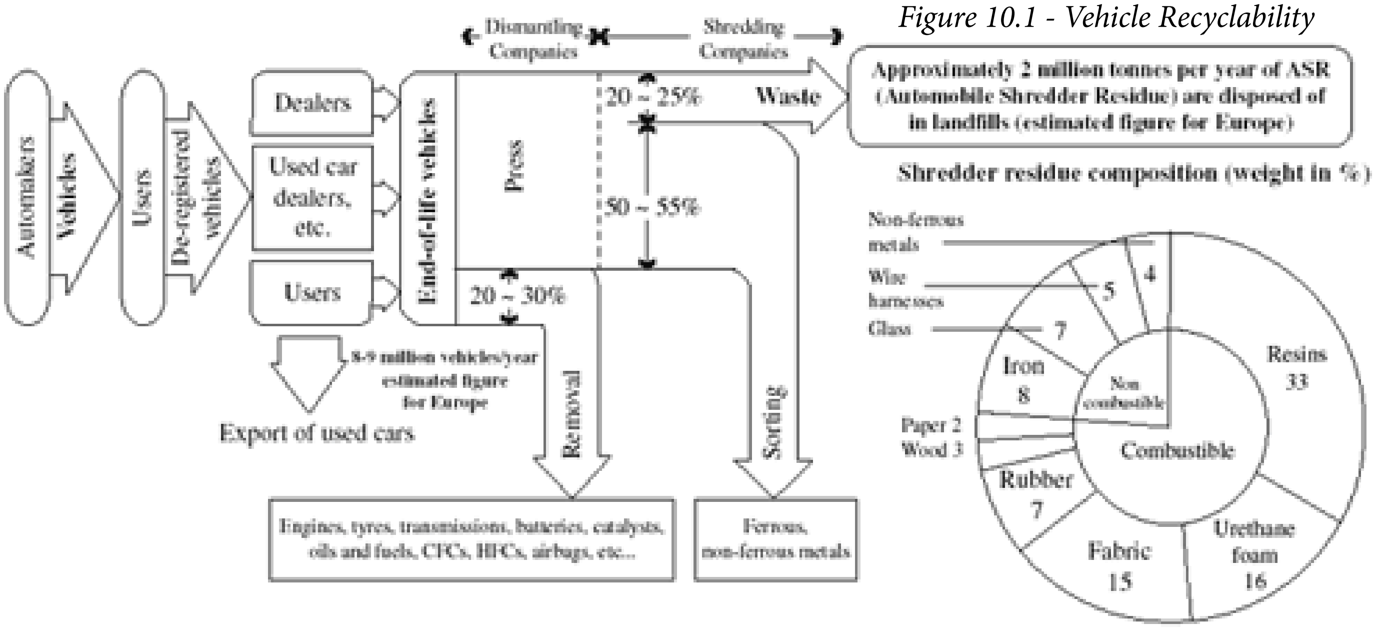
Economic Sustainability

One of the largest issues today is the economic viability of recycling processes. "The need for PRM (product recovery management) is triggered, for instance, by the increasing awareness and interest of the public in the environment and conscious governmental policy decisions on industrial and economic activities" (Shultmann, 2007). Long story short, recycling doesn't just happen for the sake of happening. Like all economic perspectives, recycling (of cars or structures) has a large and complex system of events which determine economic viability.

The Victorian Model: Design over the course of human history is a widely diversified and experimental creation of reputable process models. Within design, this takes the strongest form in the understanding of the Victorian (traditional) design model. A designer draws something. A manufacturer builds it. A team assembles it. A salesman sells it. The owner buys it. Business, by and large, up until the recent twenty years, considered this to be the end of the cycle. In reality, the owner uses it. The owner sells it. A broker asses its value. Its then resold or recycled. Eventually it is cannibalized or disregarded. This is a basic economic model encapsulating the exchange of materials and services profitable in every step. To close and effectively loop this foundational system it is vital to reconnect the design and dissemblance steps for life-cycle sustainable economics. Due to the huge economic success of the construction and automotive industries throughout the past century, huge waste is generated, and must be reconciled. With the uprising of easily accessible integrated design modeling software, and rapid prototyping processes, we're given the opportunity to revamp this traditional model into a cyclical process.

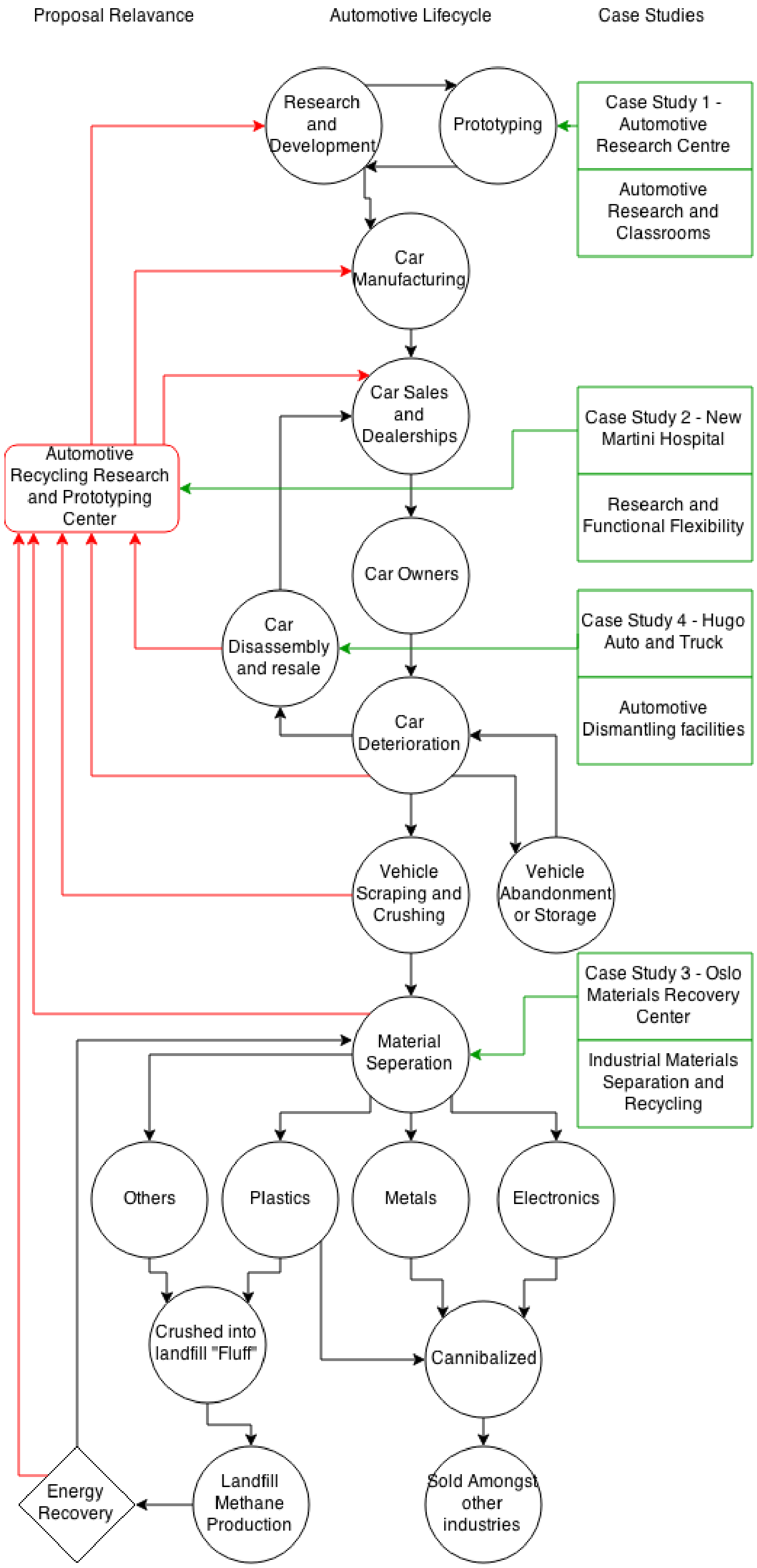
Automotive Recycling: Functionally, automobiles around the world are vastly reused and run through rigorous recycling processes before being disregarded into waste. They are recycled by all the means and processes mentioned above. "Fed by annual new car sales that hover around 17 million, the U.S. automotive recycling industry reclaims some 750 million pounds of scrap each and every month" (Hewitt, 2007). However there is a great concern within the industry that as automobiles become increasingly complex and specialized by economic forces, they become more difficult to reutilize. Essentially, the more they use and integrate infinite plastic materials into vehicles, the greater difficultly it is to recycle. "Pound for pound, aluminum, brass, copper and zinc are the most valuable stuff in a car" (Hewitt, 2007). "That's largely because landfill space is still relatively cheap and the technologies to recover nonferrous material are still expensive. That may change, thanks to pricing pressures on both real estate and resources"

Figure 10.1 - Vehicle Recyclability



Theory Research Analysis

Figure 10.2 - Vehicle Life-Cycle



(Hewitt, 2007). Current automotive recycling systems economically favor the cannibalization of ferrous materials (metals, especially copper, steel and aluminum) because of their efficient reusable properties (they're easy to melt down to their original properties and resell). "A high-tech flotation process sorts out the 'twitch' (aluminum) from the rest of the debris, which is exported to cheap labor markets such as India and China for hand sorting" (Hewitt, 2007). So as our cars change into plastics, we're struggling to find effective solutions for recycling. Most of an automotive's plastics, foams and vinyls are destined to be minced up and layered as "fluff" sealing methane into the landfills for energy consumption. Because, you guessed it, fluff doesn't really decompose in a timely manner (if at all). Though preaching sustainability and economic incentives, automobile designers continue to manufacture with disregardable materials. It's long overdue for a facility dedicated to the research and experimentation with closing these automotive recycling process loops.

Architectural Recycling: When designing a building for the promotion of automotive recycling design, it would be a hypocritical bastardization to ignore our industry's waste management problems. Ironically, the building, construction and architecture industry takes these above for mentioned issues and brings them to entirely new levels of disregard. "The fact that the U.S. demolition industry takes down 200,000 buildings every year explains why activities related to the built environment generate 30 to 40 percent of all waste" (Knecht, 2004). Aligning with the automotive industry, cannibalization of the ferrous construction materials are generally considered to be the only economically viable materials to reuse. Metals, mechanical equipment and even glass windows gain the greatest value for recycling, but that leaves huge portions of construction waste left to live in landfills (then covered by shredded automotive plastics for methane production). "There is a lot conspiring against it. Building components are difficult to separate without damaging them; salvaged materials have low value; buildings are rife with hazardous materials; and equipment, transportation, and disassembly time and labor are costly" (Knecht, 2004). Similar to the automotive industry, disassembling buildings carries huge energy, labor intensive and costly processes making recycling with current technologies not very in investable. "Ultimately what designers need to consider is the carbon impact per dollar invested as a way to be able to see the most promising strategies for a particular building and find overall optimal solution," David Marr, principle at

Tipping Mar Architecture (Cockram, 2012). It requires a huge financial burden to dismantle buildings. "The 2004 Northeastern University study "An Analysis of Cost and Duration for Deconstruction of Residential Buildings in Massachusetts," noted by the blog Real Life LEED, found that deconstruction can cost between 17 and 25 percent more than the demo-and-dump model" (Volner, 2012). Despite the hefty up front costs I propose to use deconstruction strategies to give opportunity for financial success throughout the multi-functional life-cycle of the building.

Ecological Sustainability

"Often the building is designed as a throw away--like a car crash that you walk away from, but the car is totaled," David Mar (Cockram, 2012). This pretty much sums it up. Mr. Mar is referring to the structural resilience (or lack there of) in many of the west coast constructions which ignore seismic structural design practices. "It would be inconsistent with the larger green goals to not make a resilient structure," David Mar (Cockram, 2012). Whether you're talking about automobiles or architecture, it is increasingly vital to understand the life-cycle of a design. This is a belief that the source of a "sustainable building" lies much deeper than energy recovery and governmental incentives. "A 2008

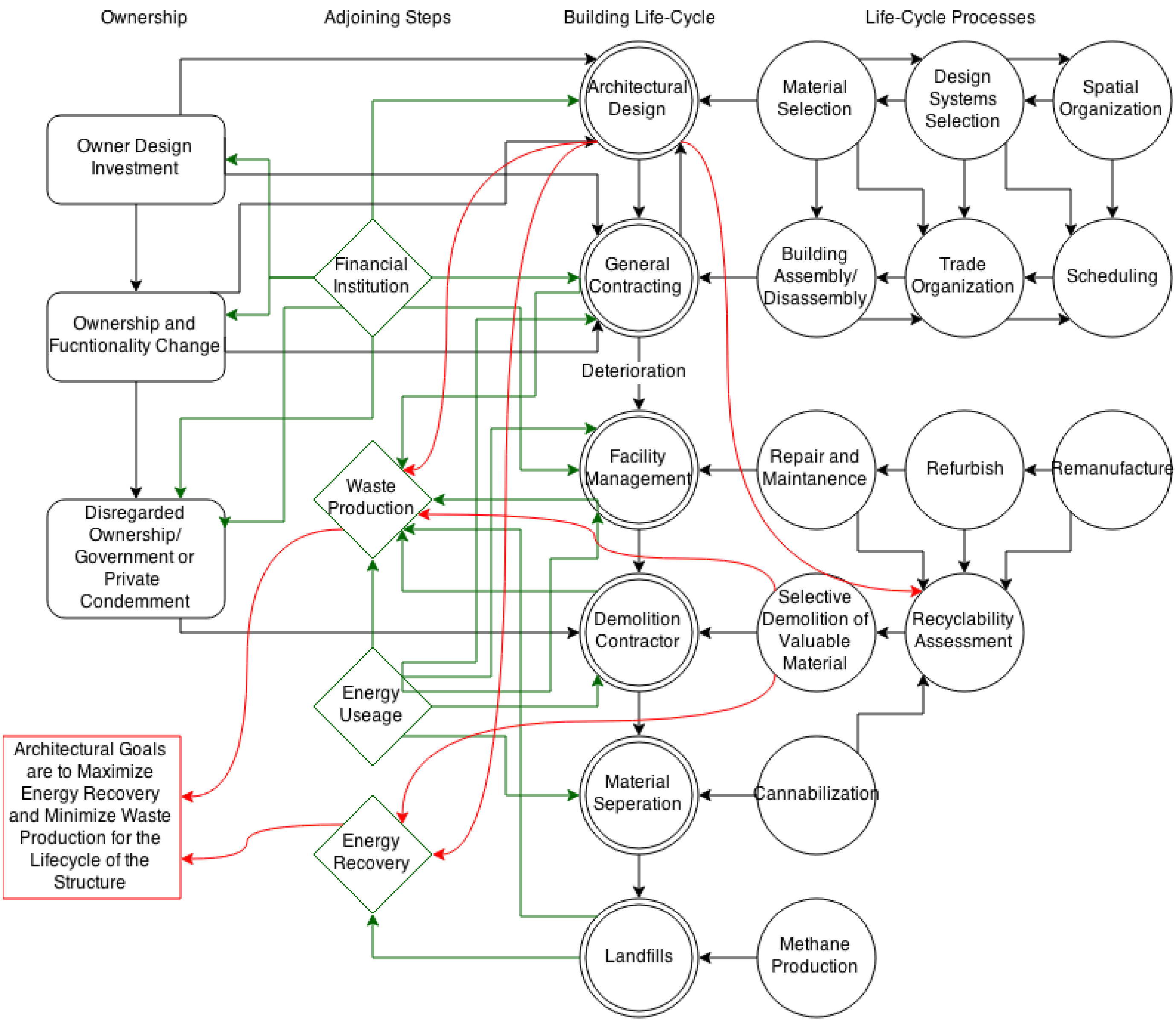
Figure 10.3 - Landfill Rates

Table I. ASR Landfill Costs in Different Countries

Country	Cost ($/t)
E.U. countries	
Austria	140
Belgium	55
Denmark	70–110
France	40–60
Germany	60–170
Italy	75–80
Netherlands	70–90
Spain	20–60
Sweden	90–100
United Kingdom	30–35
Eastern European countries	
Poland	25–30
Czech Republic	30
Non-E.U. countries	
Australia	20
Japan	135–160
Norway	50
United States	50–60
South Africa	25–40
Switzerland	120

report by the Boston-based Tellus Institute suggests that, in concert with other efficiencies in the waste stream, a 75 percent diversion rate (of building material waste) could result in the carbon equivalent of taking 50 million cars off the road" (Volner, 2012). This thesis will be designed with the intent of life-cycle planning, functional variability, multi-phase design and deconstructable/ modifiable components for the success of its ecological sustainability.

Figure 10.4 - Building Life-Cycle



Theory Research Analysis

Life Cycle Planning: “Though we live in the era of the 50-year building, the U.S. General Services Administration requires its facilities to be built for a 100-year lifespan” (Cockram, 2012). Considering the length, usage and life-cycle is vital for ensuring economic and ecological sustainability. Conceptual design of the building is the best opportunity for life-cycle design considerations to be implemented. “The design phase is the most comprehensively addressed portion of the life cycle in most sustainable building guidelines and evaluation methods” (Bunz, Henze, Tiller, 2006). “Extending a building’s life can save much of its embodied energy and eliminate the enormous amount of energy and resources spent in replacing it” (Cockram, 2012). A huge amount of energy production, consumption, labor burden, and ecological deterioration occurs during a building’s life. Massive quantities of waste are generated amongst every stage of the building’s life. Design phase decisions must be made to give opportunity to ultimately minimize the human footprint left from buildings. This directly links to the finite goals of a sustainable society. Considerations for life-cycle planning take a holistic approach to making educated guesses as to the future of the building. I propose to outline a master plan for potential options for the buildings creation, expansion and eventual deconstruction.

Functional Variability: “The counterpoint to extreme structural efficiency is that sustainable buildings should be built for longevity by making them durable and adaptable to future uses” (Cockram, 2012). Non-housing buildings are rarely single functional occupancies, so they are renovated, altered and deteriorated through countless phases. By segregating the various systems of design which comprise buildings, it is possible for easier deconstruction and renovation adaptability throughout its life. This adaptability is key to maintaining the structure’s functional value across its variety of ownerships and functions. “Instead of hiding small shear walls within partition walls, Mar advocates the use of a few strong frames such as steel or concrete rocking frames. 'The goal is to make buildings more flexible for future incarnations,' he says" (Cockram, 2012). This line of thinking brings a higher level of design sustainability thinking past initial investors mind-set. I propose to develop and adaptable system of spaces to promote the functional versatility of my structure.

Multi-phase design: To go about this same philosophy in an adjoining way, many institutions and planning commissions implement staged planning phases. Basically, the initial investments are not great enough to integrate all functions of the desired plan. Instead they design a business growth model which allocates the timely manner in which to inspire additions and expansions within the master phased

Figure 10.5 - Building Recyclability

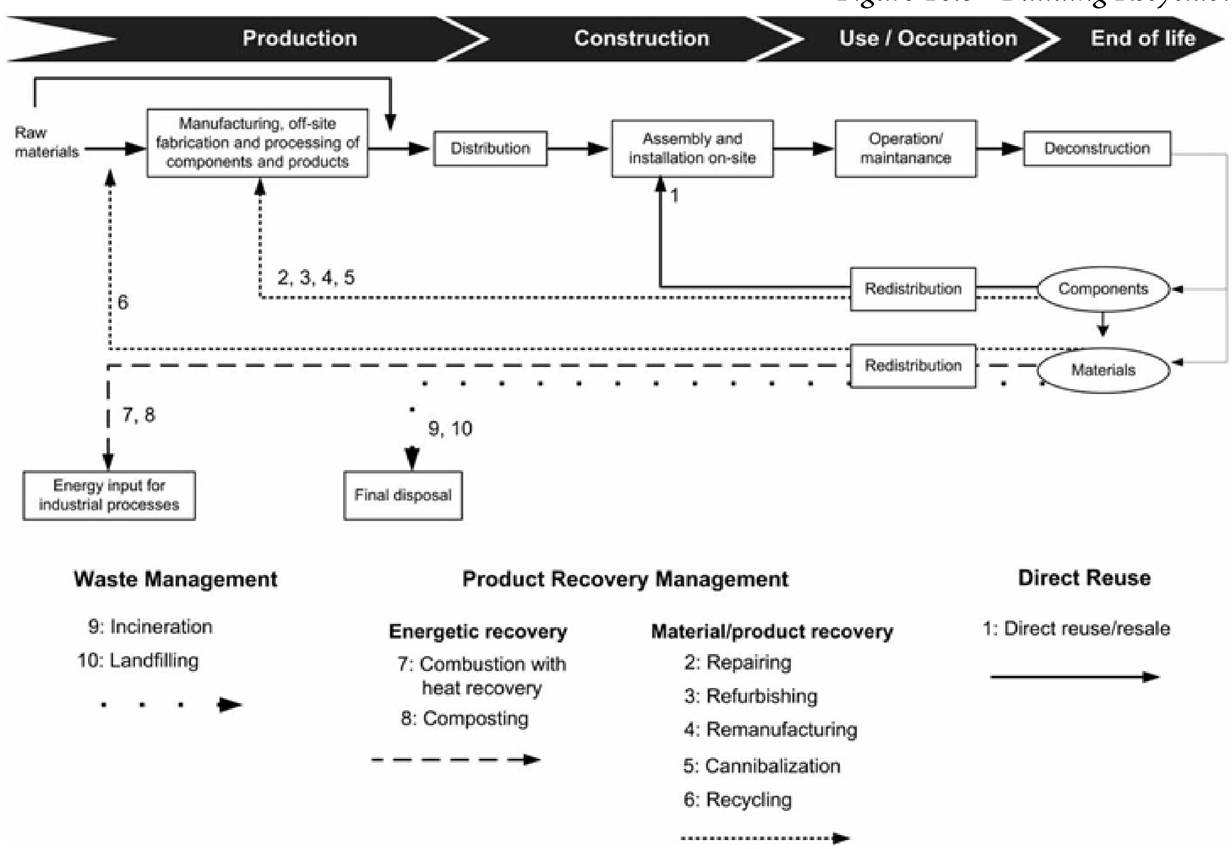


Figure 1 Recovery strategies in the building construction sector

plan. A good example of this is the Kangan Institute's staged planning facilities. They're currently on phase two of four, and as the success of their business continues they'll continue to commission unique phased buildings. This process carries the benefit of scheduling ecologically sustainable alternatives throughout business's economic life-cycle. The site begins to be considered for "future expansions" and growth area. It is also possible to develop ecologically beneficial intermittent phases for the master plan. By designating expansions in conceptual design, you're able clear and stage your site intervention. By integrating these strategies with individual building deconstruction strategies, the campus functionally has the capability of utilizing building systems in between individual structures. As one buildings value depreciates a replacement can conceivably be made of its deconstructable components.

Deconstructability: "The highest amount of construction and demolition (C&D) waste over the life cycle of the building occurs during deconstruction, so this needs to be discussed and included within the parameters of sustainability" (Shultmann, 2007). Waste is a huge issue in our society today. "The reduction of waste through the establishment of closed-loop material flows has an important role in creating a more sustainable built environment. Especially in deconstruction projects, participants could take advantage of the application of waste management and recovery strategies while adhering to the principle of 'sustainable quality construction'. (Shultmann, 2007). This waste reduction must be a crucial design factor for the creation of this thesis. "According to Charles Kibert, founder and director of the Powell Center for Construction and the Environment at the University of Florida in Gainesville, 'We are starting to do a good job of diverting construction waste, but we are not yet very good at preventing waste in the first place'" (Knecht, 2004). By implementing "Design for Deconstruction" strategies I believe that we can begin to drastically prevent mass quantities of building waste.

Architectural Strategies

We've been excellent at creating, utilizing, demolishing and reutilizing products in our buildings in the grand scheme of history. Our civilization's buildings either still exist and are maintained to do so, or have crumbled back into the earth from which they came with minimal environmental hazards. However with the rapid popularity of synthetics, plastics, and composite (currently minimally recyclable) building materials, we have run into a designers ethical fork in the road. Do we continue to use these materials ignorantly expecting the problem to rectify itself (like say asbestos or lead), or do we reconcile to designing with currently recyclable materials?

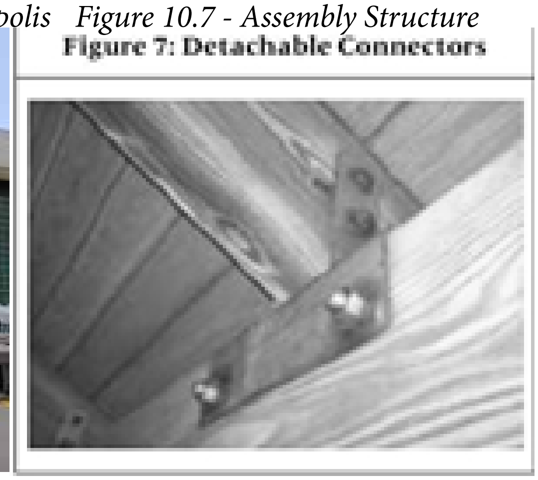
Materiality Simplicity: "Not just the uncertainty of composition but also the complexity of the final product and the variety of materials (e.g. metals, ceramics, concrete, masonry, bricks, timer, natural stone, plastics) and components (e.g. heating systems, piping) add to the enormous planning effort in recovery or recycling planning in deconstruction projects and hamper a proper recovery" (Shultmann, 2007). Working in the general contracting industry over the past few has taught me handful of things. Most importantly, if nothing else, buildings comprise a very complex layering of materials and systems. This is obvious by the most basic general contracting tool of CSI Master-formatted divisions. In modern construction estimating there are no less than 34 construction work divisions each with multiple subdivisions. Each represents a specific system of construction, and can combine to infinite project designs. Minimizing permanent connections and designing with modular connection systems, deconstruction much less costly. "(...) Avoiding glued and composite systems and by using assemblies of resources that can be retrieved and reused at the highest value (Knecht, 20004). Essentially, by limiting the variety of materials, trades, systems and process to their basic interchangeable pieces, makes the value of deconstruction increase. Minimizing materiality will be crucial to the design of this project.

Shearing layers: As demonstrated by architects layering papers, and documents, it is obvious that buildings encapsulate a series of layered systems. Physically separating (rather than integrating) these layers is a great asset to the deconstruction and recycling of a building. "Promote the idea of shearing layers, in which building elements are replaced at different rates of time. Layers such as interior finishes and "stuff" (furniture, equipment, etc.) are replaced relatively frequently, whereas the structure has a longer lifespan," Stewert Brand (Cockram, 2012). Most layers of projects are designed at the same time, in hopes of creating a seamless architectural composition. Over the life of building, and countless iterations of ownership and functionally, additional layers are integrated into the building. This makes a huge mess when it comes to the ultimate demolition of a structure. By "shearing" or separating layers and giving them large spatial separations, functional renovations and deconstructions promote waste reduction. By minimizing

Figure 10.5 - Deconstruction

Figure 10.6 - VA Hospital, Minneapolis

Figure 10.7 - Assembly Structure



welded and “permanent” connections, and utilizing bolted inherently dissassemblable connections encourages building deconstruction.

The “Anti-Deconstructable” Facility Example: The best example of this I can conjure is the VA Hospital in Minneapolis, MN. Built in the 1950’s for veterans medical care, this is the second largest structure (behind MOA) in Minnesota. The basic structure of the building is a 30ft floor to floor ratio, with a reinforced concrete superstructure. There is a 10ft “interstitial space” underneath each floor’s concrete structural system for the implementation of the mechanical systems dictating the facility’s various functions. In conception this is a good idea offering separation from inhabitable spaces to mechanical ones. However after 60 years of renovations, “regime changes” and alterations these interstitial spaces are essentially unalterable and permanent. They are clogged with generations of functioning and nonfunctional ducts, electrical conduits and waste (maybe not the landfill kind, but waste of time, energy, space and functional opportunity). This building was of course designed as a permanent structure and will probably never be unmade. But the lack of planning of expansion and structural alterations, combined with heavily integrated building systems makes future expansions excruciatingly costly and labor intensive. Working at and with the facility managers of this hospital, I’ve come to realize that expanding outward from their single building is the only option for hospital growth. Which we’re running into now. By integrating less finite and constricting materials and building systems, longevity is insured not by construction practices but continuing functional value.

Theory Research Summary

Waste is around us in many ways. Waste of materials, waste of energy, waste of potential, waste of money, waste of time and (most importantly as a designer) waste of space. We live in a wasteful society, have for some time and will continue for some lengthy time further. But we're catching on and making efforts to rectifying our wasteful ways. I've chosen to exemplify two means of major waste rectification: automotive recycling waste and architectural life-cycle waste. The reasons for my waste conscious agenda are expanded upon in the historical context portion of this document. Simply enough we live in a growing sustainable conscious society, and as an architect I find this opportunity explore waste reduction strategies in our industry as a privilege. By exploring waste reduction strategies within the automotive and architectural industries, I believe I'll be able to propose a sustainable architectural solution.

Automotive Waste: Automobiles are heavily recycled and reutilized throughout their lives. However as we transition into inexpensive automotive material products like vinyls, plastics and foams, we drastically increase the quantity of waste in the automotive stream. These materials are difficult to separate, difficult to reuse, difficult to resell and difficult to recycle. They promote a large quantity of waste in every step of the process and wind up in landfills. The current automotive design industry has only begun tap this understanding, making it plausible for creation of a facility dedicated to closing these automotive waste streams. Why can't cars be 100% recycled and revalued? How could a facility promote the research and development of this? Who would utilize such a facility as this and how would it function? Most importantly, wouldn't it be hypocritical to ignore the construction industry's waste when designing a facility addressing automotive waste problems?

Theory Research Summary

Architectural Waste: "Whether they're putting something up or taking something down, architects are indirectly making a mess" (Volner, 2012). "Construction waste constitutes almost a third of the entire waste stream in the United States. The EPA estimates that 92 percent of construction waste comes from demolitions and renovations" (Cockram, 2012). "Research about sustainability in construction has mainly focused on design and construction phases, the sustainability of buildings materials and their recovery. However, sustainability criteria are not limited to the design of a building and selection of its components and materials" (Shultmann, 2007). The building industry is a messy hyper conservative economic driven one. Architects, being the liberal parallel to contracting, must find ways to efficiently push the green agenda within all future buildings. If minimizing construction waste is left up to the construction industries, it will not happen. Not, it might not happen, or it will take longer… it will not happen. It lies with architects, designers, engineers and innovators in the industry to prioritize and incentivize sustainability. To do this we must implement strategic and affordable processes to promote ecological and economic sustainability.

All industries have a precedence to increase efficiency and minimize waste. I've chosen to express this between architecture and automobiles. It is my belief that to truly inspire automotive recycling innovation, architectural recycling innovations must encapsulate the facilities. Architectural decisions like material selections, limitations, phasing and deconstruction are all crucial to persuading the "client" to invest in the recyclable green agenda being proposed. Architects may make quite a mess in the societal scheme of things, but we also provide a glimmer of directional hope to any sustainable future we may build.

Project Justification

Waste burdens our society across all physical, political and economic borders. Whether it be abandoned cars riddling this country's countryside or the crippling physical infrastructures of the third world, it is our duty to repair the value of waste. As a designer questioning the rationality of the automobile industry's waste problems, it would be hypocritical to ignore architecture's own waste problems. I believe that to begin considering how to "facilitate automotive design for recycling" bringing architectural recycling processes to the forefront of this thesis project will be essential. By focusing on life-cycle processes I believe that I'll be able to draw design parallels between automotive and architectural recycling concepts. This is my justification for designing for deconstruction.

There are many systems and strategies focused on this deconstruction of products and buildings. Life-cycle planning strategies, material efficiency, construction/deconstruction processes, along with phased design strategies are my main focuses.

I hope to apply these concepts throughout the design process and highlight them upon the final installation and presentation. Building Information Modeling (BIM) and other digital modeling offers the opportunity to demonstrate my understanding and exploration into construction, life-cycle and deconstruction strategies. Physical modeling allows practical application to demonstrate materiality and assemblages carried through the design. Developing deconstruction plans in combination with proposal documentation of my design gives the conceptual intent of the buildings end of life plan. I intend to develop a minimal material model (Metals and wood) with only non-permanent (bolted) connections to highlight this. Finally, to cohesively knit these ideas together I will be performing a presentation among peers and professors to drive my recycling biased conversion.

Thesis Context

"With talks on climate change gaining more significance every minute, we have reached a point when sustainability is unavoidable, whichever field it may be" (Sasidharan, N. a., & Chani, P. p., 2011). Waste is a huge problem within all industries. However the building and vehicle industries bring this to new heights. This issue has had huge upheaval within today's society, catalyzing especially within growing "sustainability" concerns. I am proposing to develop an architectural exploration of an automotive recycling and prototyping center focused on facilitating automotive design for recycling. This thesis bears its contextual roots within program incentivization and architectural deconstruction precedence.

Incentive Programs

Cash for Clunkers and End of Life Vehicles Directive: Automobiles face the same sustainability burden that the building industry does. In recent memory two major governmental incentives programs have shifted the public's opinion of recycling automobiles. First was the European Union's End of Life Vehicle Directive (ELVD). Established in 1997 this directive tasked corporate incentives for researching, developing and promoting the recycling of automobiles. Over a decade of alterations in legislation lead to the International Dismantling Information System which has been adopted for recycling cars world-wide. The US was late to the party but in 2009 developed our own automotive recycling incentivization program. The Car Allowance Rebate System (C.A.R.S aka cash for clunkers) incentivized the public to "exchange" their low mileage vehicles for there more environmentally conscious counterparts. "Currently in 2014 the Cash for Clunkers (CARS) federal funding has been depleted however there are many local private buyers that have stepped in and will provide cash

Figure 11.1

Figure 11.2

for clunkers, junk cars, scrap cars and gas guzzlers from all years" (Cashforclunker.org, 2014). Lasting an entire summer before it was governmentally abandoned, this program did two crucial things that remain with us today. It stimulated automotive production for the struggling manufacturing and maintenance industries; and drastically decreased automotive recycling efficiency. It was good for immediate economic stimulus, but incentivized the destruction of otherwise value retaining vehicles in the middle of their life-cycles. This lead to a huge kink in the automotive recycling process. Which after overstimulating the cannibalization industries, forced excess "automotive waste" into landfills. Not to worry though, only .06% of this country's "clunkers" were removed from the roads reducing carbon waste by a statistically insignificant amount.

World green collaboration: When tackling environmental building concerns we must begin with the worldly interpretation of understanding "sustainability." Within my lifetime, this story begins at the 1992 UN earth summit. "The 1992 United Nations Earth Summit was intended to bring sustainability to the forefront in policy formulation. More than 100 nations participated, with the exception of the United States" (Bunz, Heinze, Tiller, 2006). It is here that the modern 12 ideologies took precedent in the world's understanding of sustainability and its importance. "These 12 recommendations constitute the foundation for many international sustainable design guidelines and recommendations, and collectively they cover many aspects of the life cycle of a building project" (Bunz, Heinze, Tiller, 2006).

1. The use of local materials and indigenous building sources;
2. Incentives to promote the continuation of traditional techniques, with regional resources and self-help strategies;
3. Recognition of the toll that natural disasters take on developing countries, due to unregulated construction and use of inadequate materials and the need for improvements both in use and manufacture of materials and in construction techniques, as well as training programs;
4. Regulation of energy-efficient design principles;
5. Standards to discourage construction in ecologically inappropriate areas;
6. The use of labor-intensive rather than energy-intensive construction techniques;
7. The restructuring of credit institutions to allow the poor to buy building materials and services;
8. International information exchange among architects and contractors, on all aspects of construction related to the environment, particularly about nonrenewable resources;
9. Exploration of methods to encourage and facilitate the recycling and reuse of building materials, especially those requiring intensive energy consumption in their manufacture;
10. Financial penalties to discourage the use of materials that damage the environment;

	North America		Europe			Asia		
Phase	United States	Canada	United Kingdom	Germany	Netherlands	Japan	Hong Kong	Korea
Programming phase	LEED ASHRAE GreenGuide	C-2000 IDP and CBIP GBTool	BREEAM	Guideline for sustainable building		CASBEE	HK-BEAM	
Design phase	LEED ASHRAE GreenGuide	C-2000 IDP and CBIP GBTool	BREEAM	Guideline for sustainable building	GreenCalc	CASBEE	HK-BEAM	GBRS
Building construction	LEED ASHRAE GreenGuide	C-2000 IDP and CBIP GBTool	BREEAM	Guideline for sustainable building			HK-BEAM	GBRS
Building operation	LEED ASHRAE GreenGuide	C-2000 IDP and CBIP GBTool	BREEAM	Guideline for sustainable building		CASBEE	HK-BEAM	GBRS
Building demolition		C-2000 IDP and CBIP GBTool		Guideline for sustainable building				

Figure 11.3 - World LEED Programs

11. Decentralization of the construction industry, through the encouragement of smaller firms; and
12. The use of "clean technologies." (Bunz, Heinze, Tiller, 2006).

These 12 pillars have formed the foundation for most international governmental policy relating to sustainability. Only until recent years however have we begun to consider life-cycle design as an equally important pillar to add to this. "Building life cycle forms the framework for our comparison of sustainable design guidelines and practices" (Shultmann, 2007). Despite international concerns, the popularization of life-cycle planning is slow going. The only two countries incentivizing building deconstruction within their sustainability policies (LEED equivalents) are Germany and Canada. "In Germany, for instance, around 86% (161.764 million tonnes) of all accumulating C&D (construction and demolition) waste (187.478 million tonnes) was being recovered, with 0.5% in combustion (0.884 million tonnes) with heat recovery and 99.5% in product/material recovery (160.880 million tonnes) in 2004. The remaining 25.714 million tonnes of C&D waste were either land-filled (98.8%) or incinerated (0.2%), only a small amount of C&D waste was treated for disposal (Federal Statistical Office Germany, 2006)" (Shultmann, 2007). How again is the US

"LEEDing" us into sustainable paradise if we're not even leading the research? Leadership in Environmentally Efficient Design would be more accurate as LEEDOR (leadership in environmentally efficient design – outsourcing research). "In Europe, forces encourage separation of materials and reuse. The land is scarcer, the value of materials higher, the availability of raw materials more restricted, and the regulations tighter. In the Netherlands, there is no such thing as demolition debris; it all has to be reused, and they have a robust 'down-cycling' market for materials to be reused in lower value applications" (Knecht, 2004).

LEED Green Incentives: "LEED recognizes and encourages strategies that consider materials and resources from a long-term, life-cycle perspective," says USGBC spokesperson Ashley Katz. (Volner, 2012). Despite being late to the life-cycle design innovation party, LEED and the US are making crucial steps toward incentivizing deconstructable buildings. "Now that LEED and the building sector are considering the life cycle of buildings and materials, it's perhaps time to look at the end-of-life scenario more closely" (Cockram, 2012). "In the last decade, new incentives have emerged to divert more types of materials from demolition into the reuse-and-recycling market. Existing landfills have reached capacity, and new ones are hard to locate and permit. Tipping fees have risen, especially for hazardous materials, and the LEED scoring system encourages waste diversion. (Knecht, 2004). Waste diversion has begun to been rectified within construction, but deconstruction is the next step LEED needs to make for promoting a truly sustainable building. "The LEED system, which has proved to be a huge catalyst for diversion of waste materials during construction, has been in place considerably less than a decade, but we have hardly begun to address the companion movement — Design for Deconstruction or Disassembly (used interchangeably) — that integrates waste prevention into the design process. Together they approach the problem from material and design decisions," Charles Kilbert (Knecht, 2004). "With LEED criteria changing every few years, and designers increasingly looking to go "beyond LEED" with programs such as the Living Building Challenge's Net Zero Energy Building Certification, a best-practices standard for environmental construction remains in contention. (Volner, 2012)

EPA Incentives: "The Environmental Protection Agency (EPA) has also launched a number of programs to encourage the building industry to look more closely at sourcing and disposal. Its Life-cycle Building Challenge, for example, invites architects to 'design for disassembly' and compete in creating structures that not only deploy reused or recycled materials, but are themselves primed for recycling when the buildings are eventually scrapped. The EPA's Construction Initiative encourages builders to look outside the typical sourcing channels to find recycled industrial materials" (Volner, 2012). Though LEED is a privatized incentive program through the USGBC (corporation), the EPA is not. "The Life-cycle Building Challenge (2009) invites professionals and students to submit their ideas for buildings and products that are created for adaptation, disassembly, or dismantling for recovery. This national Web-based competition is sponsored by EPA, the American Institute of Architects, West Coast Green, the Collaborative for High Performance Schools, and StopWaste.Org" (EPA.gov, 2014). Programs like this may have just been stimulus ideas to distract from the height of the economic downturn in 2008 and 2009, but they were well responded to on every academic and professional level.

This has brought us to the ethical fork in the road I mentioned earlier. From a design perspective it asks the simple question of: Is LEED good enough? LEED has only begun to tap the idea of life-cycle and deconstruction design. Why? "Between the years 2000 and 2030, an estimated 27 percent of existing buildings will be replaced, and 50 percent of the total building stock will be constructed" (EPA.gov, 2014). This is not a problem that is new. Why did take so long for us to come back to what humanity discovered hundreds of years ago?

Historical Precedence

There is a vast historical precedence with recycling rooted to humanities nomadic cultures. Nomadic societies across the world unknowingly developed cyclical processes for everything. Automotive's have never functioned this in this manner because it was only after the height of industrialization that they were developed and thusly have a noncyclic life-cycle. Architecture (being much older) however has roots in both cyclical and linear life-cycles. "Buildings are divided into two general categories: figural and fabric buildings. 'Fabric buildings make up the consistent aesthetic of the city, such as housing and commercial. For fabric buildings we should be creating structures that are as flexible as possible. 'Figural buildings, such as churches, museums, and civic buildings, tend to keep their function'" (Cockram, 2012). Function and its perceived permanence or impermanence dictate importance of deconstructability.

Ise Shrine, Japan: "The Japanese too have extensively used this concept (life cycle design) due to the presence of timber, the mild climate, and earthquake-prone, geography combined to create a craft-intensive architecture based on wood joinery that is highly disassemble-able. For the last 1,300 years, the Inner Sanctum of the Ise Shrine is being dismantled and reconstructed every 20 years. This is sustainable because the forest grows back in a cycle of 20 years" (Sasidharan, N. a., & Chani, P. p., 2011). This example represents the combination of fabric and figural function. It's made and unmade every 20 years manifesting as a fabric manipulable building. This life-cylce correlates exactly to the quantity of time it takes to regrow the materials used in its construction. When it is rebuilt, its function remains identical to its predecessor making it a figural structure also. This is an example of life-cycle planning of the institution as a continuous multi-phased planning design. This institution not only minimizes physical waste, but also minimizes waste of time, and energy by eliminating unscheduled alterations.

Chartwell School - Seaside, California: "This is an educational institution for children having abnormalities such as dyslexia. The 21,200 sq. ft building was built in 2006 and earned the LEED-NC platinum rating for its green features. The campus' two buildings, one a multi-use building and another a classroom building, both are designed to infuse reused timber and other parts from old structures. A 'Utility raceway' runs parallel and adjacent to the corridor of the classroom building to accommodate the utilities in the building. This utility raceway accommodates all utility piping and cables. From the corridor, the doors are recessed resulting in the formation of shelves inside the classrooms. This disentangles the structure from the utilities, and helps minimize utilities running through wooden studs (reduce drilling and thereby preserves quality of timber components used for reuse)" (Sasidharan, N. a., & Chani, P. p., 2011). This is a modern day example

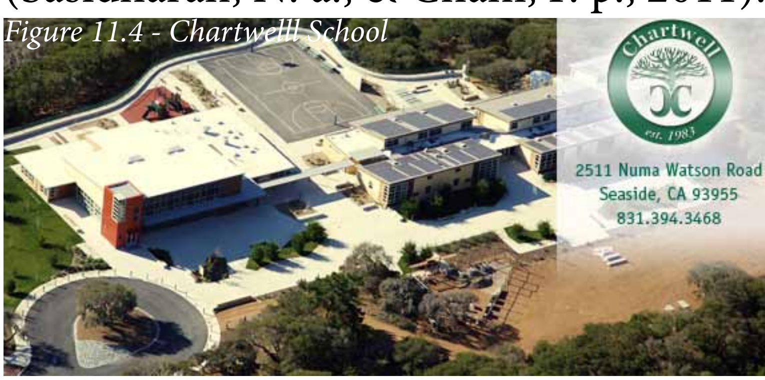


Figure 11.4 - Chartwelll School

Figure 11.5 - Ise Shrine

of building a functionally fabric building with interchangeable modular systems. This encourages figural function from its conception but integrates the opportunity for deconstruction of function and structure. This minimizes the anticipated physical, monetary, timely, and energy waste throughout the structures life.

"If a building doesn't support change and reuse, you have only an illusion of sustainability. You may have excellent building orientation and other energy-saving systems, but the building must also be able to be flexible to meet a change in curriculum," Randy Croxton, principal of the Croxton Collaborative (Knecht, 2004). In today's flexible and constantly updating society it is essential that our buildings begin to acknowledge and prioritize flexibility. Flexibility within function, physical systems, and construction processes must come to the forefront of our future works of architecture. With the help of governmental incentives and exploration of historical precedence I believe that there is hope for this society to rise to our worldly recycling challenges.

Site Analysis


Figure 12.1

My site is located at 1 Ridder Court, St. Paul, MN, USA. This is a site that is adjoining to the minimally trafficked St. Paul Airport, just stones throw away from downtown St. Paul. The river wraps around the north end of site leaving the site with spectacular 360 views of the city. Beautiful river bluffs, downtown skyline, airport grasslands, and glistening Mississippi waters highlight this underdeveloped location. To analyze this site I've approached it from a micro site (seen in narrative portion) and macro site (regional analysis) perspectives. This has yielded a wide variety of design opportunities.


Figure 12.2

Site Analysis - Narrative

Site Visit Narrative

After visiting my site on two occasions, I've come to gain a brief understanding of my site's dynamic personality.

The approach is a slow and lazy one, (via car) meandering through the light industry and commercialized city streets into the open grassland area from the southwest. After parking in the dead-end cul-de-sac, you arise and breathe in the frigid Minnesota air. Gazing northwards upon the site, your confronted by old train tracks running between the downtown to the West and for sale manufacturing plant to the East. You see a middle aged man walking his black lab down the abandoned train tracks. He's startled by your presence, as he clearly expected not to see another soul venturing on his perceivable private walking route. After collecting himself, he smiles, waves and continues with his unobservant pup on his way unaltered from there course.

Across the tracks you then migrate up the small, and only hill on the site. You try not stumble in the slippery snow as you clamber to the top. Looking upwards you see spectacular views of the bluffs across the barge and ice coated river to the North. The shivering wind brisks across your face from the northwest, typical of a late November day. This draws your attention to the clear blue St. Paul skyline from which the breeze is

Northern Panorama of Site

coming. You continue to spin leftward, and gaze upon the industrialized land south of downtown. This wraps up into the bluffs on the southwest as it transitions into residential housing. Farther to the south you see the grasslands surrounding the St. Paul Airport and its untrafficked runways. You continue spinning and you peer upon the chain-link boarded for-sale manufacturing paper plant easterly adjacent to the site. A small site for sore eyes but the for-sale parcel offers opportunity for future expansion to the property. This comes into play when proposing multi-phased designs. Finally, you spin back up the river wrapping up into the northern sandstone bluffs.

Coming full circle, you glance down to your feet crunching in the snow and prairie grasses. The waist high grasses and few bushes and trees covering the site offer minimum wind or sun protection. With the site being positioned at the top of the hill, your left very open the natural elements. Being just an earshot away from downtown, and surrounded by industry, your experiencing a surprising amount of silence and solitude. I am very curious to imagine how the experience would differ at other points in time. A small jet out of the airport; summer barges cruising up and down the unfrozen river; trains grinding along the other side of the river; heavy machinery clanging around the adjacent

Figure 12.3

Site Analysis - Narrative

properties: any of these would greatly alter the peaceful experience of the site. Its easy to imagine that the noise levels of site would be greatly varied depending upon time of year. This would be a poor place for residences, but ideal for a daytime working environment.

This site offers a very unique 360 degree view of the area. Beautiful cliffs, wrapping riverway, open grasslands, with skyline views, its utterly amazing nothing occupies this site. Day and year times would shade the site differently, but being such and open area on a high point would be

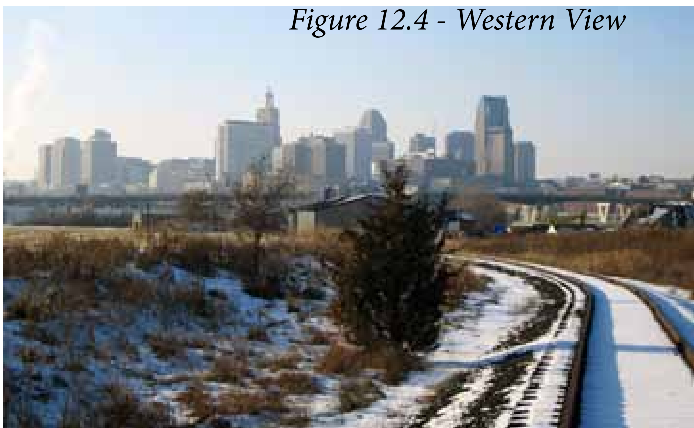


Figure 12.4 - Western View

Figure 12.5 - Eastern View

Figure 12.6 - Northern View

minimally unaffected and retain strong solar intensity.

You're very pleased by the airy crispness, stunning colorful panoramas, waving thatchy grasses, sharp solar rays, nearby trickling icy water, and topographic variations. This is truly a remarkable untapped gem in the greater St. Paul downtown area. The only question left, is how to build architecture in this unparalleled beautiful place.

Figure 12.7 - Southern View

Figure 12.8 - South Western View

Site Analysis - Macro Site

Macro Site Analysis Introduction

A thorough quantitative analysis of the macro region of the site is essential to understanding the environment in which my site is located. This includes a wide variety of census demographical statistics, mapping information data and regional climatology each of which presents design consideration opportunities. The "site" is especially key to any work of architecture, and can offer unparalleled design opportunities.

Figure 12.9

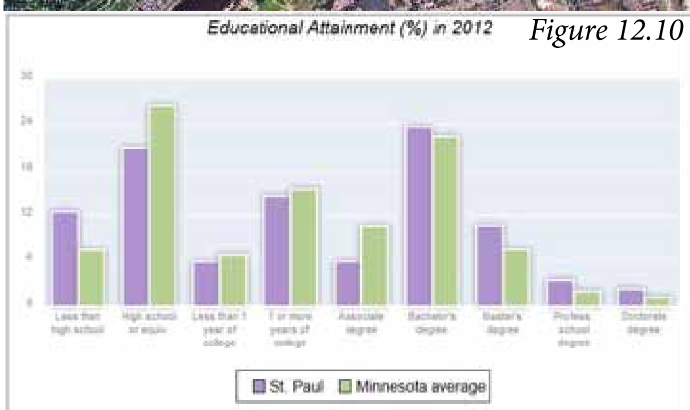


Figure 12.10

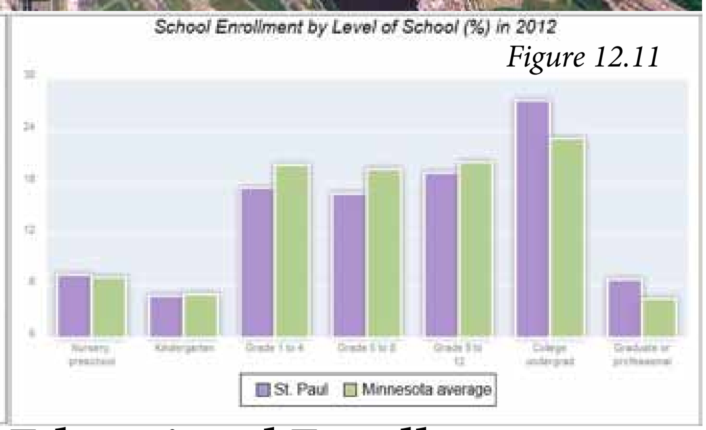


Figure 12.11

Educational Attainment

Educational Enrollment

Minnesota carries a very high level of education per capita, which St. Paul correlates almost identically. This makes it a prime spot for additional educational facilities. St. Paul also offers a great quantity of its growing population attending school further reinforcing the opportunity for an automotive recycling design facility.

Site Analysis - Occupation

Most Common Occupations and Industries - Male

The census industry statistics show that the “Educational Services” category is the greatest industry in St. Paul. The area is also flush with “Post Secondary” educators and “Production Staff” which will be key to employing permanent faculty for a new educational automotive recycling facility.

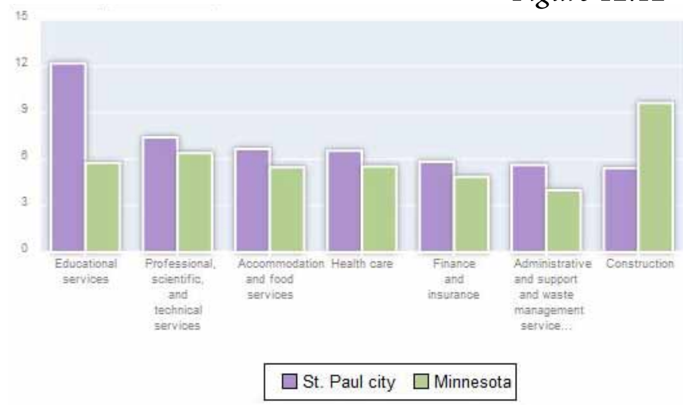


Figure 12.12

Figure 12.13

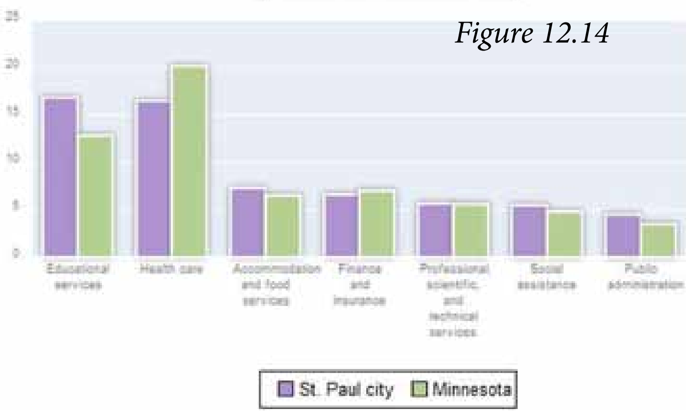


Figure 12.14

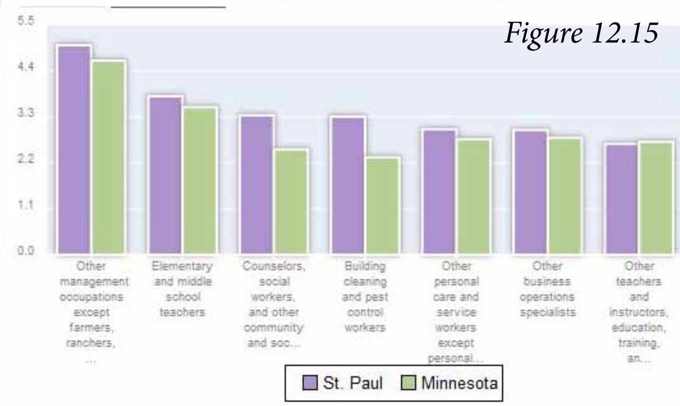


Figure 12.15

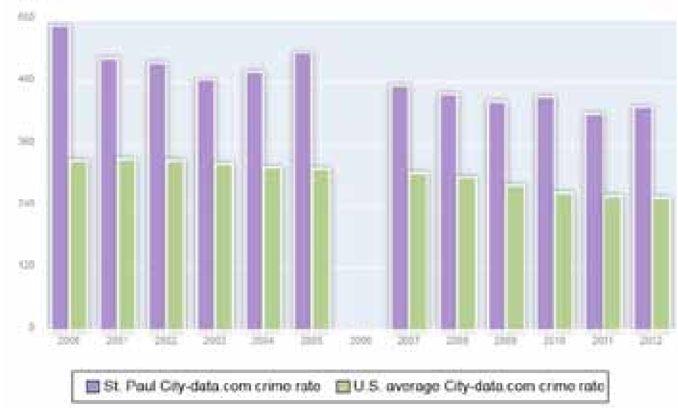
Most Common Occupations and Industries - Female

“Educational Services” is also the greatest industry in the area for females. However, Females in area focus on management and non adjacent occupations to my facility. I would like to claim that this will be gender equal industry (someday) however it is currently a Male dominated area of development.

Site Analysis - Population

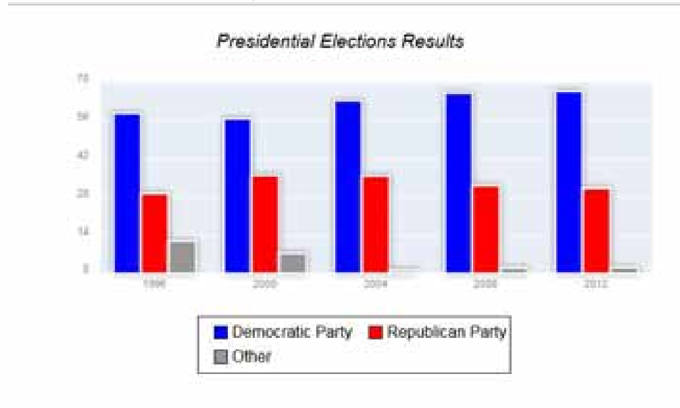
Crime Rates

Figure 12.16



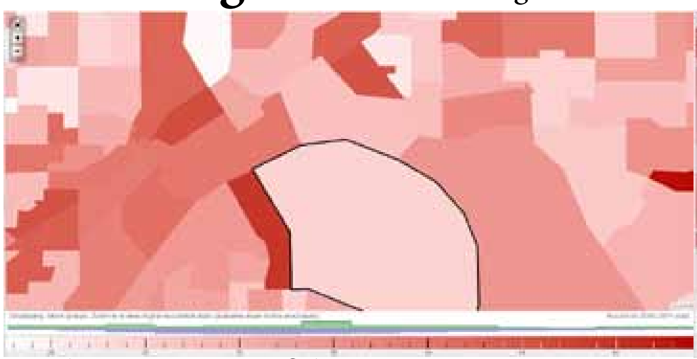
Political Agenda

Figure 12.17



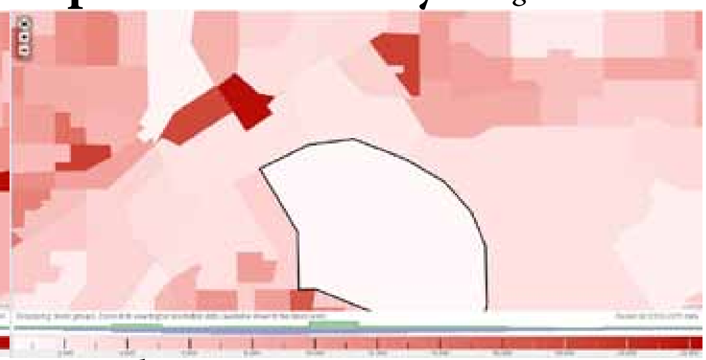
Median Age

Figure 12.18



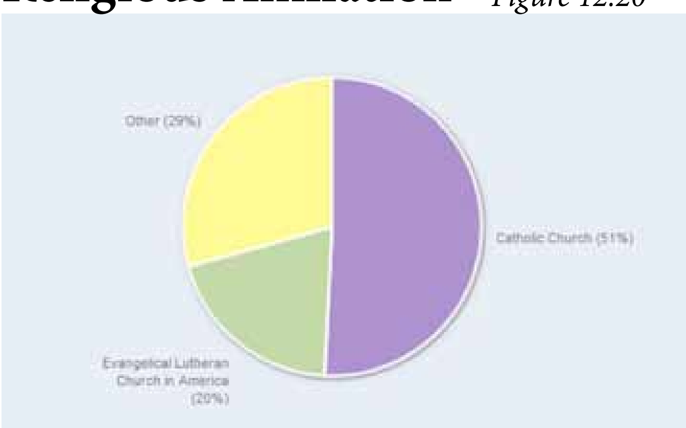
Population Density

Figure 12.19



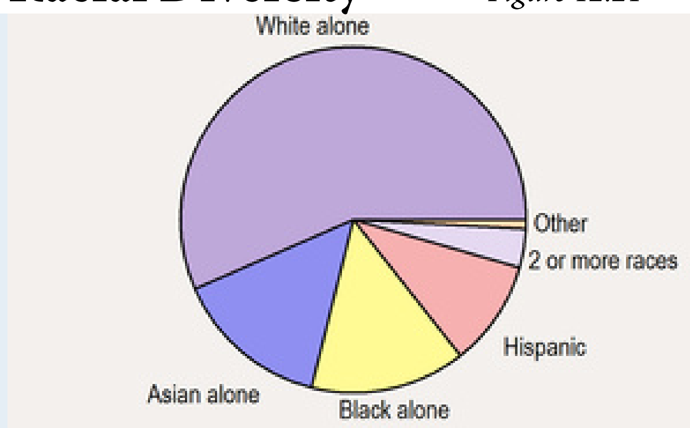
Religious Affiliation

Figure 12.20



Racial Diversity

Figure 12.21



St. Paul General Population Demographics

The design implications are often unconsidered, but above are the key demographics for the area. Race, Religion, Population Density, Age, Political Agenda, and Crime rates are all important to detailed design decisions such as security, construction potential, and building circulation strategies.

Site Analysis - Transit

Transportation Analysis

My thesis presents a new typology for transportation research and development. Analyzing local transportation systems and infrastructures is vital for finding design opportunities.

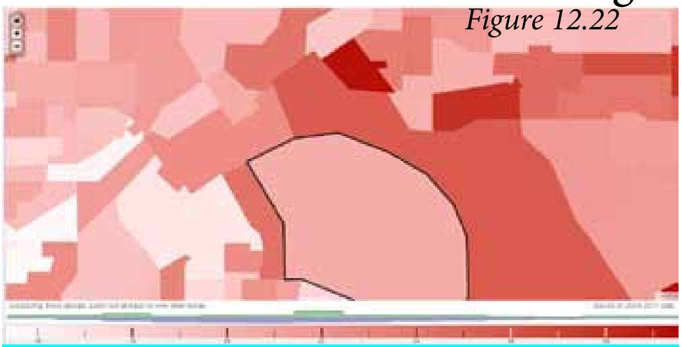


Figure 12.22

Commute to work

Only about 16% of the population works from home, and with 11% unemployment, more than 73% of the local population commutes to work daily.

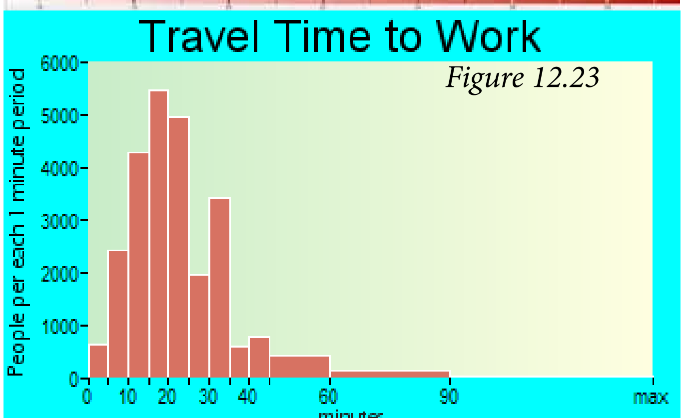


Figure 12.23

Transportation mediums

With the majority of commuters traveling twenty minutes or more, opening up the design to multiple forms of transportation will be essential.


Figure 12.24

Asphalt and Pavement

Much of the inner city is dominantly impermeable surfaces with flood sewer runoffs into the river, causing contamination issues. Designing with permeable and green surfaces reduces erosion.


Figure 12.25

Buildings (Figure Ground)

Building development deteriorates as you migrate away from the city core transitioning vertical spaces towards horizontal ones.

Site Analysis - Transit

Figure 12.26

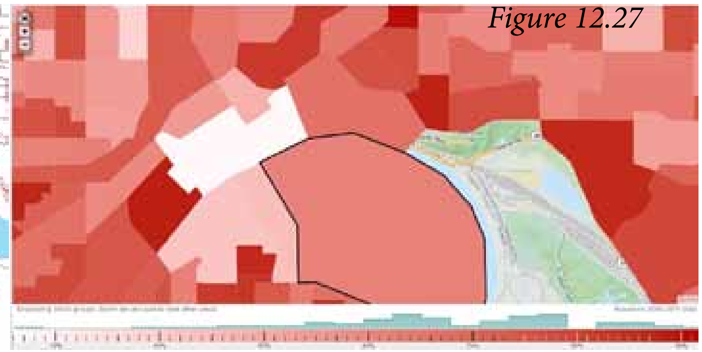


Figure 12.27

Automotive Transportation

Automobiles are the essential transit systems of most American cities. St. Paul is no exception and has a large per capita vehicle ratio. With exception to the downtown region, automotive is by far the greatest means of transportation for the area. Approximately 70% of the population drive to commute, with 80% of them driving alone. Automobiles command a stronghold on the transportation market in the region, and is a huge local industry. I believe that this makes the study and research of automotive life-cycles an unsurpassable opportunity.

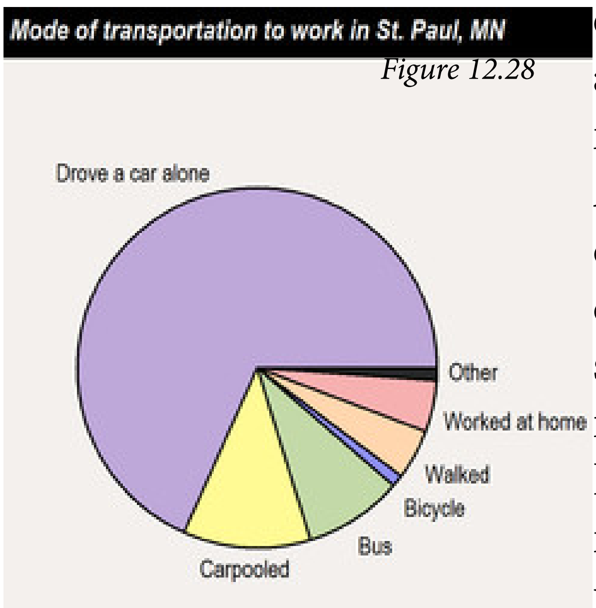


Figure 12.28

Figure 12.29

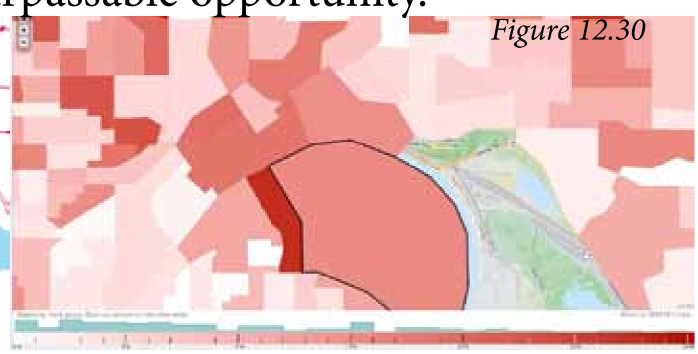


Figure 12.30

Busses

Bus routes are vital to everyday transportation variety. They allow for inexpensive alternative public transit. Approximately 13% of the population utilize the bus system, making this a major means of transit.

Site Analysis - Transit

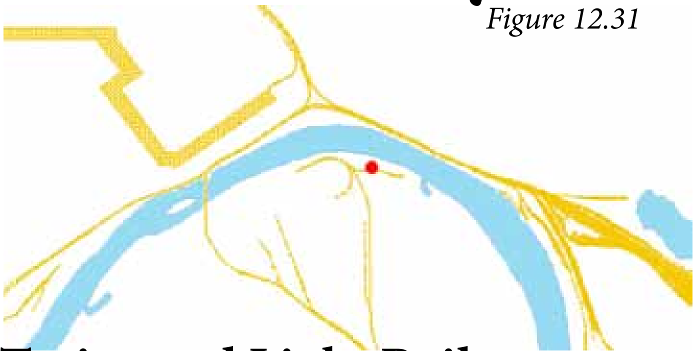


Figure 12.31

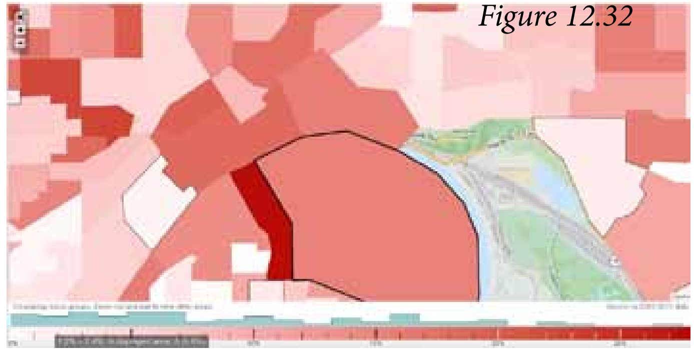


Figure 12.32

Trains and Light Rails

Trains and light rails have grown in the Twin cities and are expanding constantly. St. Paul has extensive plans to add many lines to its system. Approximately 13% of the population utilizes trains for transit.

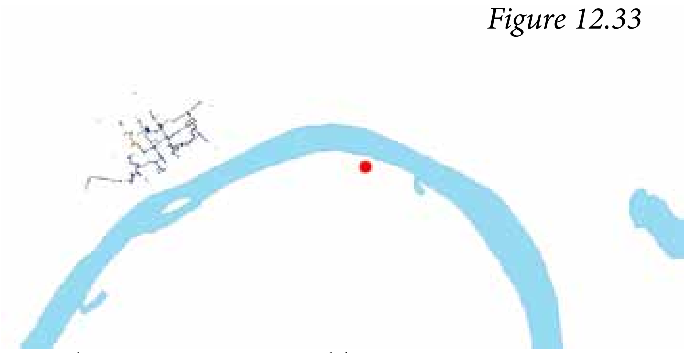


Figure 12.33

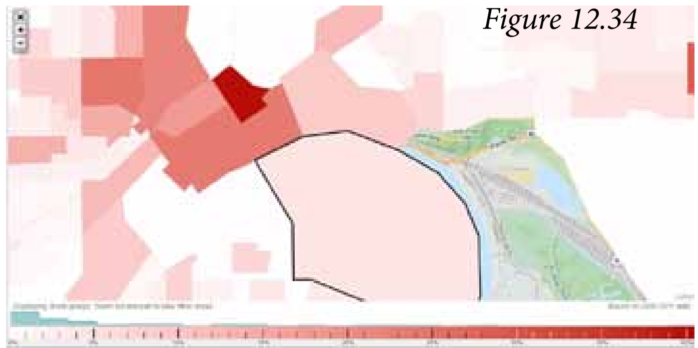


Figure 12.34

Pedestrian Walking

Walking serves vital to any and all metropolitan areas. St. Paul accommodates this seasonally by an extensive downtown skyway system. Approximately 4% utilize walking commutes, which increases with proximity to downtown.

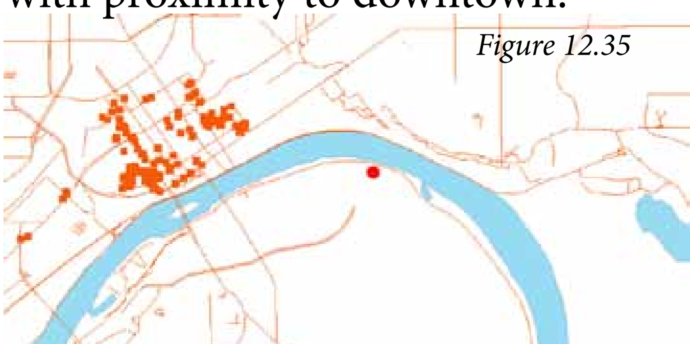


Figure 12.35

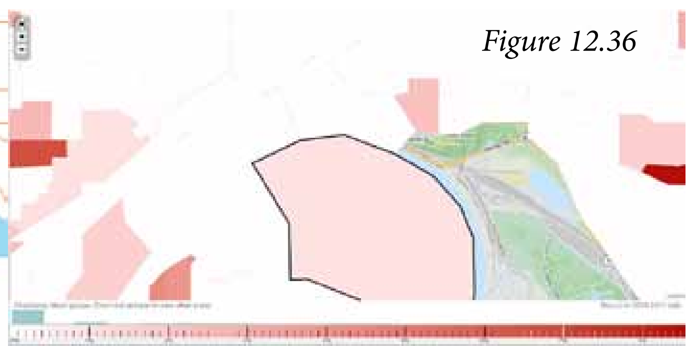


Figure 12.36

Bicycle Traffic

Bicycling has been integrated into the area in stride also. Many new bikeways and storage stops have grown in the area rapidly.

Site Analysis - Zoning

Figure 12.38

Figure 12.39

Figure 12.40

Figure 12.41

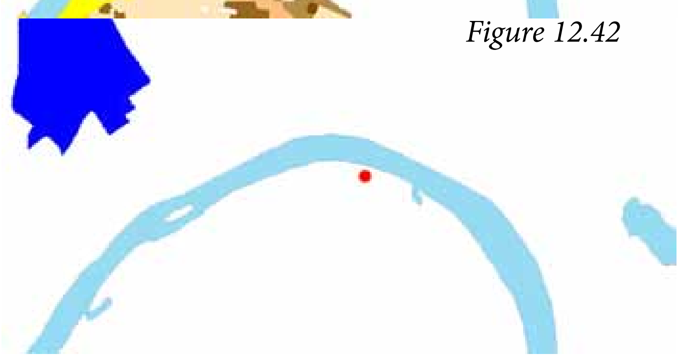


Figure 12.42

Parcels, Quarters & Neighborhoods

Quarter Section 2. NE052822
Ward 2, Neighborhood District 3, West Side Community District.
Parcel: Outlot C

Industrial

My site is currently zoned (L2) General Industrial. It is heavily underdeveloped and I believe this to a prime location for institutional expansion and research.

Commercial

The majority of commercial zoning resides in the city core, but pockets fill out in the outskirts. This is essential for day to day commerce.

Residential

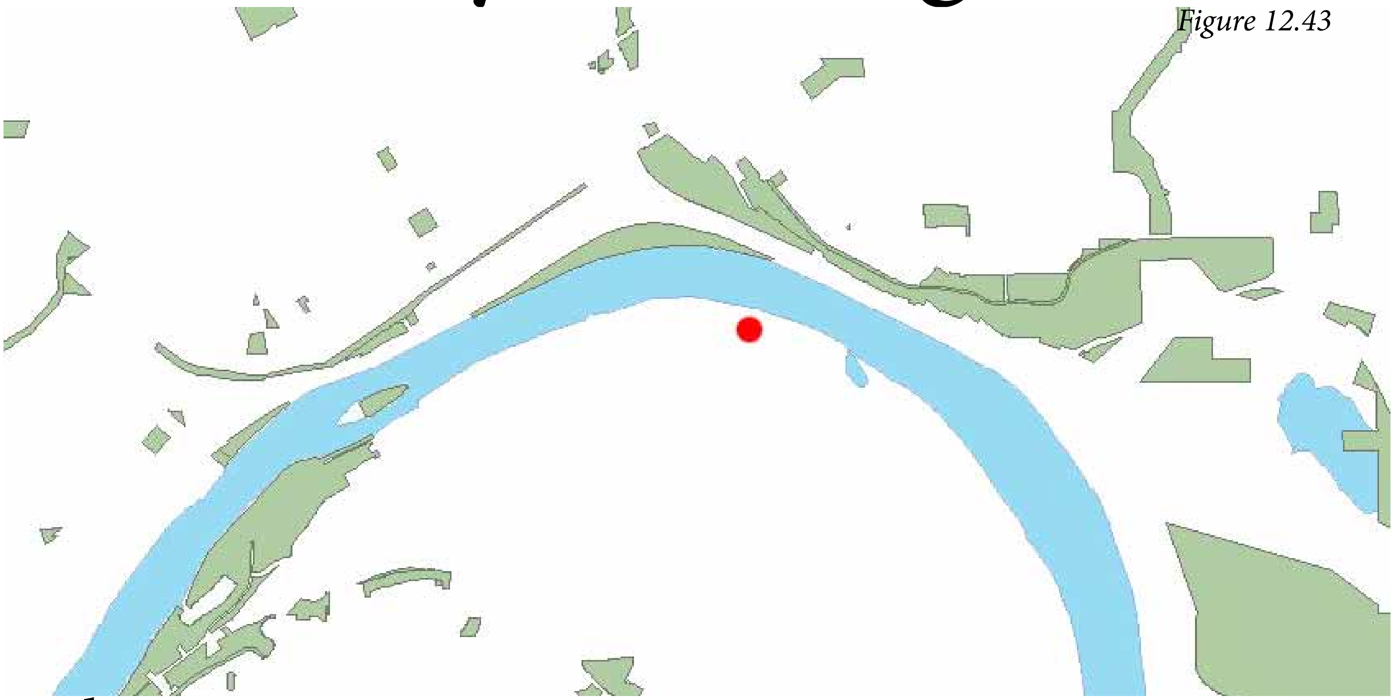
Residential housing and small apartments reside mainly outside the city core and consist of small mixed size family housing. Ideal for separating industry noise.

Governmental

Being the state capital city, much of the city is commandeered for state and city legislation campuses. This is on the other side of the downtown from my site.

Site Analysis - Vegetation

Figure 12.43



Parks

Much of St. Paul, and the greater twin cities is made up of public parts. This allows for a strong Minnesotan daily connection with nature. Keeping this connection posses an interesting design opportunity.

Figure 12.44

Figure 12.45

Grasslands

Grasslands are essential for city runoff and filtration. The grasslands near my site in combination with the airport offer excellent water filtration opportunities.

Tree Canopy

Currently less than 10% of the site has canopy coverage. The city hopes to grow that to closer to 75% canopy coverage in the open grassland areas surrounding my site.

Site Analysis - Flooding

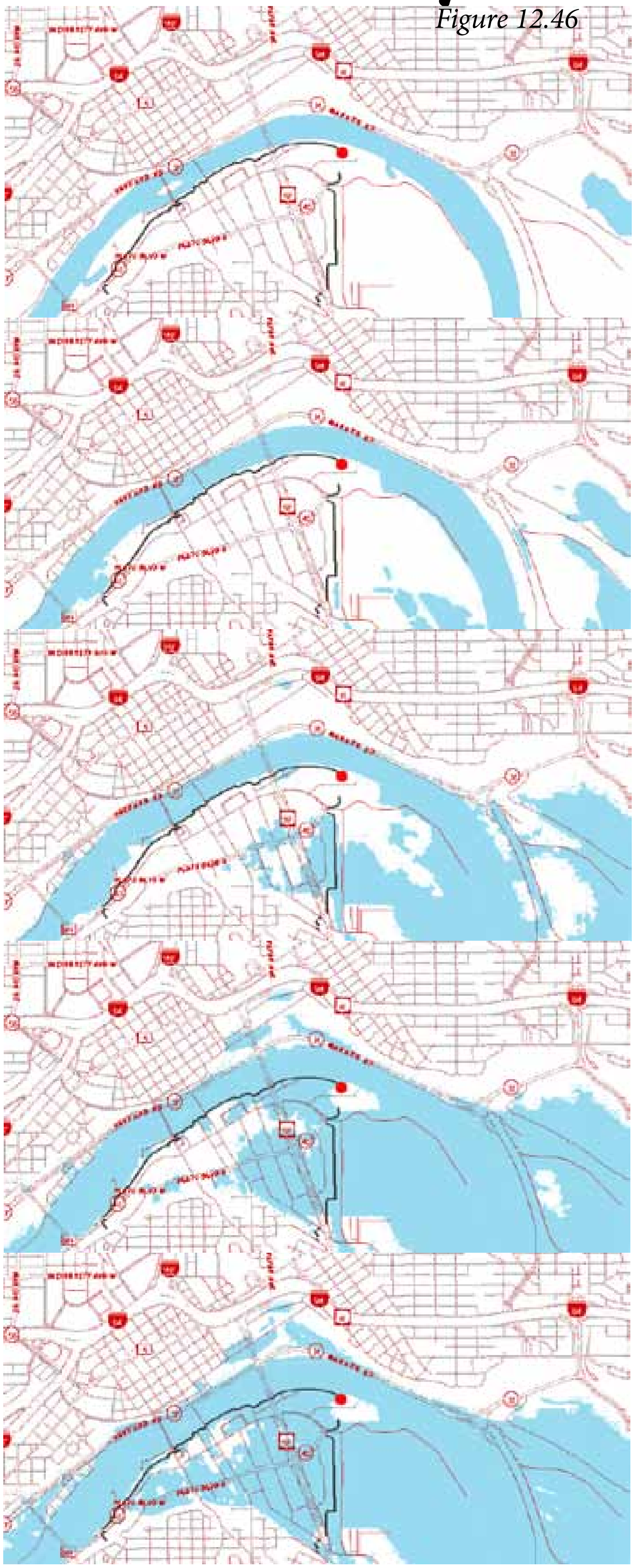


Figure 12.46

Flood Stage 0
Approximately 10.5 feet deep
Everyday levels of watershed controlled by the greater metropolitan damming systems.

Flood Stage 3
Approximately 13.5 feet deep
Flooding acknowledged and preventative actions are beginning, including opening of floodgates.

Flood Stage 6
Approximately 16.5 feet deep
Moderate to Major flooding stage and displacement begins, despite floodgates being wide open.

Flood Stage 9
Approximately 19.5 feet deep
Major flooding stages and evacuations have begun. Infrastructural systems are being maxed out and damaged.

Flood Stage 12
Approximately 22.5 feet deep and up. Maximum flooding stage and damage controls are implemented to minimized loss.

Site Analysis - Topo & Soil

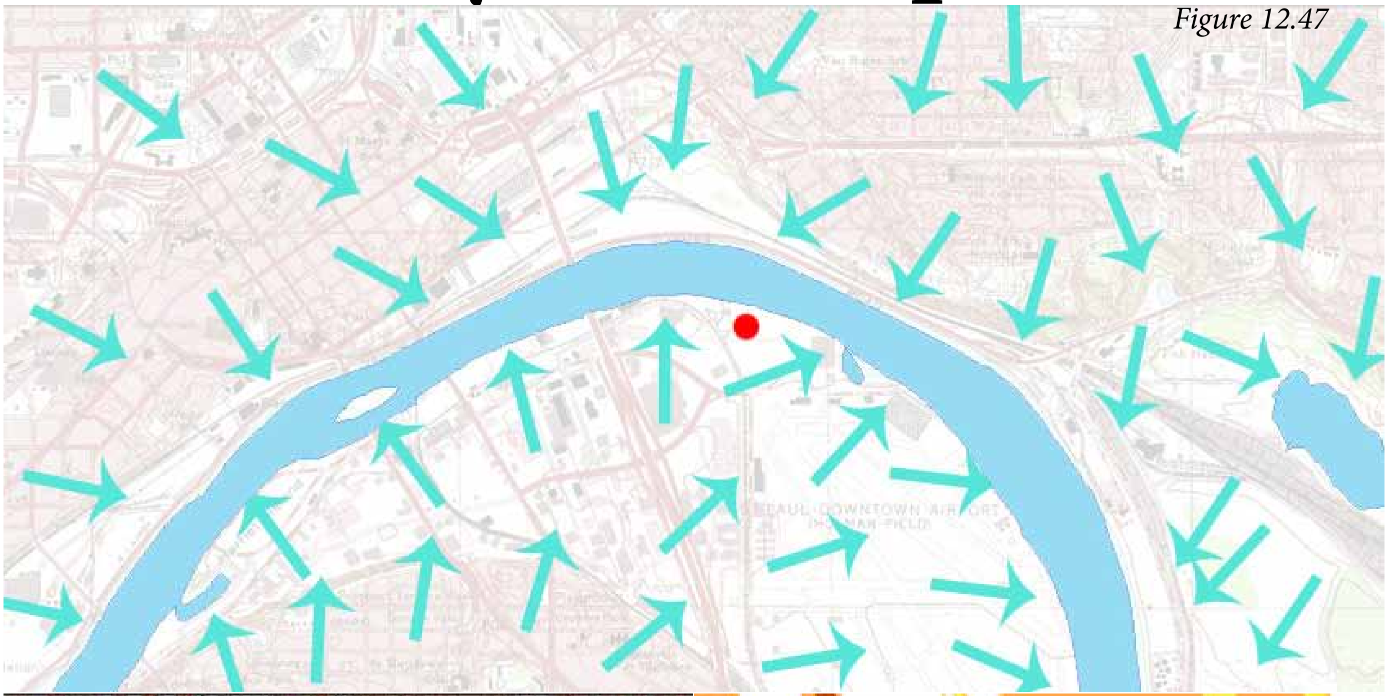


Figure 12.47

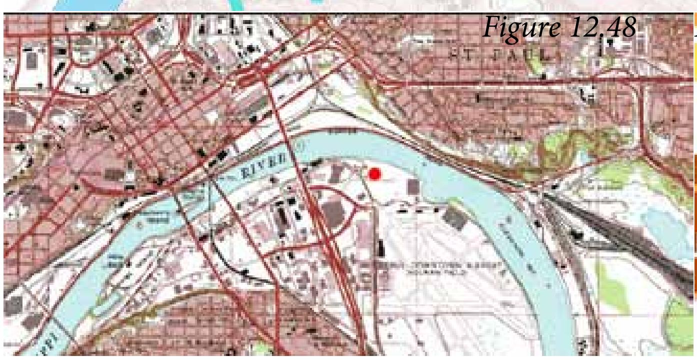


Figure 12.48

Figure 12.49

Watershed and Topography

My site is adjacent to the wrapping Mississippi river cutting through downtown St. Paul. This leads to obvious potential flooding and soil issues. However, my site will be on the high point plateau of the valley reducing these pressing concerns. The watershed for the area migrates to the river, however much of it is soaked up by the grasslands nearby.

Soils and Geology

Entisols Soil Profile
Udorthents, Wet Substratum
90% Dominant Order Enisols
10% Orthents Sub Order
In lay mans terms, my site is sitting on a sedimentary clay topsoil with bedrock a long ways under the subsurface. This is ideal for horizontally designed buildings with shallow pylon foundations.

Site Analysis - Solar

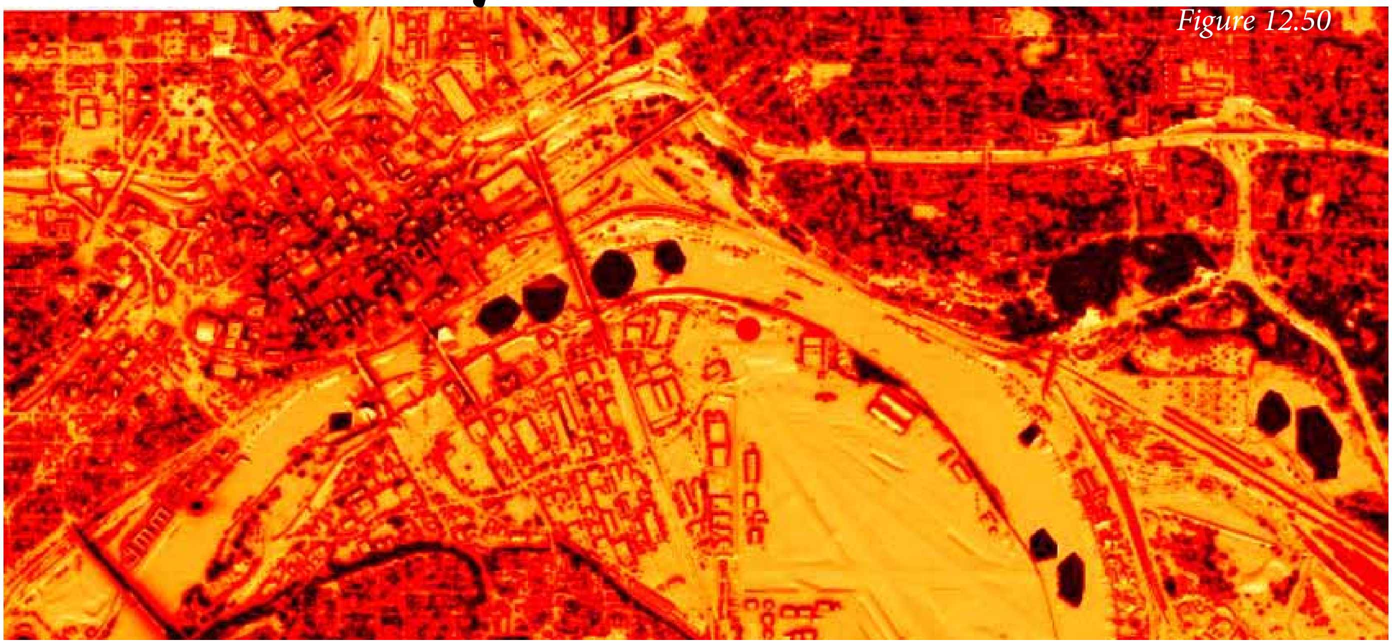


Figure 12.50

Solar Radiation

My site offers prime location for capitalizing on solar radiation for energy gain within the city as seen on the diagram above. However, due to it's cloudy climate and northern location, solar energy collection must be optimized for efficiency.

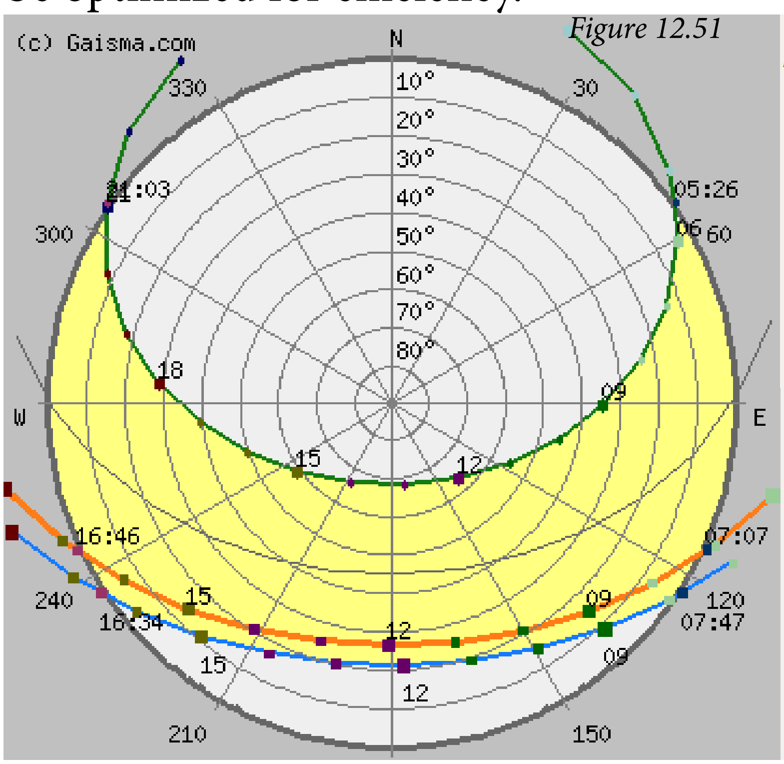


Figure 12.51

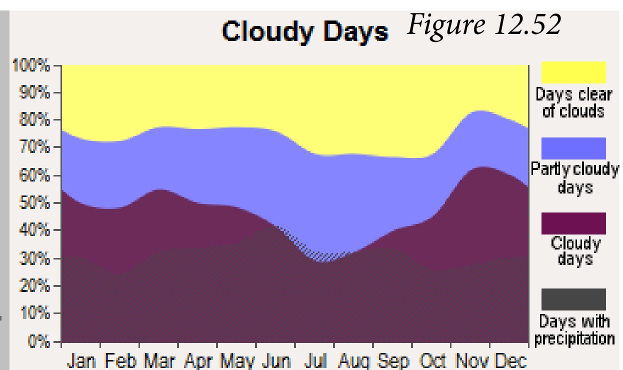


Figure 12.52

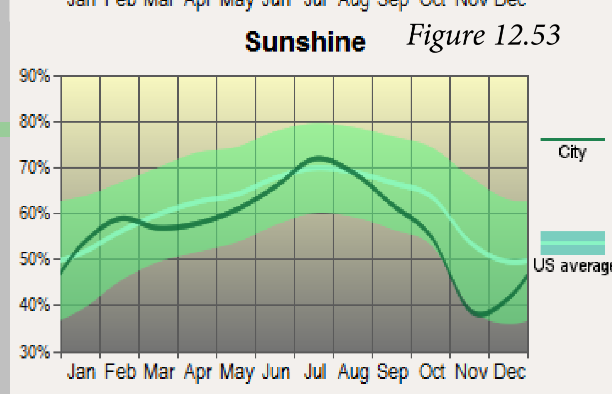


Figure 12.53

Site Analysis - Solar

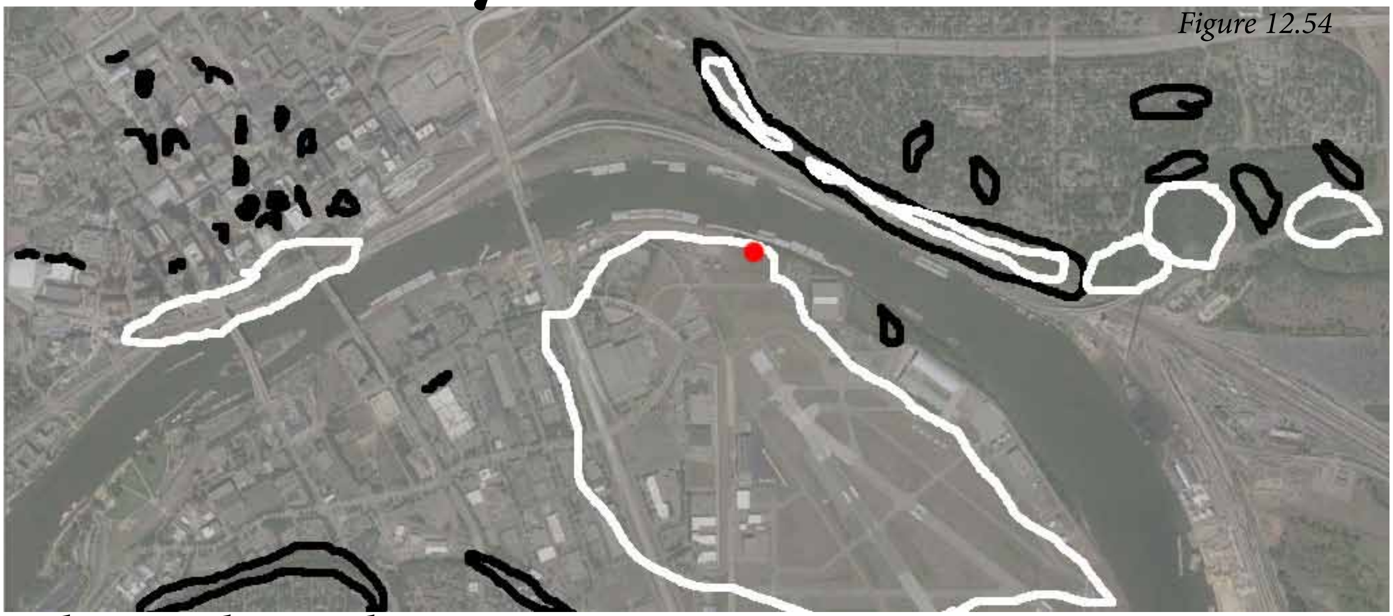


Figure 12.54

Solar Study Analysis

A basic solar analysis revealed the primary sun and shade areas.

Summer Equinox	Fall Solstice	Winter Equinox	Spring Solstice
July 21st	September 23rd	December 21st	March 20th

Figure 12.55

Site Analysis - Wind

Figure 12.56

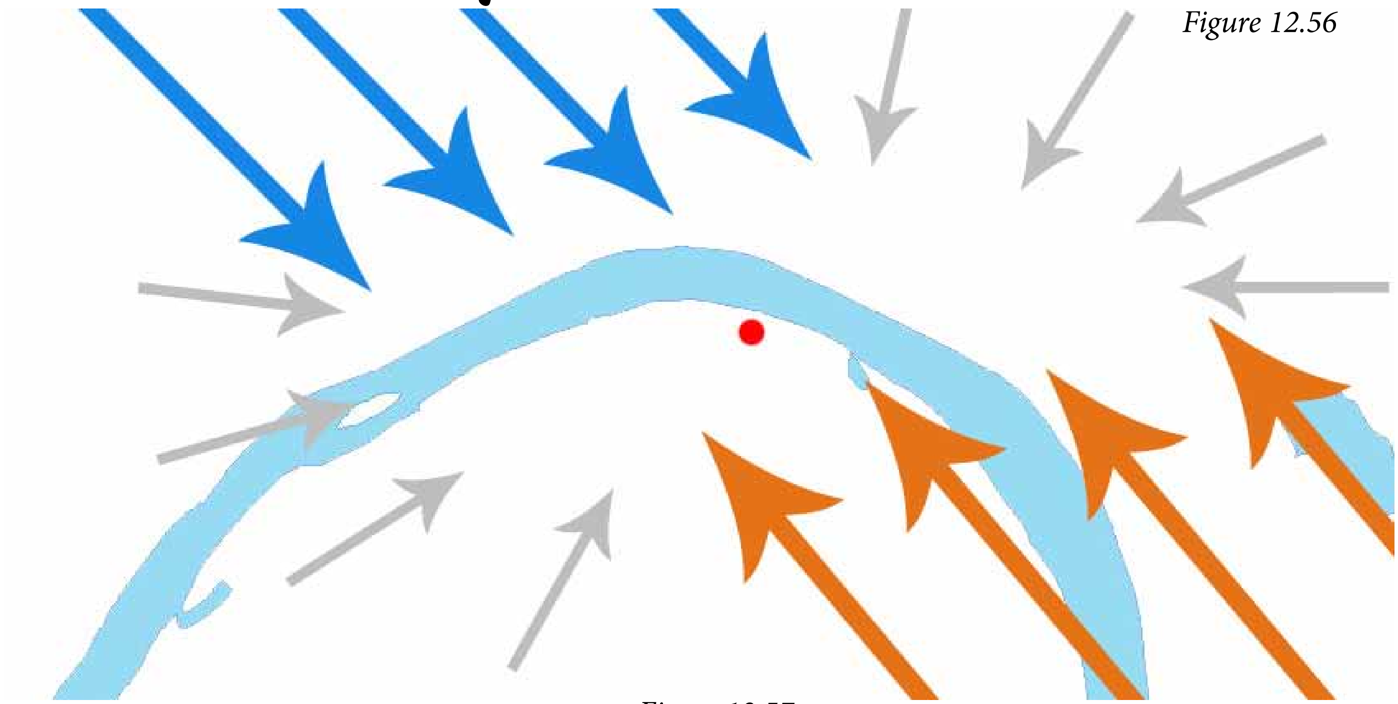
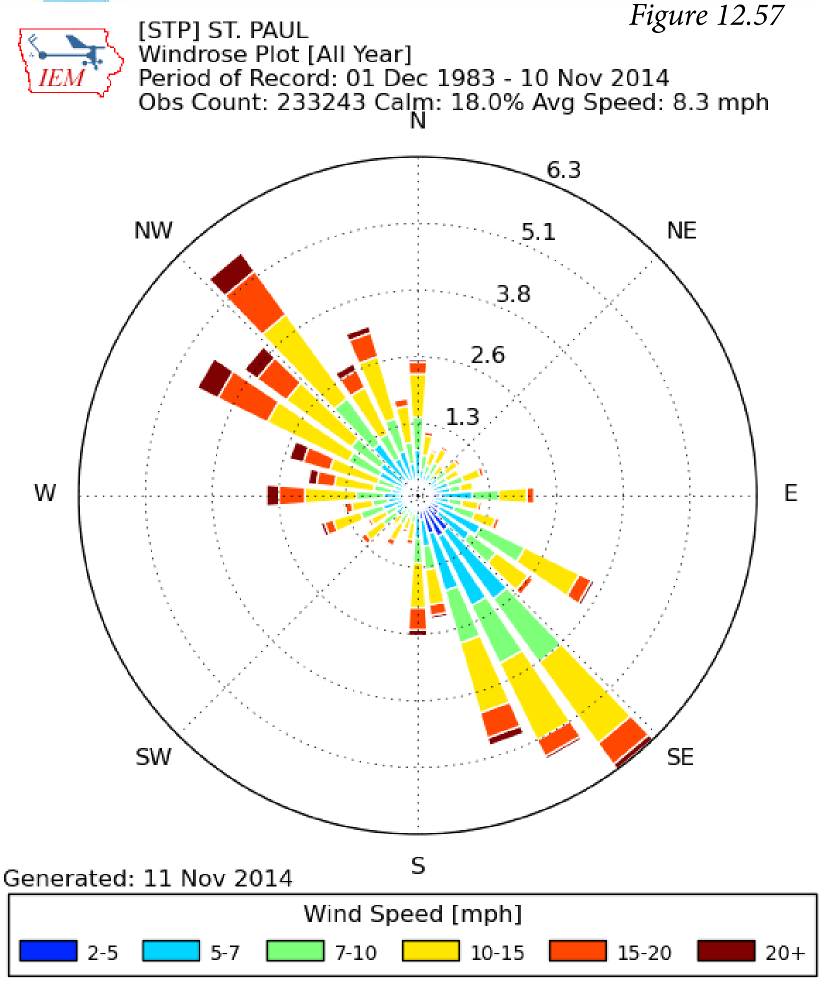


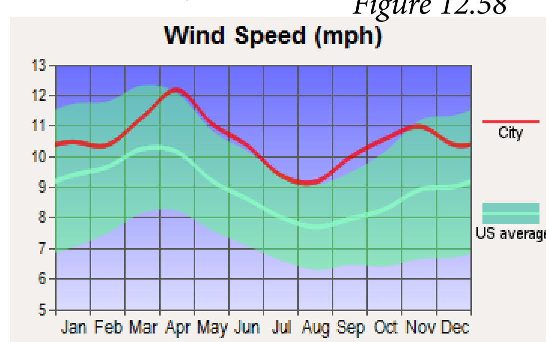
Figure 12.57



Wind Analysis

The wind rose reveals the primary wind corridor flows from the northwest in the winter and southeast in the summer months. Combining this with the wind frequency being at the top of the US average makes wind energy a strong possibility.

Figure 12.58



Site Analysis - Climate

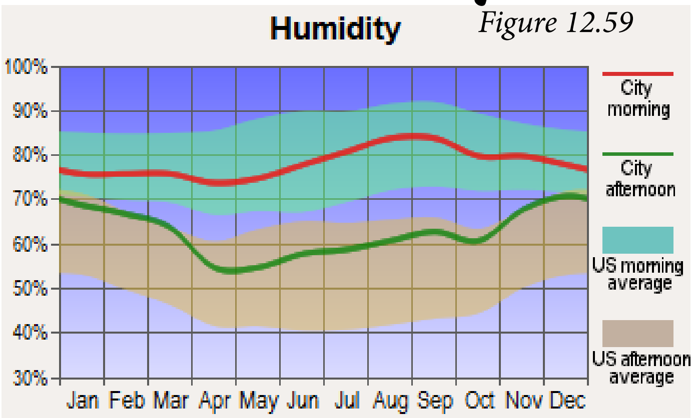


Figure 12.59

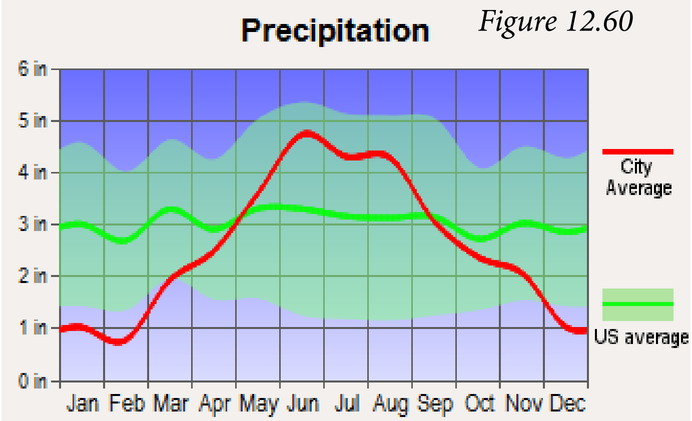


Figure 12.60

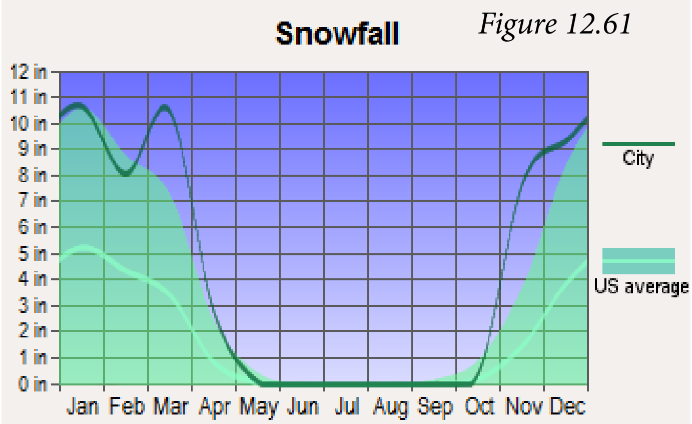


Figure 12.61

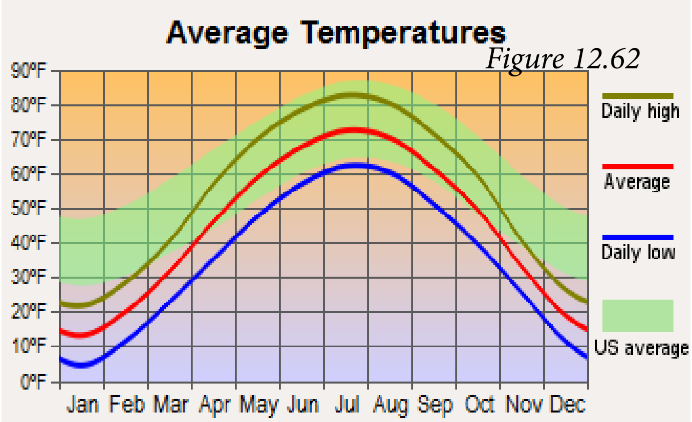


Figure 12.62

Humidity

St. Paul's humidity levels correlate strongly with the US averages, but has high afternoon humidities. This offers design opportunities for afternoon cooling spaces to balance the high humidity.

Precipitation

Minnesota has a diverse precipitation pattern which yield heavy rainfall in the summer and low in the winter. Offers design opportunities for rainfall water collection.

Snowfall

Being a very snowy climate during and throughout many of the winter fall and spring months, heavy snow loads must be considered within the structural designs of the project.

Temperatures

The winter months yield much cooler temperatures, but match the hottest summer month temperatures. This demands strong considerations for the balance of passive and active strategies for the climate control.

Site Analysis - Summary

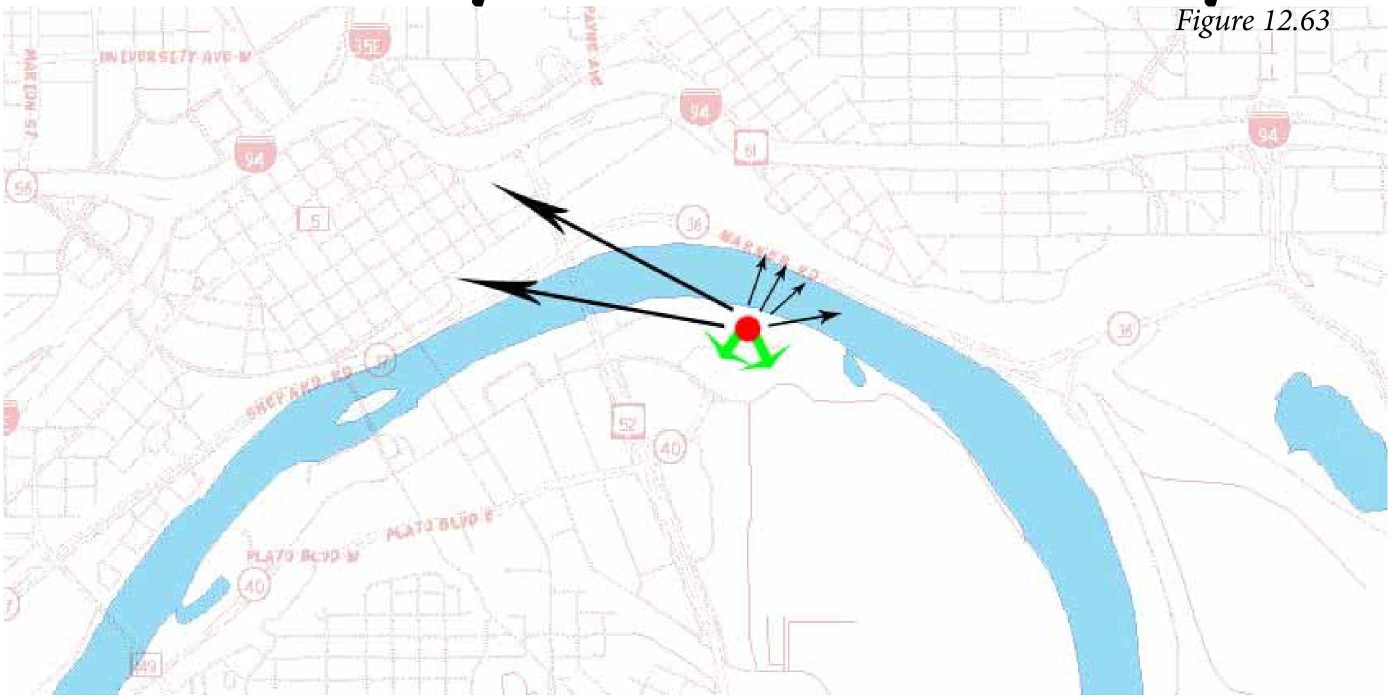
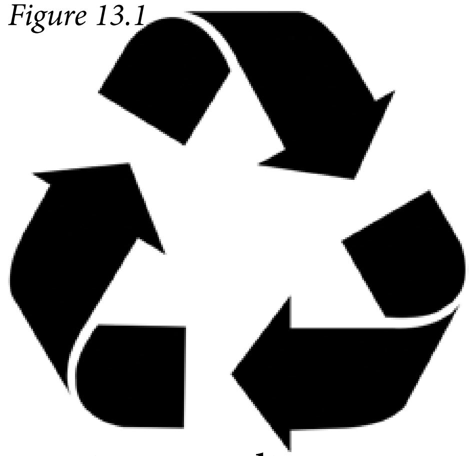


Figure 12.63

Site is a vital part of any design. The site's natural character and surrounding precedence set the scene that the new structure will integrate with for decades. My site offers many unique and inspiring qualities which will be crucial to this thesis proposal. Practically it lies in the center of a growing metropolitan area flush with economic opportunity and creative people. This a site also offers spectacular views of the skyline, river and bluffs along with peripheral views of the grasslands and surrounding commercial zones. Be physically adjacent to available open spaces offers the opportunity to outward expansion of any facilities built. This is essential to the functional life cycle of a structure and is at the core of this thesis.

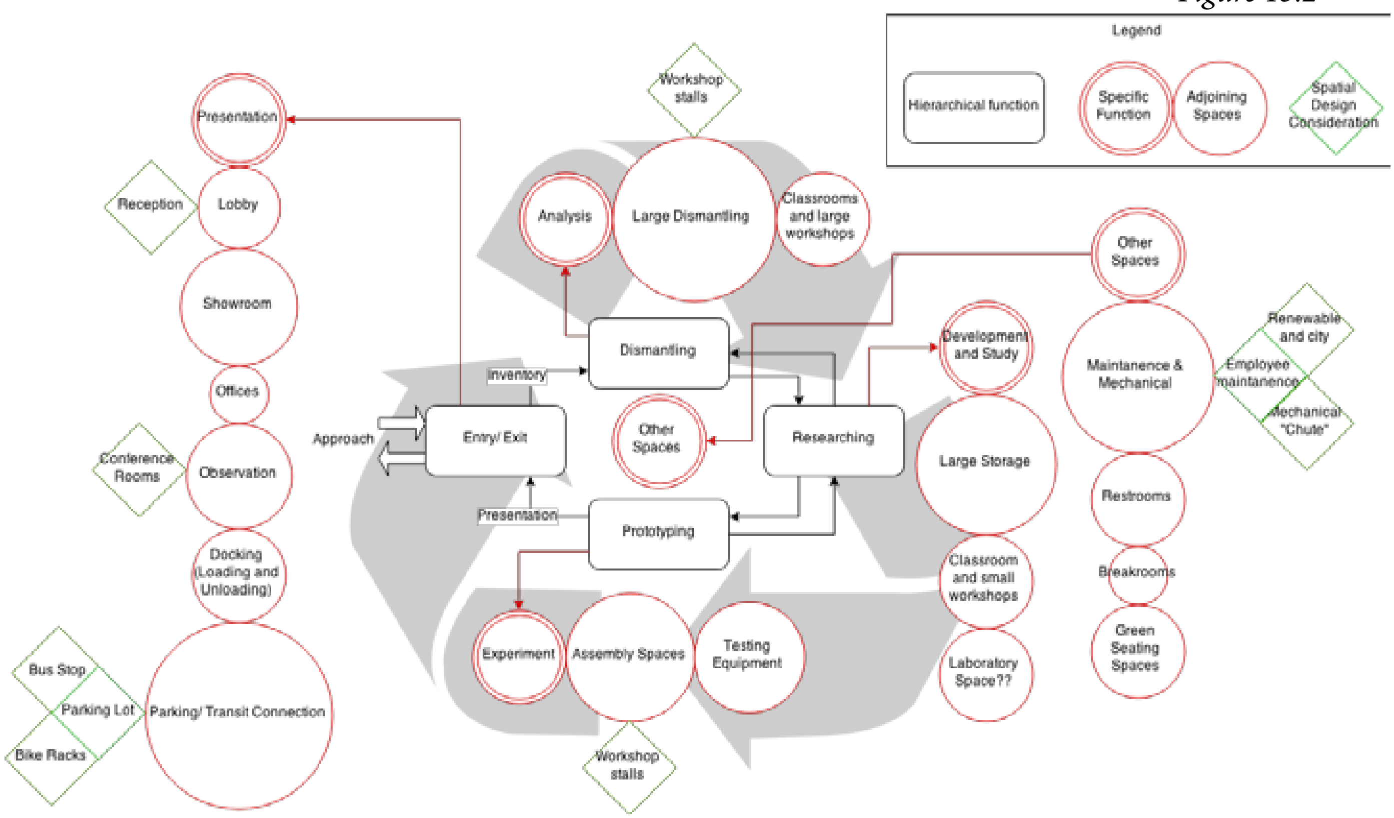
Building Program

Figure 13.1



Recycling is all about creating cyclical systems for a sustainable composition. The symbol to the right is the internationally recognized symbol for recycling. I've chosen to directly integrate this cyclical system into the functionality of my program. I propose to explore and present a life-cycle sustainable, architectural solution for the creation of an Automotive recycling and prototyping research facility. My goal is to facilitate automotive design for recycling. To do this I began with the idea of cyclical flow on a spatial level. The following diagrams detail my interpretation of the required spaces, there hierarchal value, relative size, proximity and spatial progression. To expand upon this cyclical ideology, the project's life-cylce and deconstructability are also important factors.

Figure 13.2



Building Program

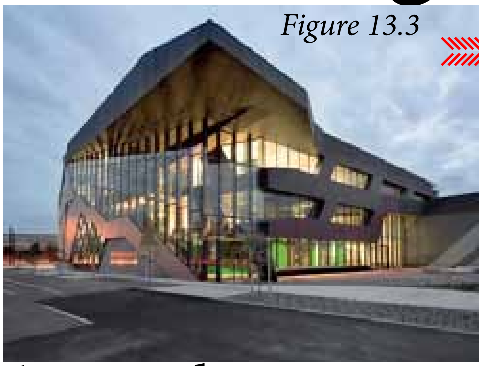


Figure 13.3

Approach


Figure 13.4

Showroom


Figure 13.5

Dismantling


Figure 13.6

Assembly

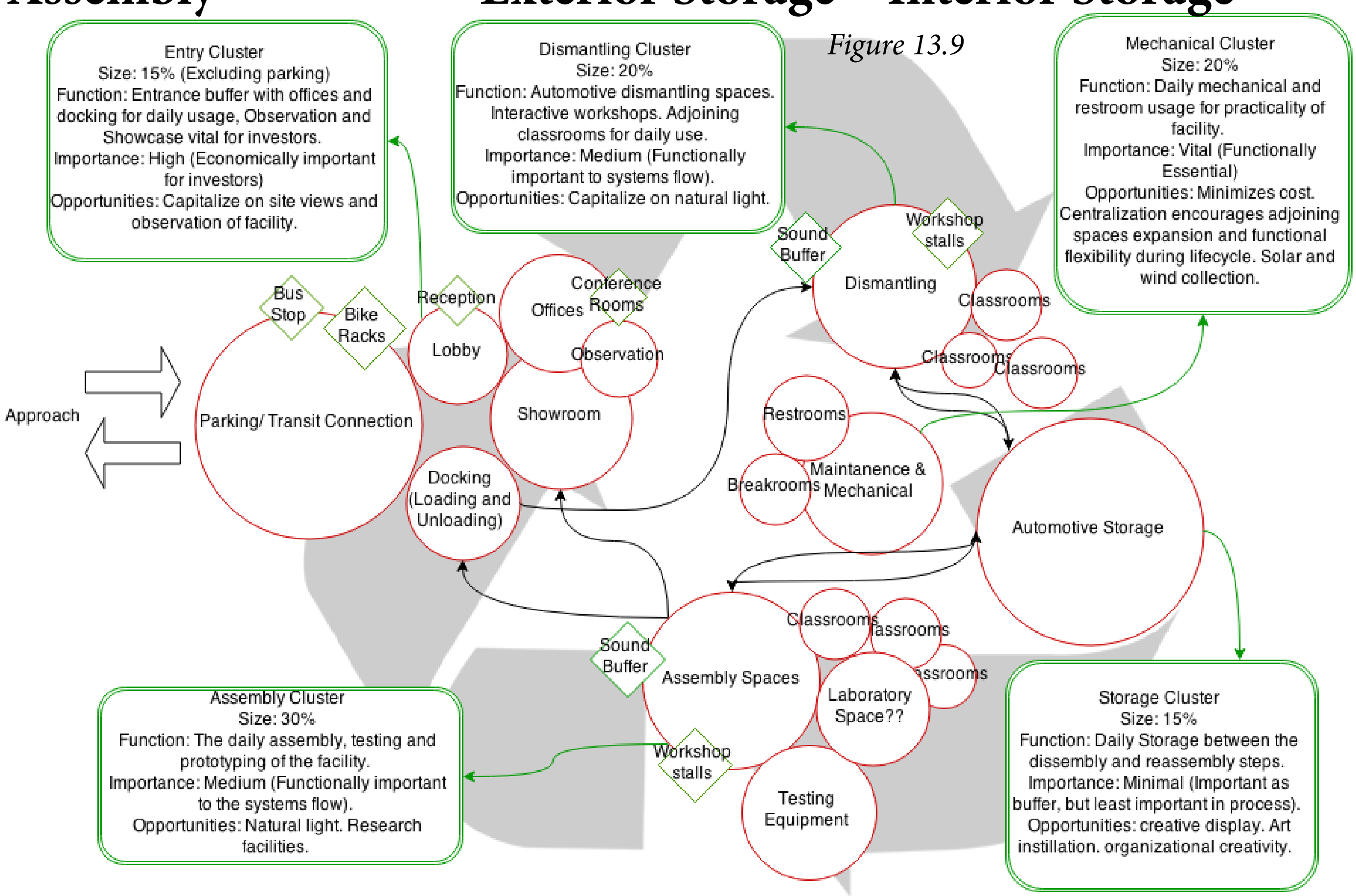

Figure 13.7

Exterior Storage


Figure 13.8

Interior Storage

Figure 13.9



Building Program

Costs and Price

Estimating a building is no easy task. Working as an estimating assistant for a general contractor for past several summers has taught me a great deal about the pricing process and organization of cost structures. Until tentative construction of the building it is hugely time consuming to accurately estimate a building. As a designer there are basic considerations to be cost conscious.

Simplicity of materiality (Steel and Glass) minimizes expensive individual trade costs. By utilizing modular prefabricatable designs you increase assembly costs and labor costs but greatly increase overall quality. Over a 100 year life-cycle this building offers functional variability which reduces the overall costs of the facility. Modular design also offers opportunity for inexpensive expansions, renovations and

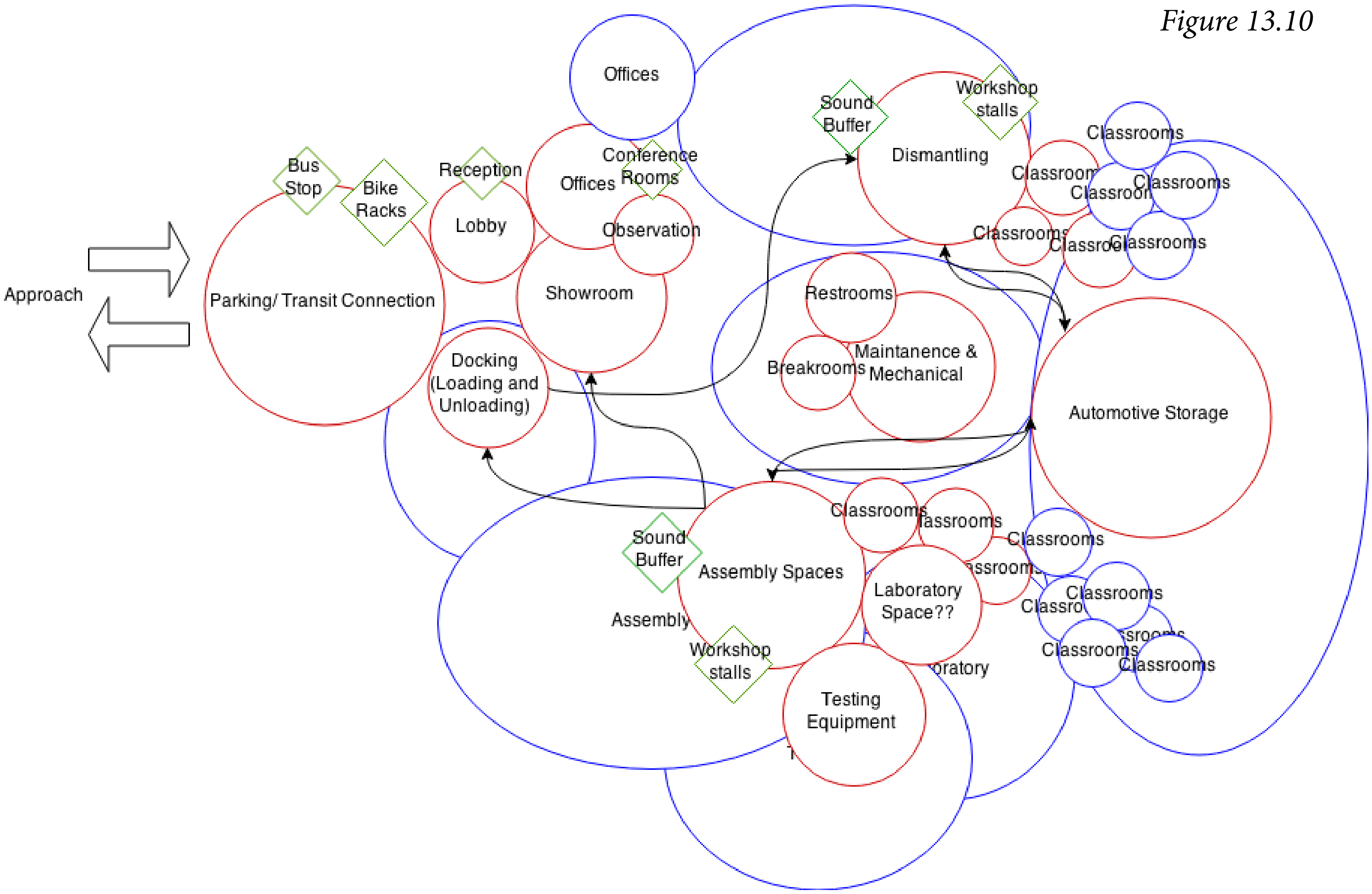


Figure 13.10

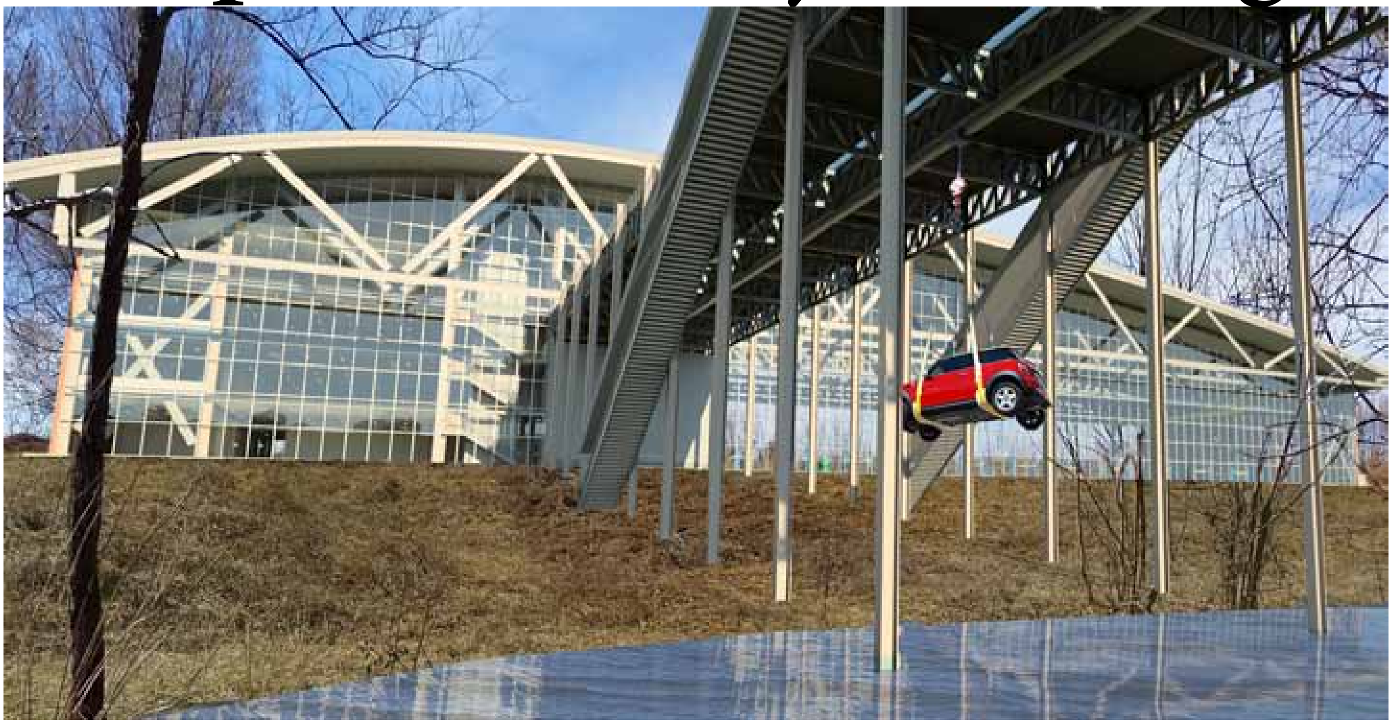
additions. These modular strategies compose the opportunity for multi-faceted staging of a building. This requires a large initial investment to begin the process, but retains value and function for longer and more inexpensively. I would anticipate this proposal to require a large initial investment on the part of the financial institutions and private investors. However, with an appropriate business growth model the economic recovery of the initial invest could be recovered very quickly. Appropriate energy recovery designs would also result in a shorter investment return yield.

Programming Away Waste

Waste is the enemy, I hopefully have over expressed within this thesis. Whether it be for economic or ecological sustainability, waste is the enemy of efficiency. I aim to deter waste as measurably as I can throughout this project. By designing for deconstruction I hope not only to minimize the structure's overall waste, but also inspire recycling sustainability within automotive design. Recycling is all about creating cyclical connections.

I propose to explore and present a life cycle sustainable, architectural solution for the creation of an Automotive recycling and prototyping research facility. Programming away waste is the core of this proposal. Whether architecture or automobiles, innovative design solutions can unlock inspiration for reduction of waste in our wasteful world.

Chapter 3 - Project Design

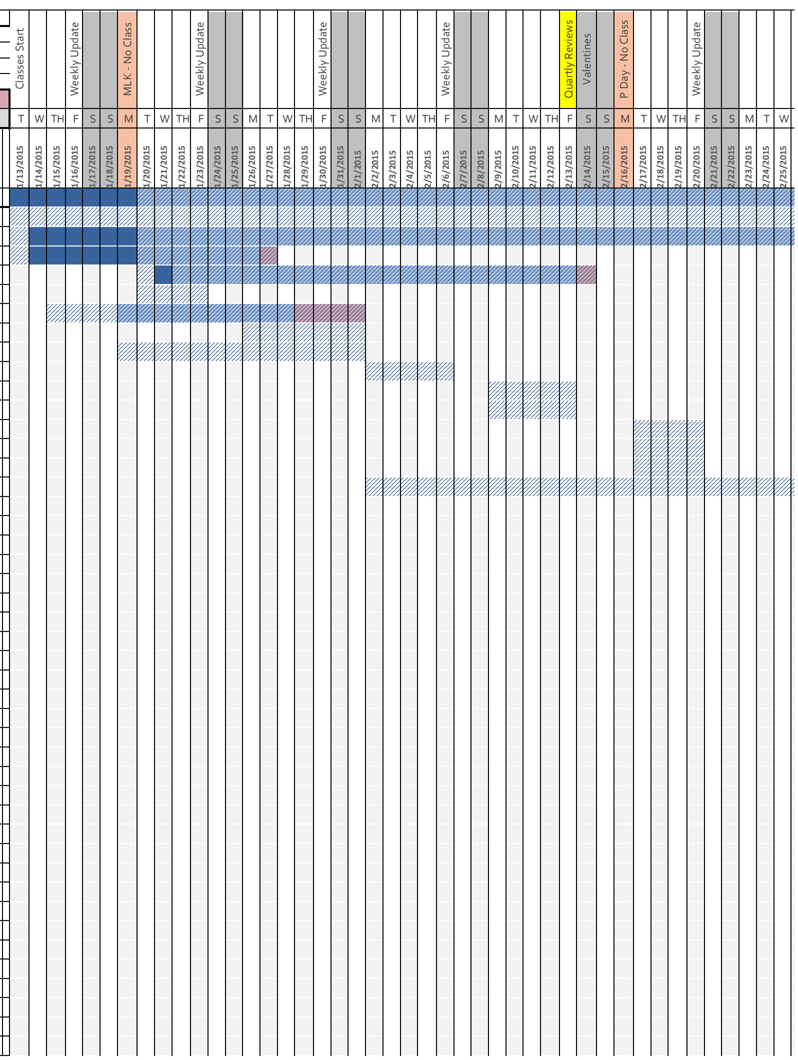


There are many ways to design a building, make an architecture, or present a thesis. And infinitely more ways to document this process. For simplicity of viewing, I've chosen to document my process by weekly images of my concepts and design work. Over the course of 17 weeks from January 12th through May 8th (2015) I've captured a semester's worth of thesis design work.

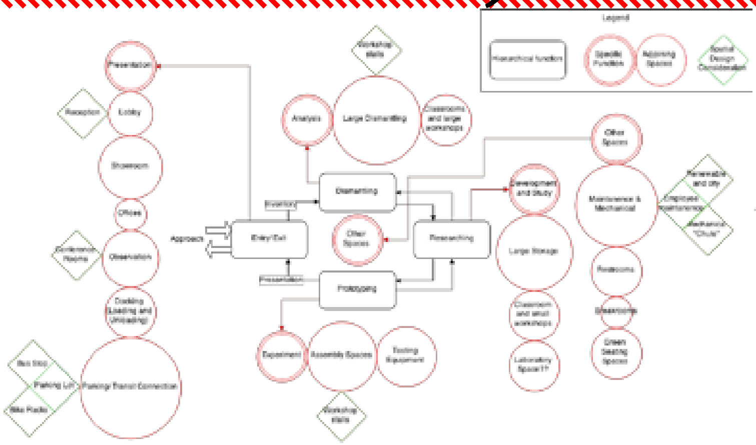
Week 1 - January 16th

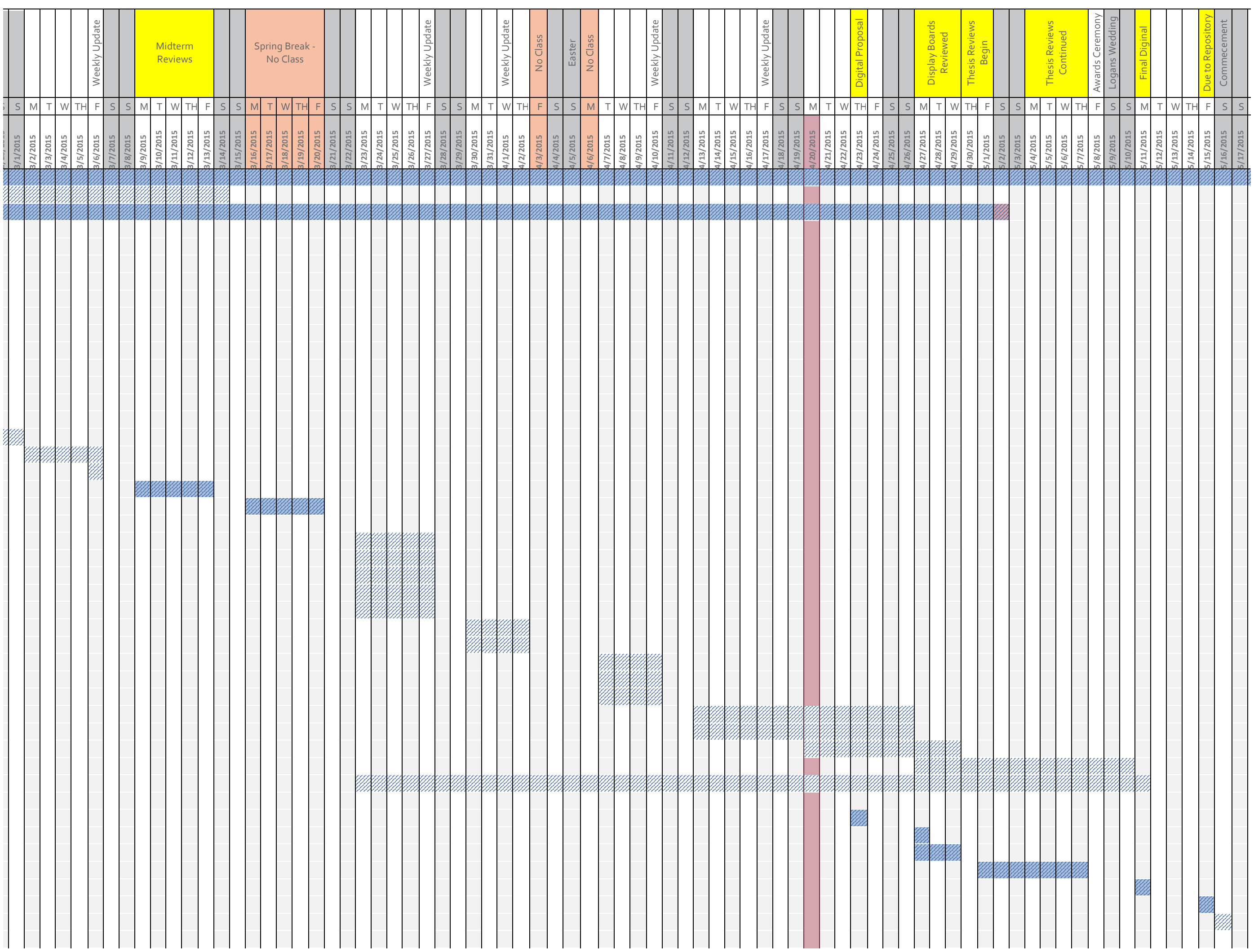
Coming out of winter break, after setting the research process aside for several weeks, is no easy task. To pick up and start again reflecting on the past semester is crucial. By reinterpreting the spatial bubble diagrams I developed at the end of the past semester I was able to reconnect and grasp a direction to head for the coming weeks. Additionally, we were asked to develop a gantry schedule for the upcoming semester to better understand our goals. Also by doing this we could associate deadlines with tasks needing completion.

Project		Thesis Timeline						
Legend								
		Plan				Actual (beyond plan)		
		Actual				% Complete (beyond plan)		
		% Complete				No Class		
Todays Date:		Monday, April 20, 2015						
Project Start:		Monday, September 01, 2014						
Activity	***Deliverables***	**Plan Start**	**Plan Duration**	**Plan End Date**	**Actual Start**	**Actual Duration**	**Actual End Date**	**Percent Complete**
Spring Semester		1/13/2015	126	5/18/2015	1/13/2015	126	5/18/2015	6%
Program Editing		1/13/2015	61	3/14/2015				
Design		1/13/2015	109	5/1/2015	1/14/2015	109	5/2/2015	6%
Spatial Organization	*Bubble Diagram*	1/13/2015	14	1/26/2015	1/14/2015	14	1/27/2015	45%
Digital Model	*Print offs*	1/20/2015	25	2/13/2015	1/21/2015	25	2/14/2015	2%
Contextetual Relavance	*Digital Model*	1/20/2015	4	1/23/2015				
Site Connections	*Drawings*	1/15/2015	14	1/28/2015	1/19/2015	14	2/1/2015	
Physical Model	*Site Model*	1/26/2015	7	2/1/2015				
Functional Progression	*Circulation Drav*	1/19/2015	14	2/1/2015				
Structural Systems	*Dig Mod/ Plans*	2/2/2015	5	2/6/2015				
Sustainability Systems	*Dig Mod/ Plans*	2/9/2015	5	2/13/2015				
Environ Systems	*Dig Mod/ Plans*	2/9/2015	5	2/13/2015				
Life Safety Systems	*Dig Mod/ Plans*	2/17/2015	4	2/20/2015				
Fire Prevention System	*Dig Mod/ Plans*	2/17/2015	4	2/20/2015				
ADA Systems	*Dig Mod/ Plans*	2/17/2015	4	2/20/2015				
Disassembly Systems/D	*Dig Mod/ Plans*	2/2/2015	28	3/1/2015				
Display Considerations	*Pin Ups*	3/2/2015	5	3/6/2015				
Speech Considerations	*Writing Pages*	3/6/2015	1	3/6/2015				
Midterm Reviews	*Present/ Notes*	3/9/2015	5	3/13/2015	3/9/2015	5	3/13/2015	
Spring Break		3/16/2015	5	3/20/2015	3/16/2015	5		
Design revisions								
Spatial Organization	*Dig Mod/ Refine*	3/23/2015	5	3/27/2015				
Site Connections	*Dig Mod/ Refine*	3/23/2015	5	3/27/2015				
Contextetual Relavance	*Dig Mod/ Refine*	3/23/2015	5					
Functional Progression	*Dig Mod/ Refine*	3/23/2015	5	3/27/2015				
Structural Systems	*Dig Mod/ Refine*	3/23/2015	5	3/27/2015				
Sustainability Systems	*Dig Mod/ Refine*	3/30/2015	4	4/2/2015				
Environ Systems	*Dig Mod/ Refine*	3/30/2015	4	4/2/2015				
Life Safety Systems	*Dig Mod/ Refine*	4/7/2015	4	4/10/2015				
Fire Prevention System	*Dig Mod/ Refine*	4/7/2015	4	4/10/2015				
ADA Systems	*Dig Mod/ Refine*	4/7/2015	4	4/10/2015				
Display Revisions	*Pin ups/ Refine*	4/13/2015	14	4/26/2015				
Modeling Revisions	*revisited model*	4/13/2015	14	4/26/2015				
Speech formation	*writing revisions*	4/20/2015	10	4/29/2015				
Thesis Exhibit		4/27/2015	14	5/10/2015				
Thesis Book		3/23/2015	50	5/11/2015				
Final Deadlines								
Digital proposal due		4/23/2015	1	4/23/2015	4/23/2015	1	4/23/2015	
Proposal Displayed		4/27/2015	1	4/27/2015	4/27/2015	1	4/27/2015	
Displays Analyzed		4/27/2015	3	4/29/2015	4/27/2015	3	4/29/2015	
Thesis Reviews		5/1/2015	7	5/7/2015	5/1/2015	7	5/7/2015	
Digital to Advisors		5/11/2015	1	5/11/2015	5/11/2015	1	5/11/2015	
Due to Repository		5/15/2015	1	5/15/2015	5/15/2015	1	5/15/2015	
Commencement		5/16/2015	1	5/16/2015				



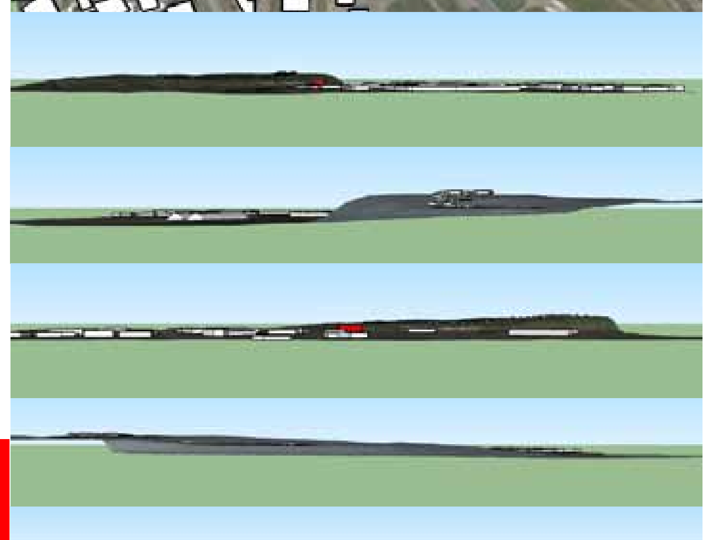
Week 1 - January 16th

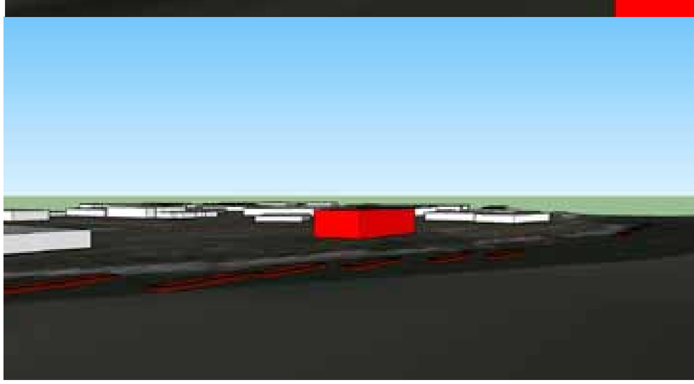




Week 2 - January 23rd

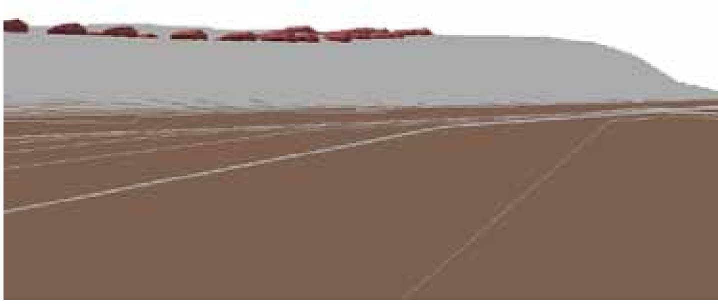
After generating a schedule outline for the semester I decided to begin digitally modeling my site constraints. To do this I began by importing the Google Earth topography of my site into Google Sketch-up. I then outlined and extruded all the buildings nearby to get a three dimensional model of my site. This process allowed me to image and explore the outer context of my site. Several key discoveries were established by this. First being the building forms nearby and associating how mine may react to them. Second this allows for understanding my building's orientation toward various topographical views.

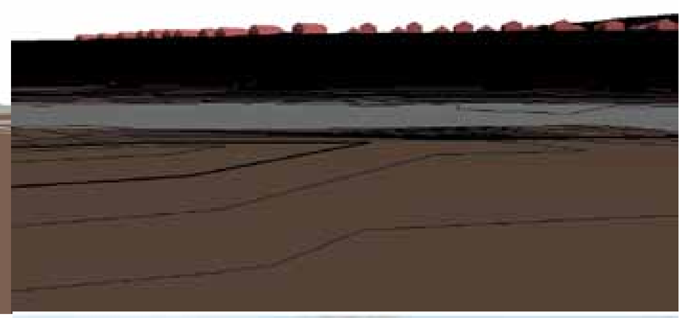




Week 3 - January 30th

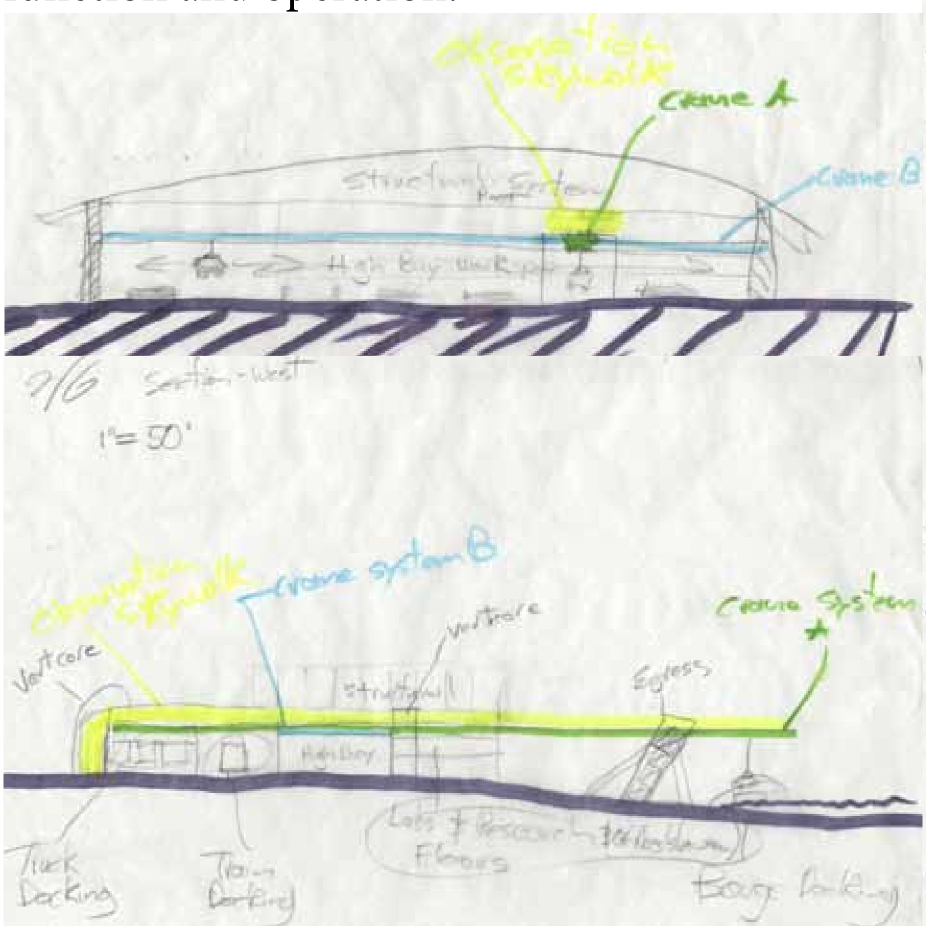
Expanding upon this site research, I imported my Sketch-up topographical and buildings model into Revit. This allows for a more analytical and accurately measurable site investigation. Additionally, I planned on using Revit to design in as it is my preferred BIM software of choice. We were then tasked with incorporating a structural grid into our designing process. I incorporated this into my Revit model. Lastly, I began to merge some site visit and 3D model photos to explore further what potential views I wanted to incorporate into my building's form.

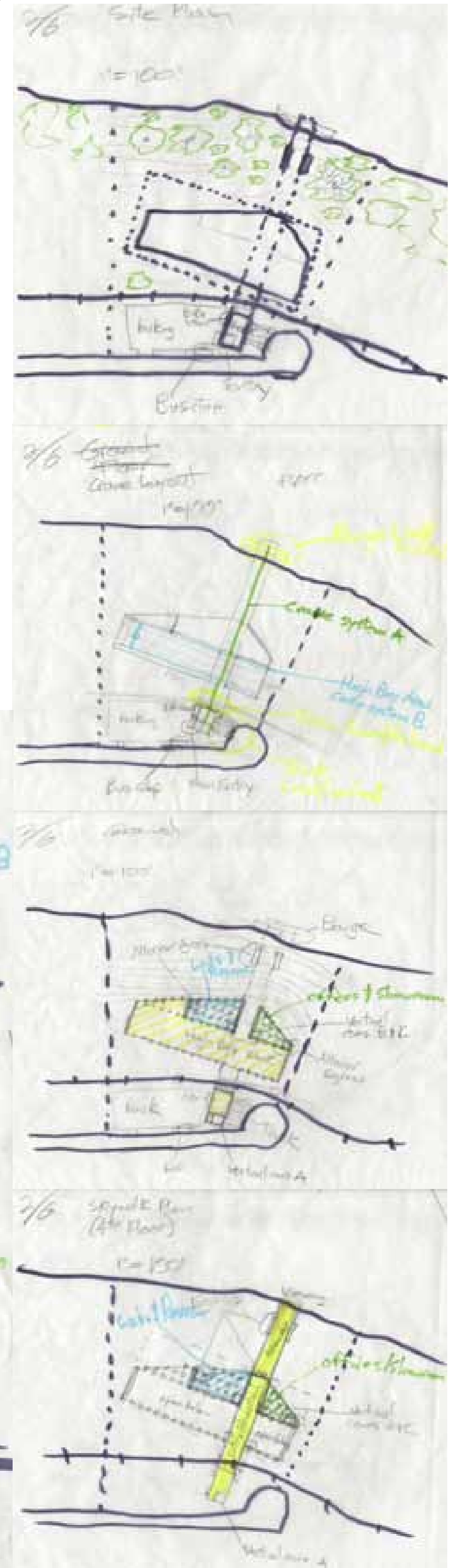




Week 4 - February 6th

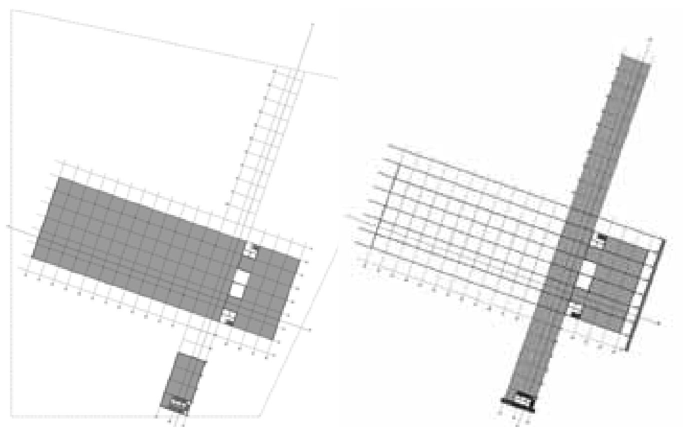
I then began sketching and further exploring the process of automotive recycling. This was an expansion of the bubble diagrams explored at the latter part of fall semester. I started to further research the site conditions and began drawing potential design solutions. This led to the first and most important acknowledgment. I must incorporate the existing road, train tracks and barge route into the final design. To do this I came to the conclusion that this project should be designed around the heavy equipment cranes vital to its function and operation.

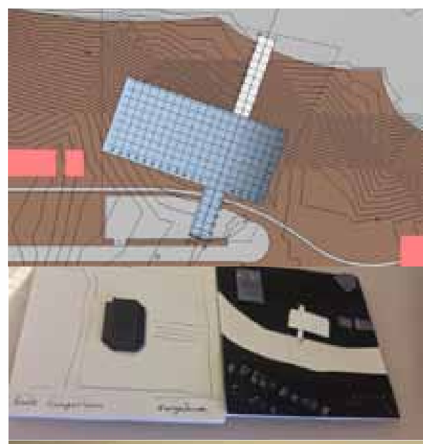


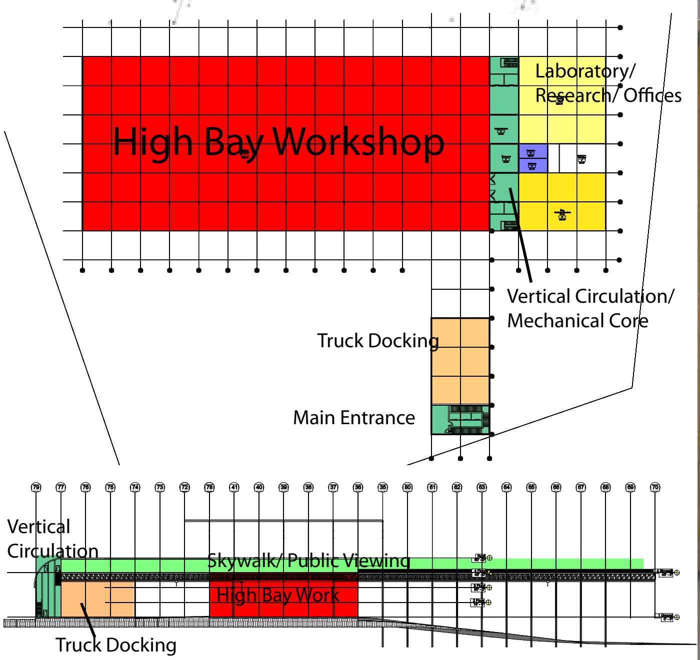


Week 5 - February 13th

This week we were tasked with presenting our progress to all of our section classmates at a quarterly review. To do this I translated and simplified my sketching progress into the Revit model I had of my site. I generated a handful of perspective images, plans, sections and basic details from this model, which I then pinned up in front of the class. On top of these images, I generated two very small mass models to associate the size and scale of my concept structure. To validate my typology, I decided a very large footprint is justified.

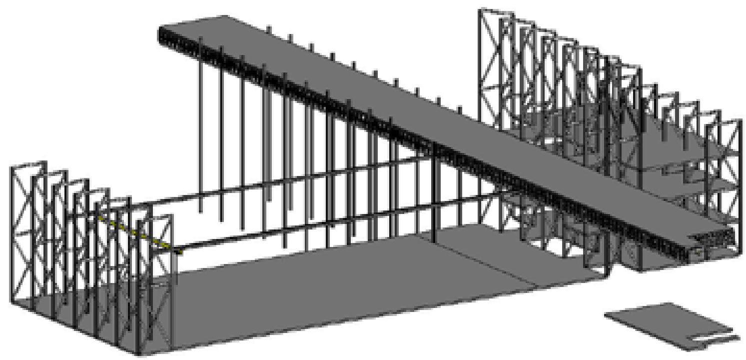


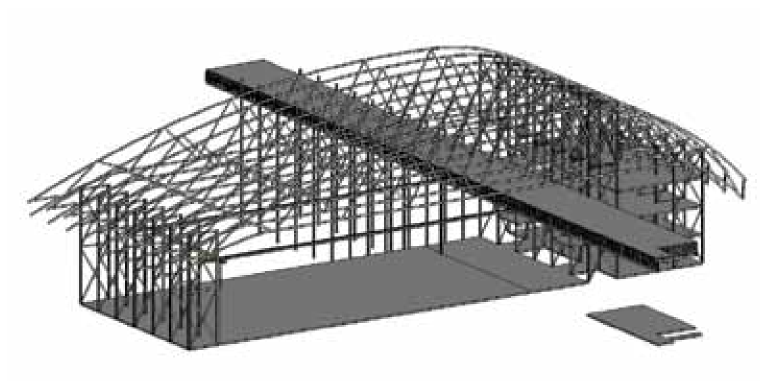


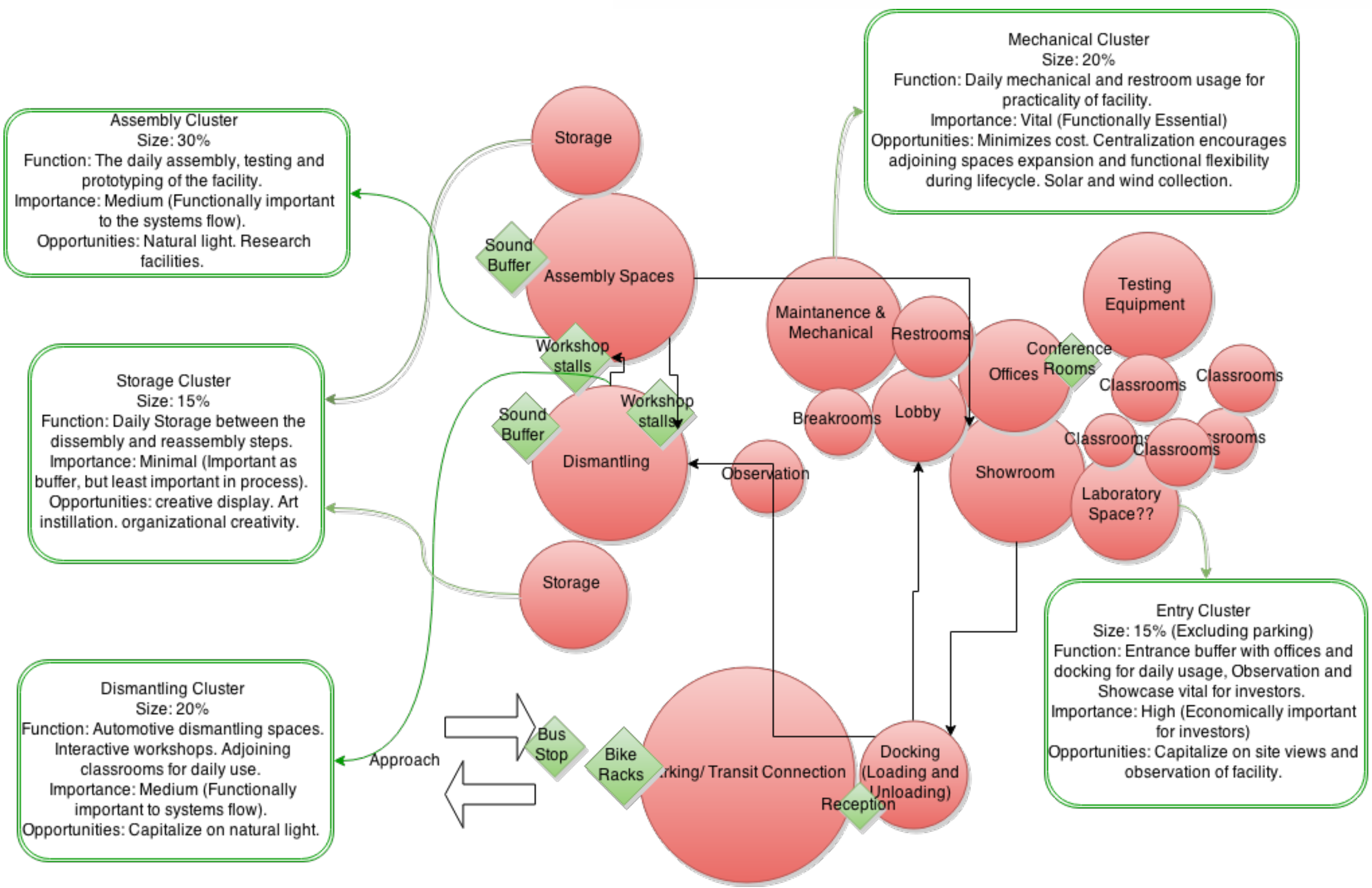


Week 6 - February 20th

Coming fresh from our quarterly review, it was apparent that I need to further elaborate and educate about my self generated typology. To do this I reestablished my bubble diagrams into the plan orientation I settled on. I also further designed my digital Revit model by beginning to explore and create structural systems.

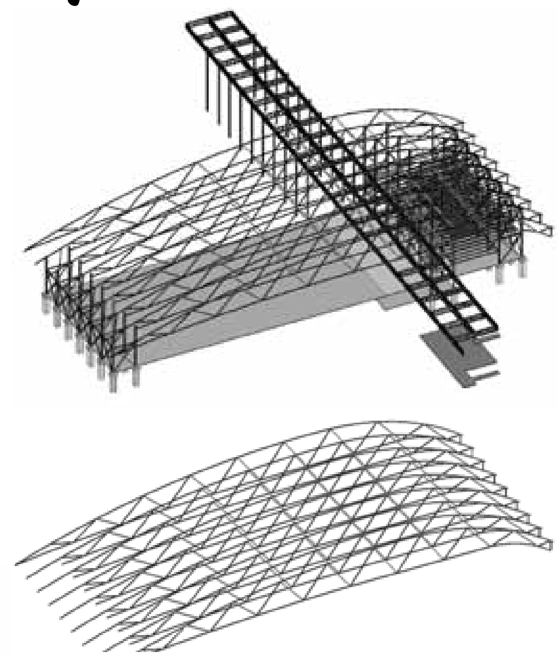


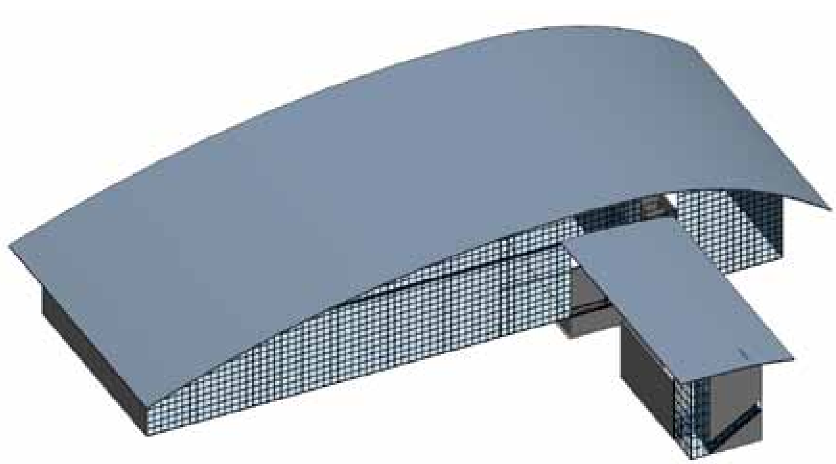


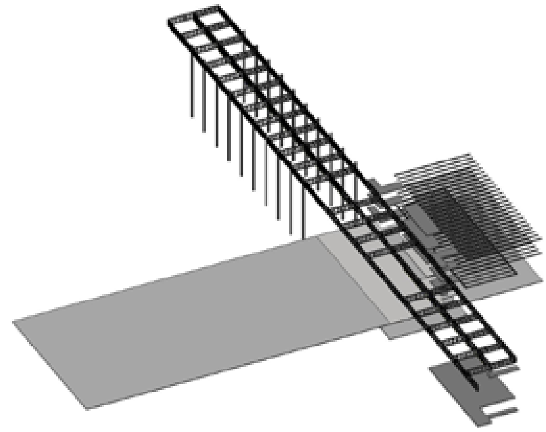


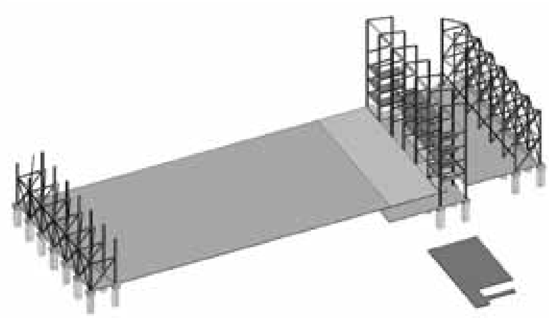
Week 7 - February 27th

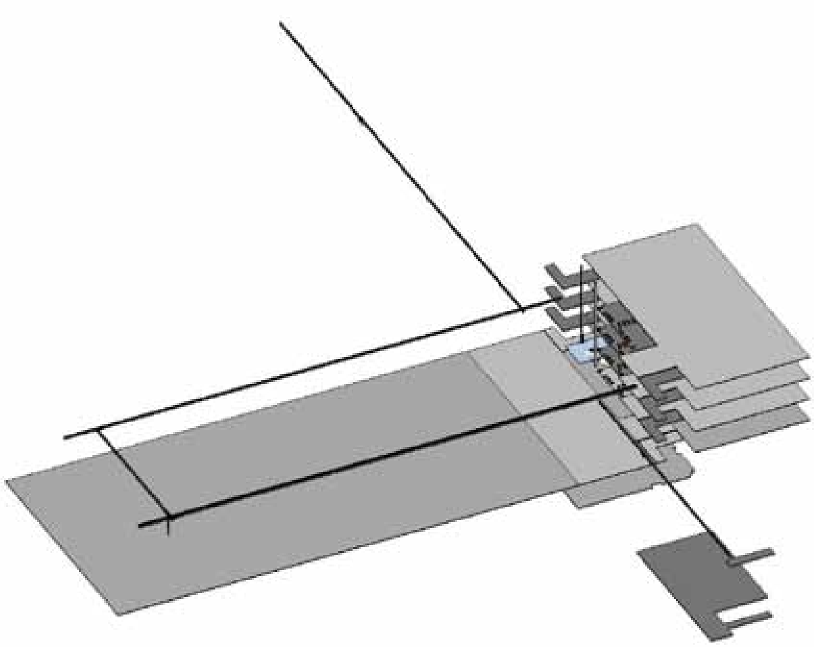
Pushing forward with the digital model I researched and modeled more structural systems. I began to incorporate the foundational, bridge, truss, floor, and column systems into the design. I also generated images of these in a consistent isometric view to “explode” the drawing. I then added the envelope and crane systems into my 3D digital model.





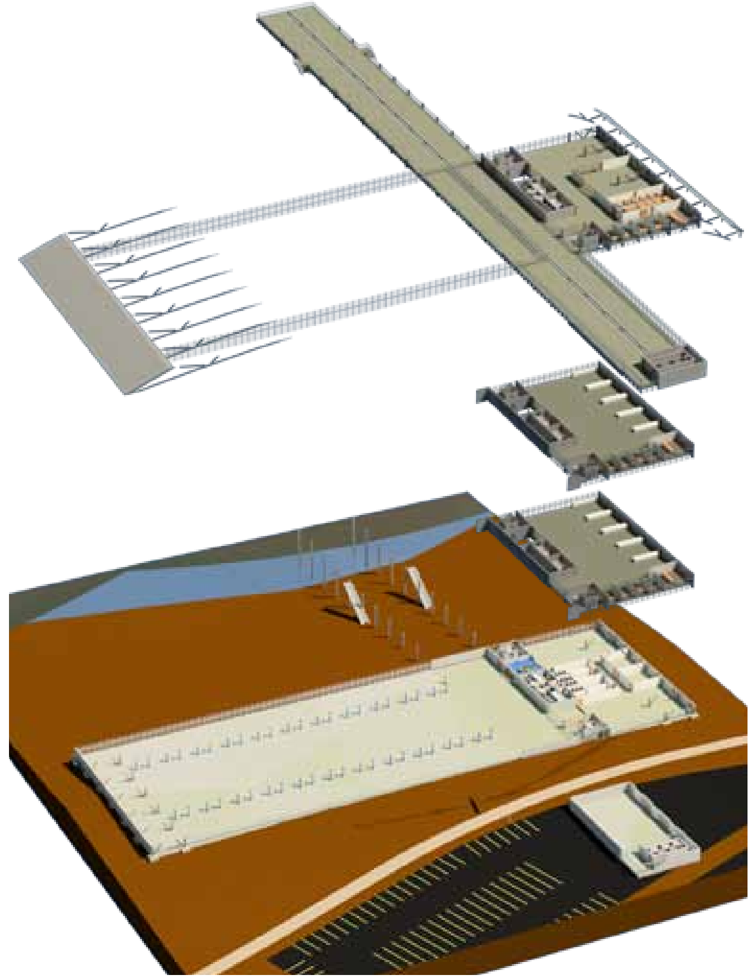


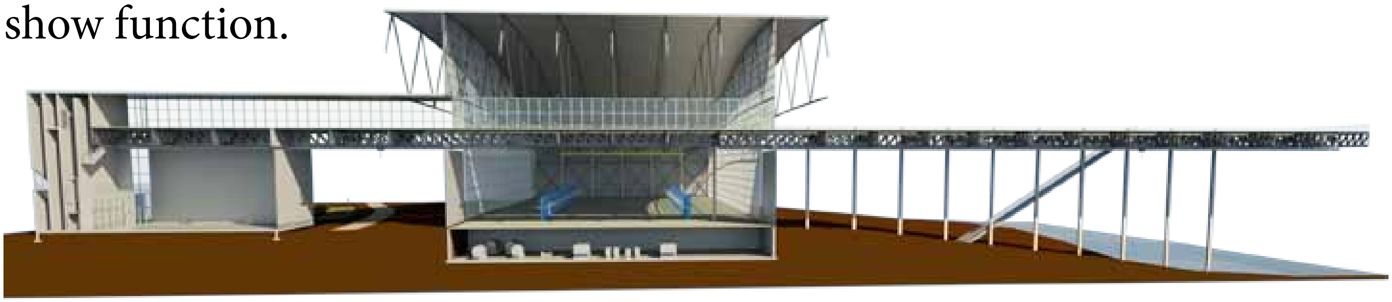


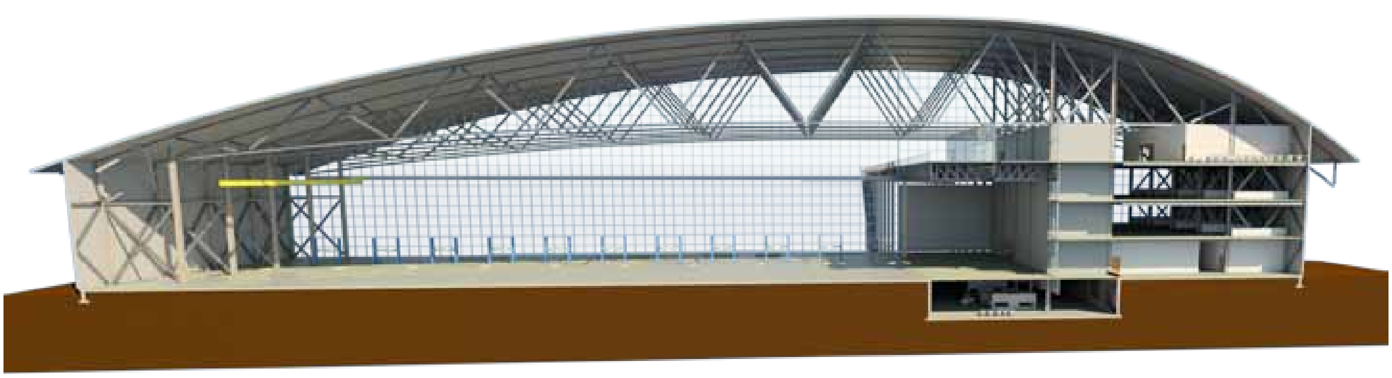


Week 8 - March 6th

As we approached the middle of the semester pressure began building to generate some sample images to present at the next week's midterm presentation. I felt to correspond with the deconstructive nature of my building typology that my drawings would have to be an exploded isometric of the building. I did this by adding interior walls and some furniture and fixtures to the Revit model, then creating floor by floor isometric section perspectives and stacking them. I also generated section perspectives to show function.







Week 9 - March 13th

Above is the board layout I generated for our midterm week's presentations. Through a handful of Revit view images, sections, and research photographs I knitted together a board oriented around my exploded isometric. To do this I used a combination of Photoshop documents, Revit generated JPEGS and vectors within Adobe Illustrator.

Week 10 - March 20th

Midterm reflections via professor Mike Christenson comments and discussion notes.

Comments specific to my project...

You need to be very clear about the building's program. Be able to state precisely what happens here. Create a much-simplified flow diagram of the process. Use this flow diagram to explain the overall form of the building. Be very clear about the movement of components – be very clear about the transportation systems.

Consider the symbolic dimension of your architecture. Develop a narrative which clarifies why this program is important. In doing so, consider the various constituencies with an interest in the Architecture: why is it of interest to industry, to the interested public, to the city at large?

Build a larger-scale model of the building including a heavy base representing the contoured ground. Consider using a sheet of acrylic to represent the surface of the river. Accompany this large model with at least three more small-scale iterative models clarifying the form and program.

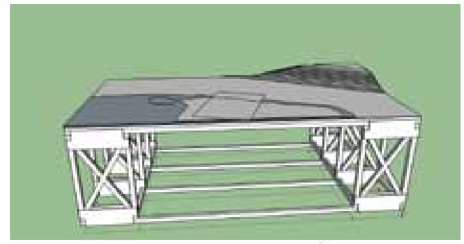
Comments for all students:

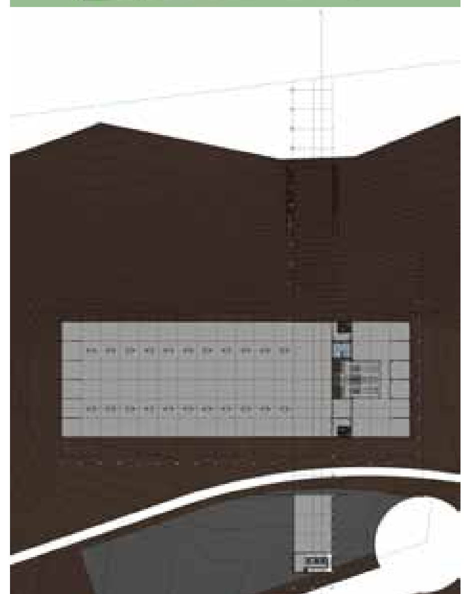
Practice, practice and practice for your presentations for clear and concise articulation. Practice anticipated answers to questions also.

Constructing large and small scale models can be very useful in developing an easy narrative of your buildings flow.

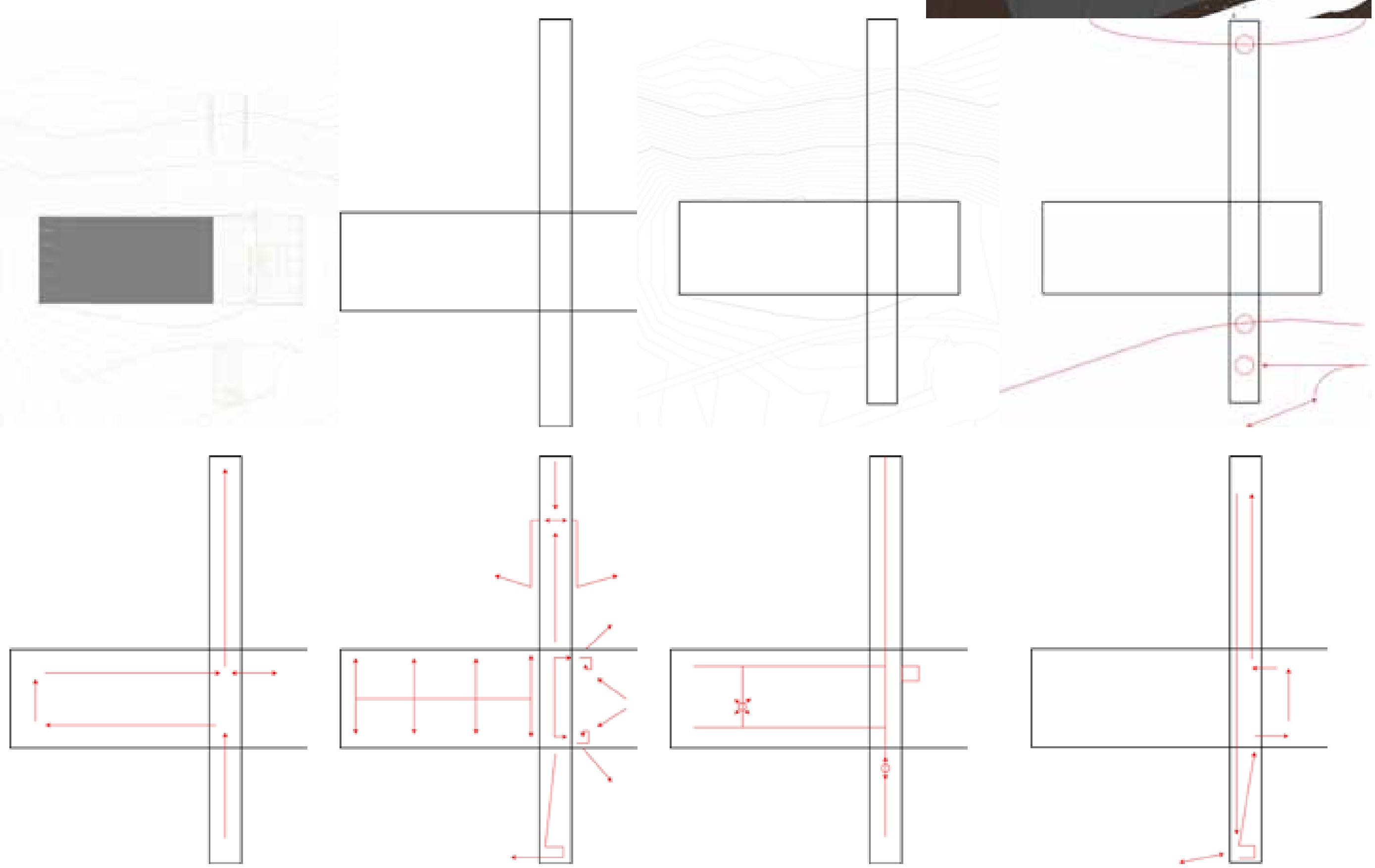
Physical visual aids versus digital representations in my experience as a juror are much easier to make connections with your work.

Week 11 - March 27th



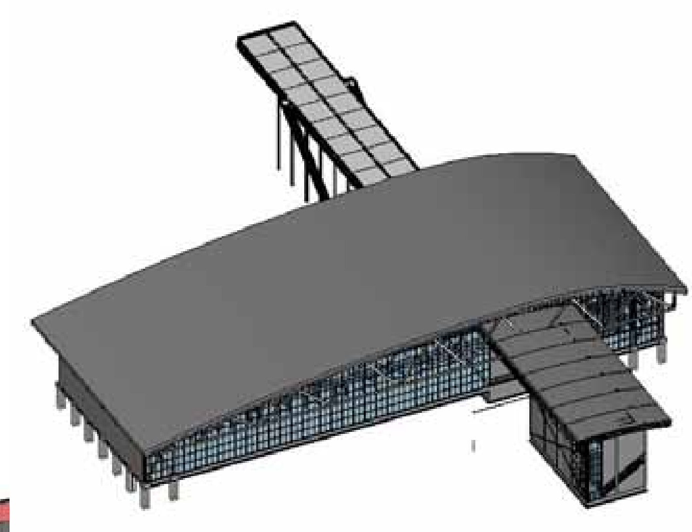


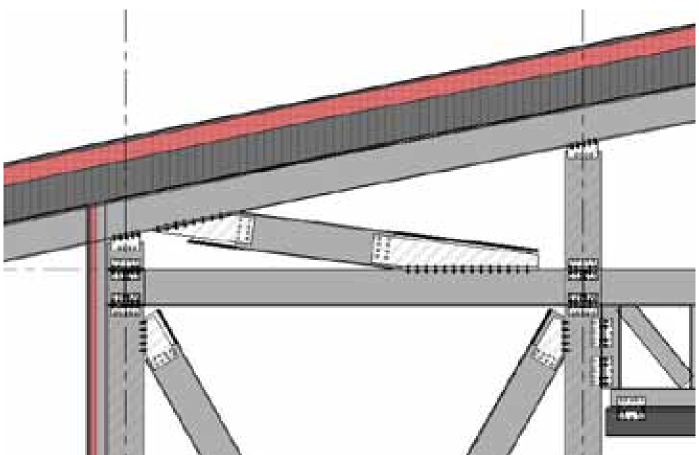
Coming off of a spring break full of pondering midterms, it became very evident that I needed to better explain the process by which people and products flow through my structure. To begin exploring how to go about this, I started generating oversimplified plan drawings with flow information. Additional to these diagrams I began a conception of a physical representation to assist in talking through my design. To over emphasize the scale and size of my proposal I decided early on to design a model (or set of models) that was equally large and powerful.

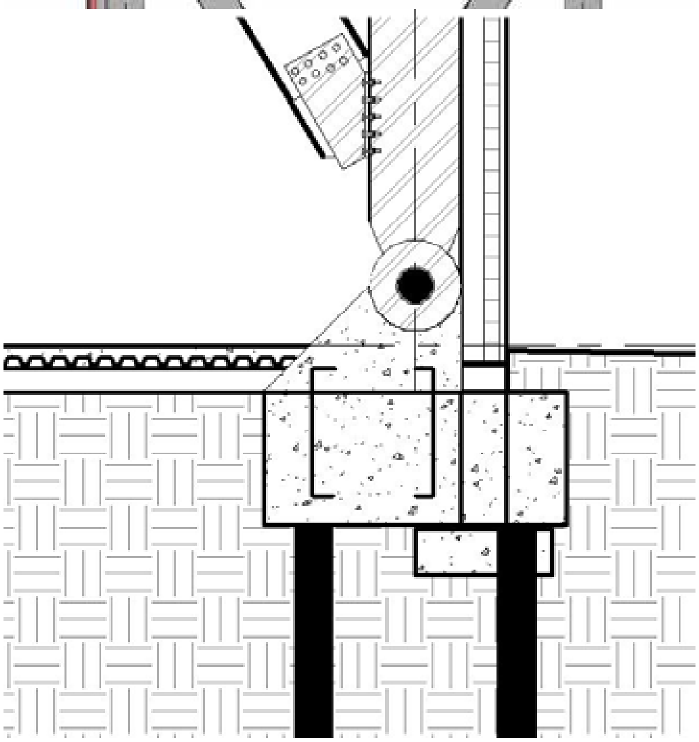


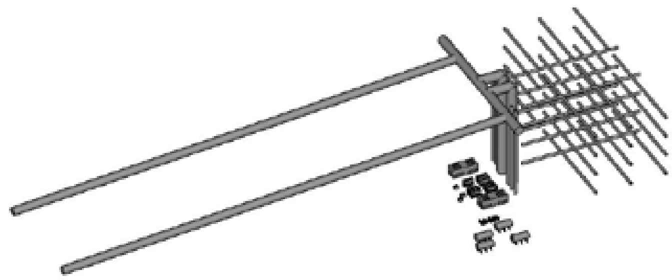
Week 12 - April 3rd

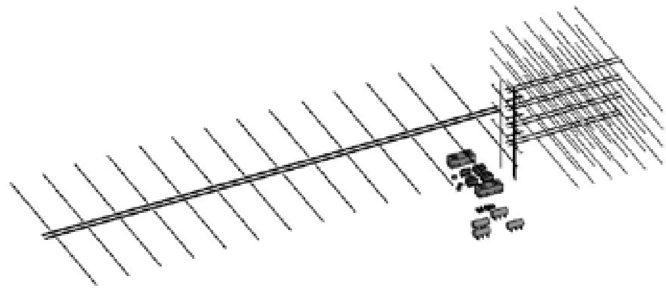
Being a dual thesis and cumulative architectural design project, an emphasis on architectural detailing became very important. For this week I focused on preliminary construction details and conceptual mechanical layouts.

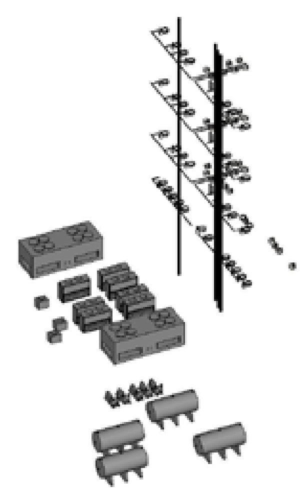






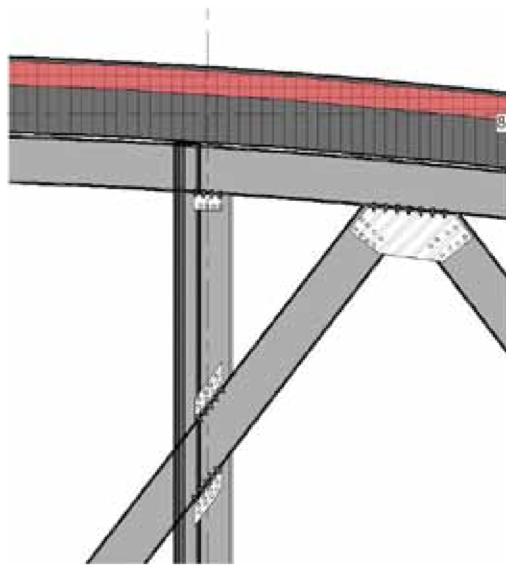


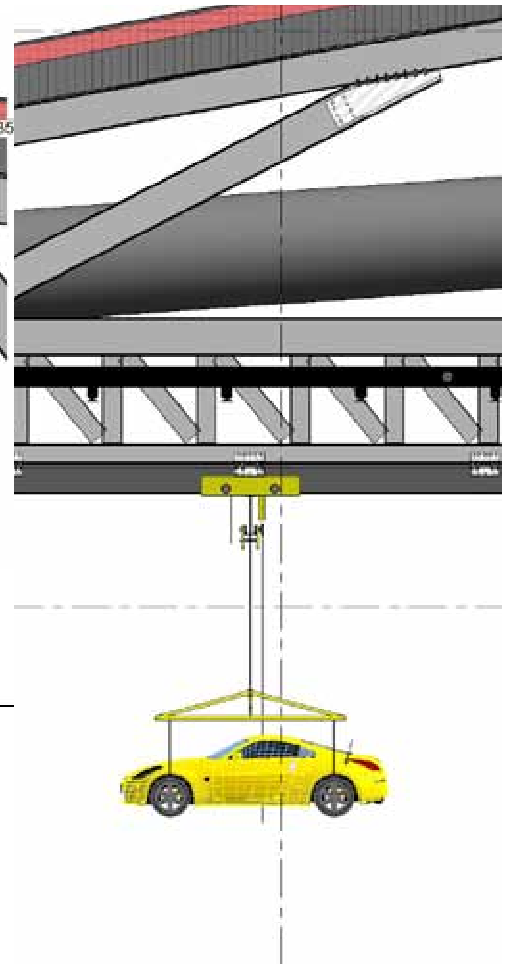


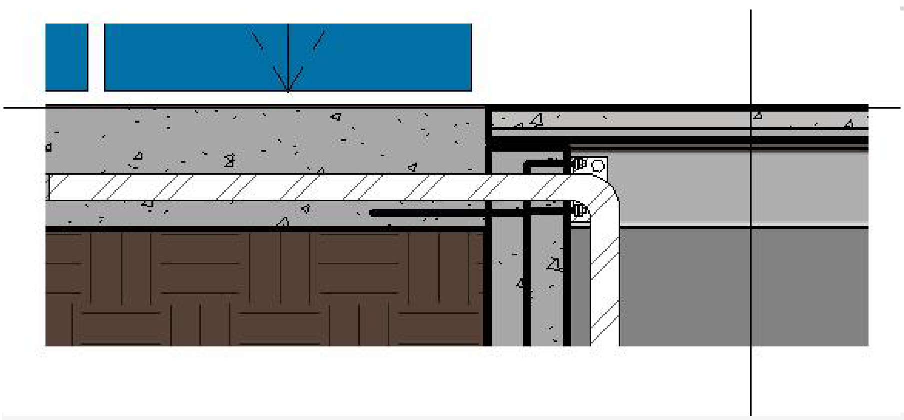


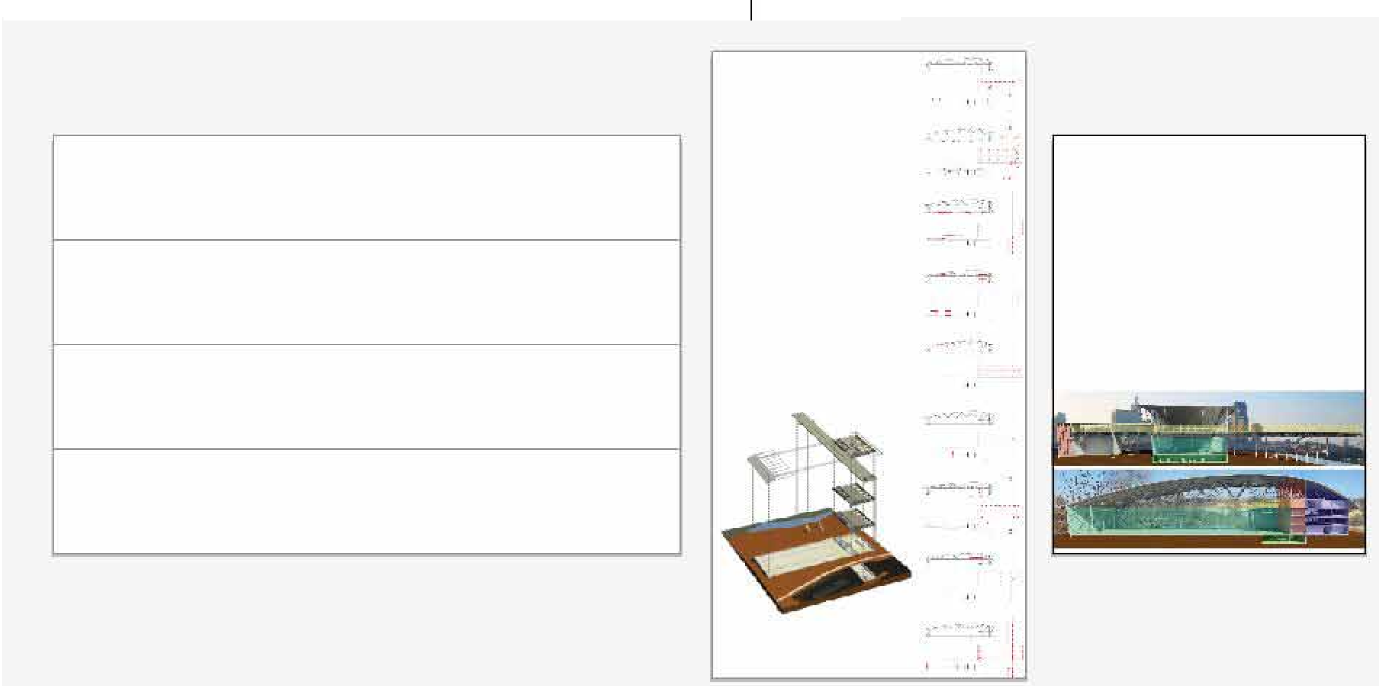
Week 13 - April 10th

I continued my work within construction details (right and on following page) and also began preliminary presentation board layouts (seen below).



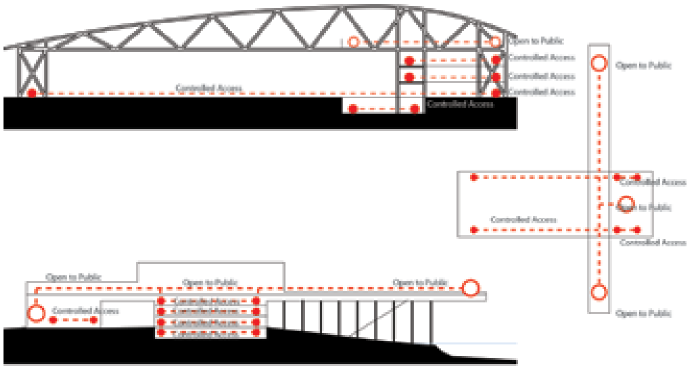




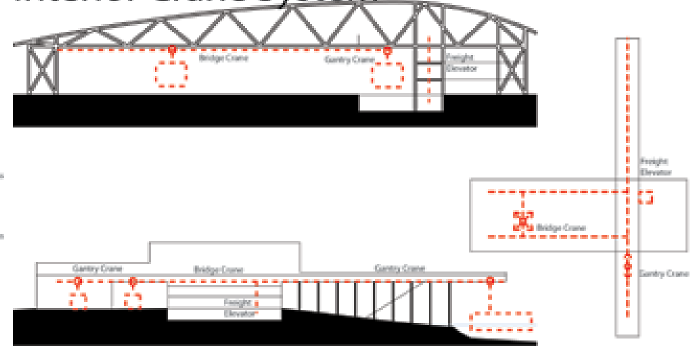


Week 13 - April 10th cont.

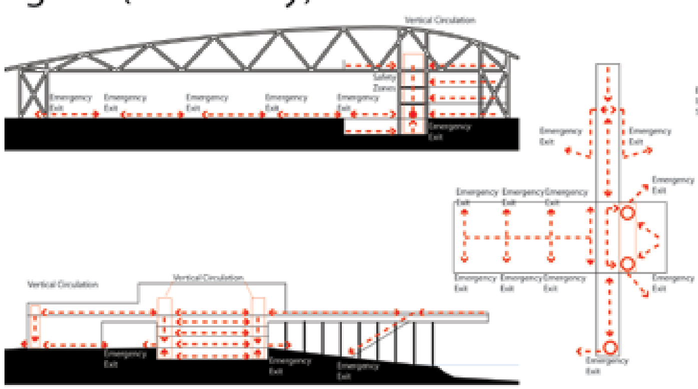
Security and Control Access



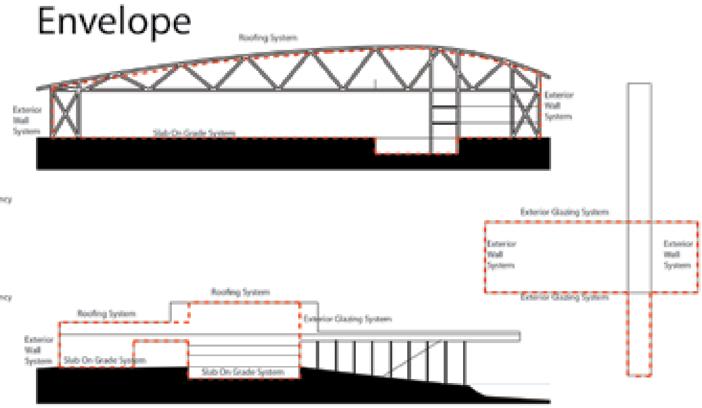
Interior Crane System



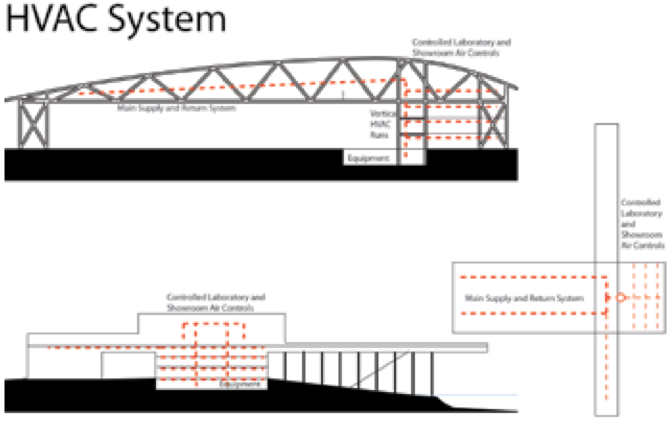
Egress (Life Safety)



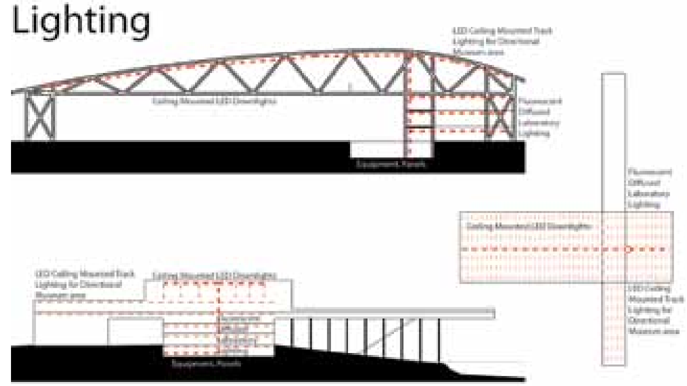
Envelope



HVAC System

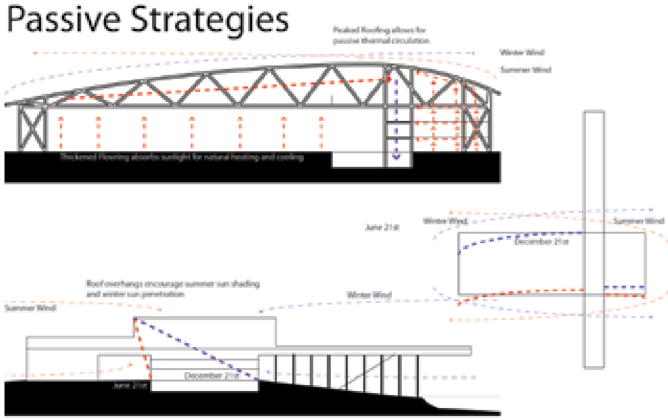


Lighting

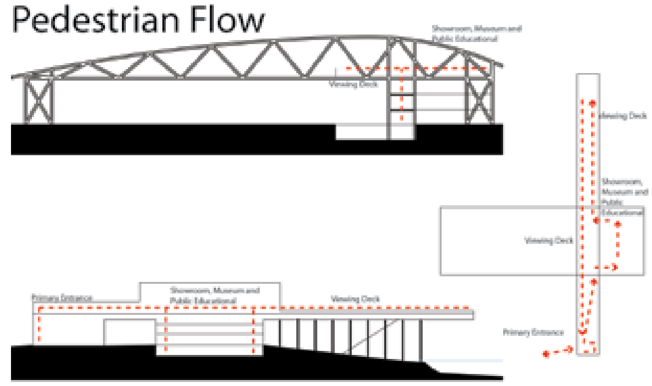


Week 13 - April 10th cont.

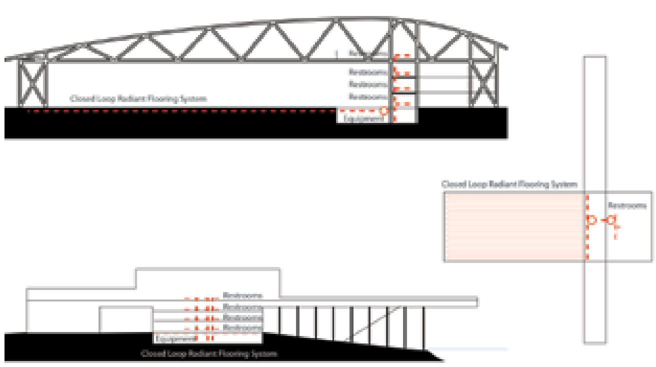
Passive Strategies



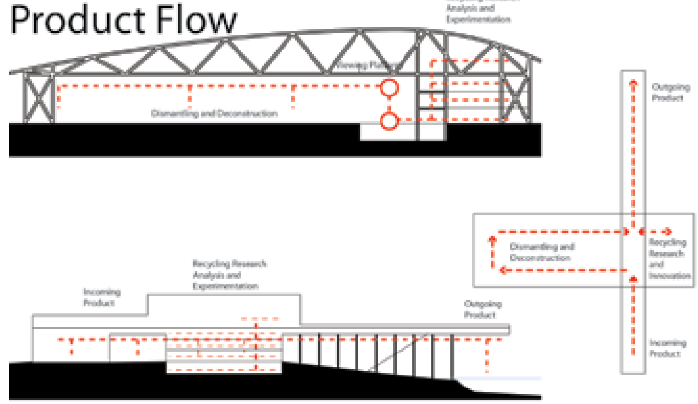
Pedestrian Flow



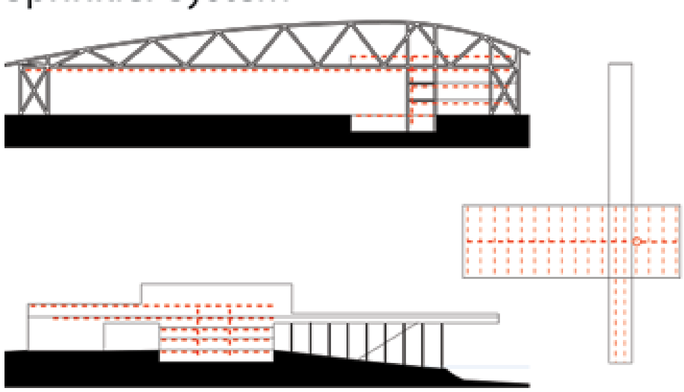
Plumbing System



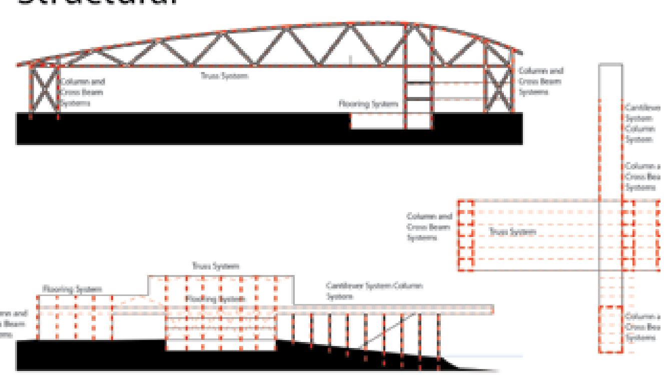
Product Flow



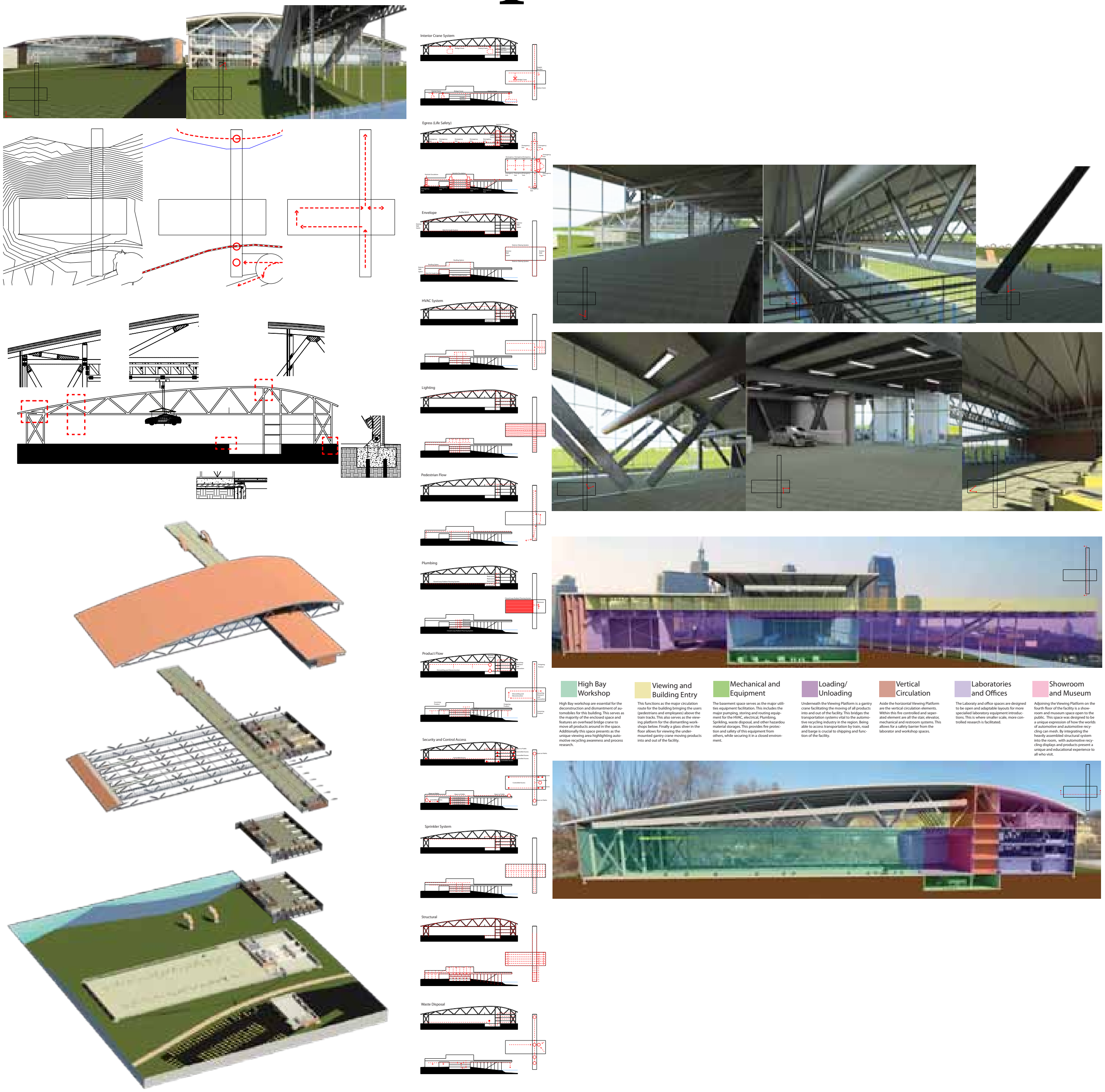
Sprinkler System



Structural



Week 14 - April 17th



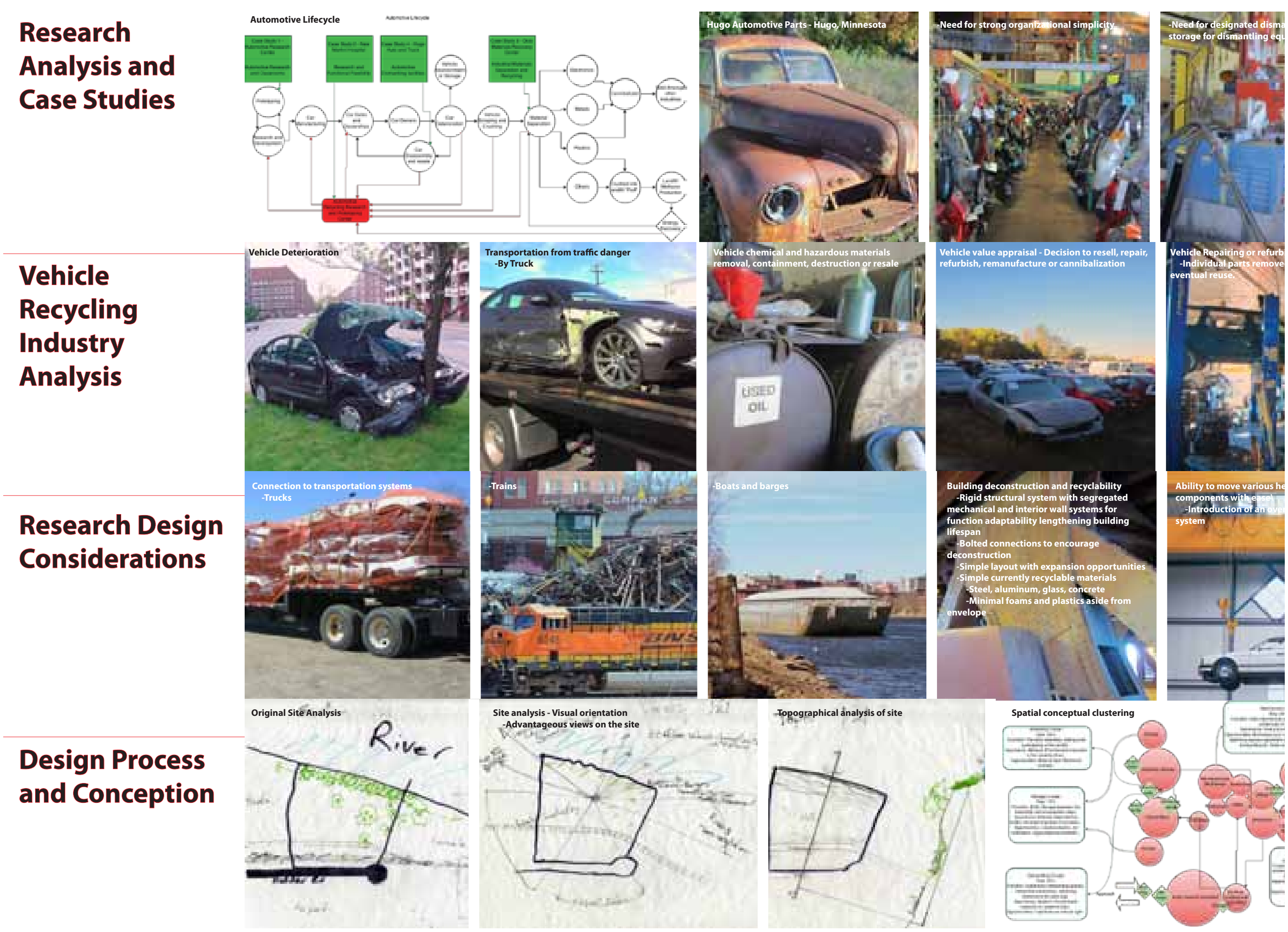
Above are my initial board layouts with details, diagrams, an exploded isometric and section perspectives. This allowed me to further explore representation with diagrams in plan, eastern and southern sections. Lastly within the section perspectives I began to color code the programmatic elements within my design for viewing ease.

Week 15 - April 24th

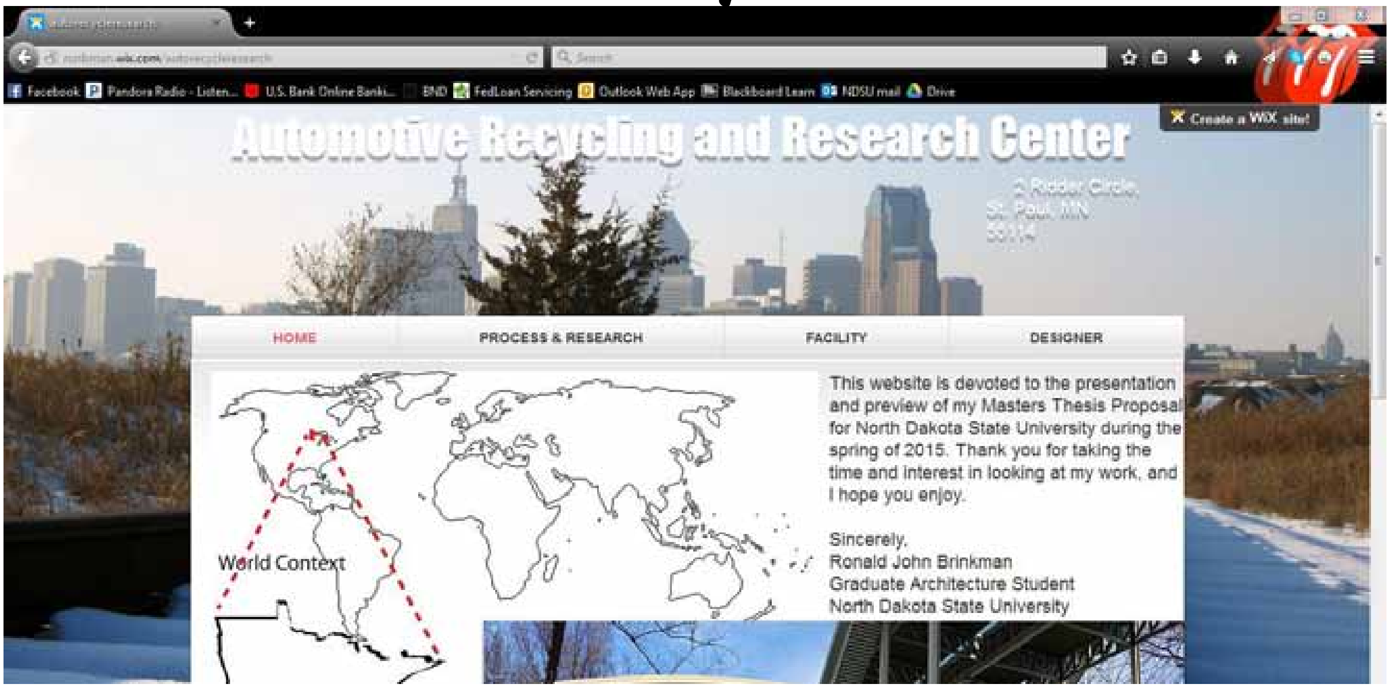
Above are my finalized presentation board spreads for our open formal gala submittal. I started by Photoshopping in more context to the renderings for a better narration of my spaces. Beyond cleaning up several of the renderings and drawings I added map references and clear text outlining broad and specific details to the project.

Week 16 - May 1st

The next submittal piece to this thesis project was a formal presentation explaining and defending my year's worth of design work. To assist in this I generated four exceptionally large printed visual aid boards. This allowed me to outline my speech and coordinate all of my specific talking points to a photo. By generating boards for a critique, versus images in a powerpoint presentation, jurors are encouraged to visually link my process to my design within my boards with ease. In addition to these boards I generated a website (seen right) for easy viewing of my project before my critique. This can be found at *http://ronbman.wix.com/autorecycleresearch* for reference.



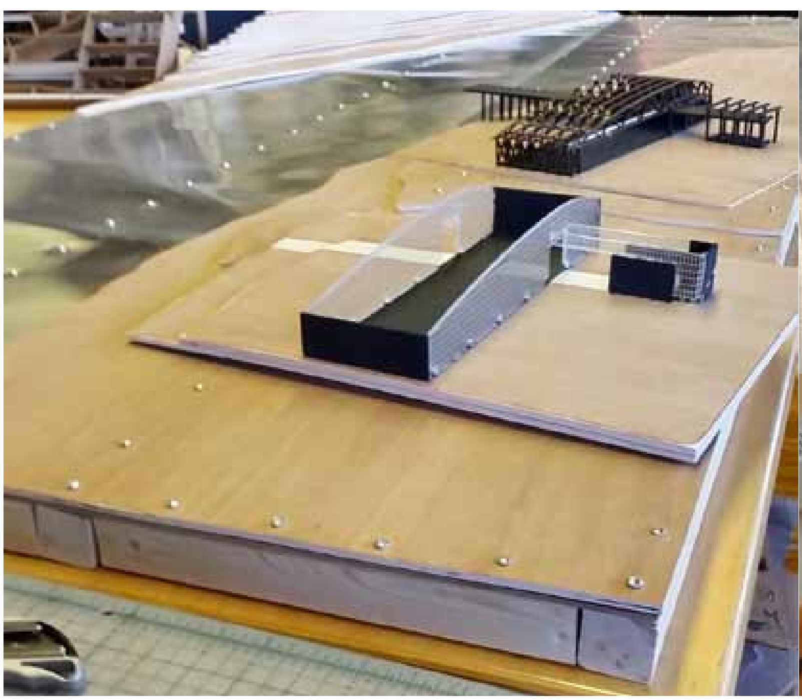
Week 16 - May 1st cont.



Week 17 - May 8th

Also coordinating the final presentation, I designed and constructed physical models for fast interpretation of the major building elements. The extra large base represented the elongated structural system of my building (seen bottom right). The two insert models shown exaggerate specific elements within the design. The first (top right) is a building envelope model showing the exterior skins of the building. Most of these are glass and steel represented by painted wood and Plexiglas acrylic. The next insert (shown center right), shows the structural system in detail with the contrasting affixed interior craning systems. This easily shows how the under-mounted bridge and gantry crane systems integrate within the rigid structural system.

Lastly I acquired a handful of automotive parts to establish a timeline of recycling efficiencies, further connecting the dots of architecture and automobiles at ease during my presentation. My final presentation instillation can be seen in the bottom right photograph.

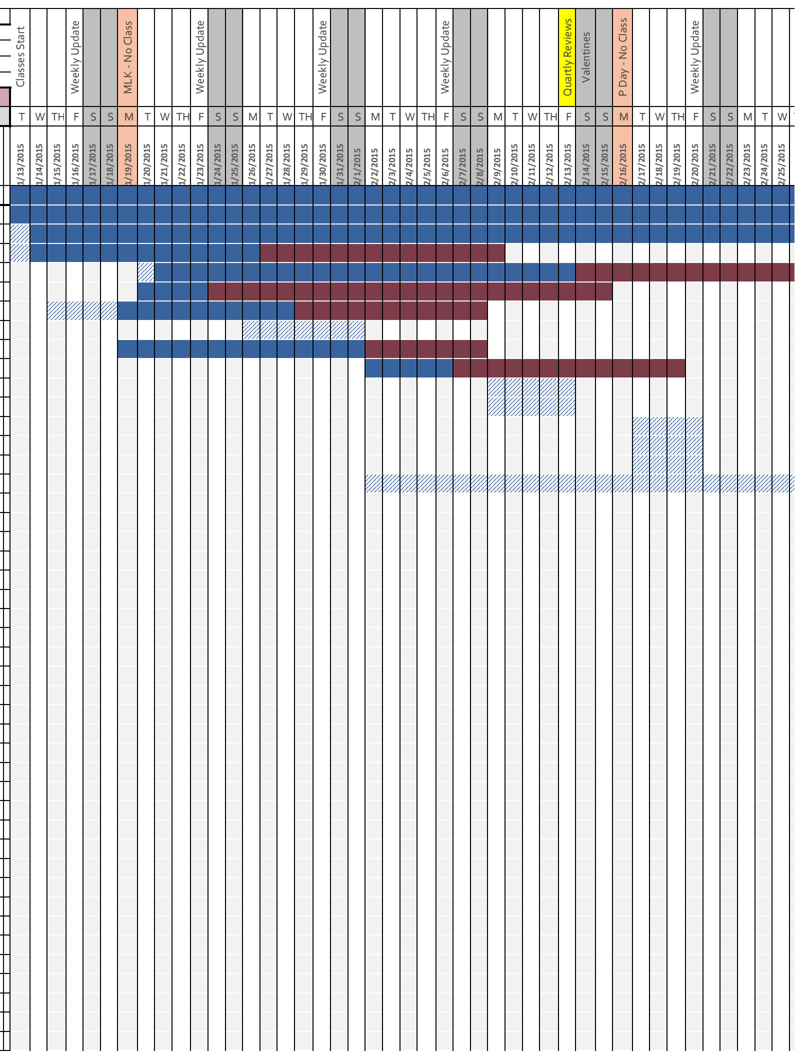


Week 17 - May 8th cont.

Wrap up

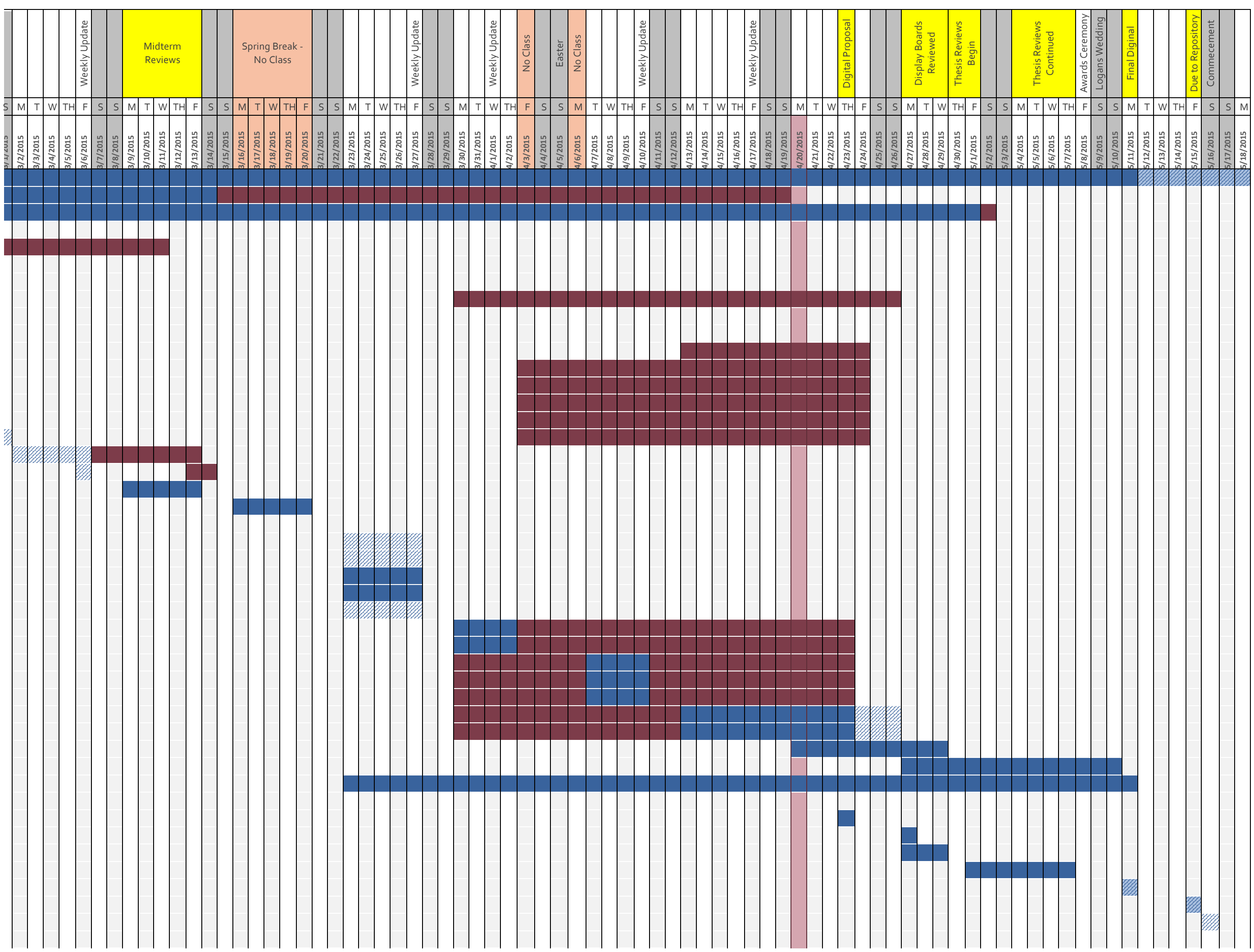
At the beginning of the semester we were challenged with creating a schedule to better understand the extents we wanted to push ourselves for the semester. Upon the finish of the semester I thought it a useful exercise to acknowledge and reflect on how I actually designed through the semester. The below result shows exactly how my actual real time design experience varied from my original plan. For easy reading, the dark blue shows when I stuck to my plan and dark maroon shows the actual deviations from the process. Everything from the conceptual work in architectural form and model making greatly deviated through the semester. It is very clear that despite the best of planning and scheduling intentions, I do not "design on a schedule" as

Project		Thesis Timeline						
Legend								
		Plan			Actual (beyond plan)			
		Actual			% Complete (beyond plan)			
		% Complete			No Class			
Todays Date:		Monday, April 20, 2015						
Project Start:		Monday, September 01, 2014						
Activity	***Deliverables***	**Plan Start**	**Plan Duration**	**Plan End Date**	**Actual Start**	**Actual Duration**	**Actual End Date**	**Percent Complete**
Spring Semester		1/13/2015	126	5/18/2015	1/13/2015	126	5/18/2015	95%
Program Editing		1/13/2015	61	3/14/2015	1/13/2015	97	4/20/2015	100%
Design		1/13/2015	109	5/1/2015	1/14/2015	109	5/2/2015	100%
Spatial Organization	*Bubble Diagram*	1/13/2015	14	1/26/2015	1/14/2015	27	2/9/2015	100%
Digital Model	*Print offs*	1/20/2015	25	2/13/2015	1/21/2015	50	4/18/2015	100%
Contextetual Relavance	*Digital Model*	1/20/2015	4	1/23/2015	1/20/2015	27	2/16/2015	100%
Site Connections	*Drawings*	1/15/2015	14	1/28/2015	1/19/2015	21	2/8/2015	100%
Physical Model	*Site Model*	1/26/2015	7	2/1/2015	3/30/2015	28	4/27/2015	100%
Functional Progression	*Circulation Draw*	1/19/2015	14	2/1/2015	1/19/2015	21	2/8/2015	100%
Structural Systems	*Dig Mod/ Plans*	2/2/2015	5	2/6/2015	2/2/2015	18	2/20/2015	100%
Sustainability Systems	*Dig Mod/ Plans*	2/9/2015	5	2/13/2015	4/13/2015	12	4/24/2015	100%
Environ Systems	*Dig Mod/ Plans*	2/9/2015	5	2/13/2015	4/3/2015	22	4/24/2015	100%
Life Safety Systems	*Dig Mod/ Plans*	2/17/2015	4	2/20/2015	4/3/2015	22	4/24/2015	100%
Fire Prevention System	*Dig Mod/ Plans*	2/17/2015	4	2/20/2015	4/3/2015	22	4/24/2015	100%
ADA Systems	*Dig Mod/ Plans*	2/17/2015	4	2/20/2015	4/3/2015	22	4/24/2015	100%
Disassembly Systems/D	*Dig Mod/ Plans*	2/2/2015	28	3/1/2015	4/3/2015	22	4/24/2015	100%
Display Considerations	*Pin Ups*	3/2/2015	5	3/6/2015	3/7/2015	7	3/13/2015	100%
Speech Considerations	*Writing Pages*	3/6/2015	1	3/6/2015	3/13/2015	2	3/14/2015	100%
Midterm Reviews	*Present/ Notes*	3/9/2015	5	3/13/2015	3/9/2015	5	3/13/2015	100%
Spring Break		3/16/2015	5	3/20/2015	3/16/2015	5		100%
Design revisions								
Spatial Organization	*Dig Mod/ Refine*	3/23/2015	5	3/27/2015				0%
Site Connections	*Dig Mod/ Refine*	3/23/2015	5	3/27/2015				0%
Contextetual Relavance	*Dig Mod/ Refine*	3/23/2015	5	3/27/2015	3/23/2015	5	3/27/2015	100%
Functional Progression	*Dig Mod/ Refine*	3/23/2015	5	3/27/2015	3/23/2015	5	3/27/2015	100%
Structural Systems	*Dig Mod/ Refine*	3/23/2015	5	3/27/2015				
Sustainability Systems	*Dig Mod/ Refine*	3/30/2015	4	4/2/2015	3/30/2015	25	4/23/2015	100%
Environ Systems	*Dig Mod/ Refine*	3/30/2015	4	4/2/2015	3/30/2015	25	4/23/2015	100%
Life Safety Systems	*Dig Mod/ Refine*	4/7/2015	4	4/10/2015	3/30/2015	25	4/23/2015	100%
Fire Prevention System	*Dig Mod/ Refine*	4/7/2015	4	4/10/2015	3/30/2015	25	4/23/2015	100%
ADA Systems	*Dig Mod/ Refine*	4/7/2015	4	4/10/2015	3/30/2015	25	4/23/2015	100%
Display Revisions	*Pin ups/ Refine*	4/13/2015	14	4/26/2015	3/30/2015	25	4/23/2015	100%
Modeling Revisions	*revisited model*	4/13/2015	14	4/26/2015	3/30/2015	25	4/23/2015	100%
Speech formation	*writing revisions*	4/20/2015	10	4/29/2015	4/20/2015	10	4/29/2015	100%
Thesis Exhibit		4/27/2015	14	5/10/2015	4/27/2015	14	5/10/2015	100%
Thesis Book		3/23/2015	50	5/11/2015	3/23/2015	50	5/11/2015	100%
Final Deadlines								
Digital proposal due		4/23/2015	1	4/23/2015	4/23/2015	1	4/23/2015	100%
Proposal Displayed		4/27/2015	1	4/27/2015	4/27/2015	1	4/27/2015	100%
Displays Analyzed		4/27/2015	3	4/29/2015	4/27/2015	3	4/29/2015	100%
Thesis Reviews		5/1/2015	7	5/7/2015	5/1/2015	7	5/7/2015	100%
Digital to Advisors		5/11/2015	1	5/11/2015	5/11/2015	1	5/11/2015	
Due to Repository		5/15/2015	1	5/15/2015	5/15/2015	1	5/15/2015	
Commencement		5/16/2015	1	5/16/2015				



well as I thought. This is perhaps a more revealing revelation on how we think about design versus how we architects actually design. While developing an academic thesis, I honestly believe that reflecting upon how your intentions and actions differ is of utmost importance. And this is possibly the greatest lesson I've learned in my personal work ethic showing the importance of proper time management as I carry into the professional world.

"We live and we die by time, and we must not commit the sin of turning our back on time," Chuck Noland (as played by Tom Hanks in Cast Away).



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Appendix - Figures/Images

Chapter One - Proposal

Chapter Two - Programming

Appendix - Figures/Images

Figure 10.2 Diagram Author
Figure 10.3 Diagram Author
Figure 10.4 Chart Kanari N., Pineau J-L., Shallari S. (2003)
Figure 10.5 Diagram Schultmann, F. f., & Sunke, N. n. (2007)
Figure 10.6 Photo Sasidharan, N. a., & Chani, P. p. (2011)
Figure 10.7 Photo Author
Figure 10.8 Photo Sasidharan, N. a., & Chani, P. p. (2011)
Figure 11.1 Photo Author
Figure 11.2 Photo Author
Figure 11.3 Diagram Bunz, K. R., Henze, G. g., & Tiller, D. K. (2006)
Figure 11.4 Photo Chartwell.org
Figure 11.5 Photo Wikimedia.org (2014)
Figure 12.1 Map Author
Figures 12.2 - 12.8 Photos Author
Figure 12.9 Map Author
Figures 12.10 - 12.46
Charts City-Data.com
Maps Geo-Information (2014)
Figure 12.47 Map Author
Figure 12.48/12.49 Maps Geo-Information (2014)
Figure 12.50 Map University of Minnesota (2014)
Figure 12.51 Solar Gaisma (2014)
Figures 12.52/12.53 Charts City-Data.com
Figures 12.54 - 12.56 Maps Author
Figures 12.57 Wind Rose Iowa Enviromental Mesonet (2014, November 10)
Figures 12.58 - 12.62 Charts City-Data.com
Figure 12.63 Map Author
Figure 13.1 Photo Author
Figure 13.2 Chart Author
Figure 13.3 Photo ACEAuto.com (2014)
Figure 13.4 Photo ACEAuto.com (2014)
Figure 13.5 Photo Author
Figure 13.6 Photo Author
Figure 13.7 Photo Author
Figure 13.8 Photo ACEAuto.com (2014)
Figure 13.9 Chart Author
Figure 13.10 Chart Author
Chapter 3 Figures/Images by Author
Figure 14.1 Photo Mike Brinkman

Appendix - Past Studios

Author's Studio Design History at North Dakota State University

Semester ***Professor***

Name	*Location*	*Vernacular*	*Typology*

Notes

2011 Fall **Joan Vorderbruggen**

Tea House	Fargo, ND	Park	Ceremonial
Boat House	Minneapolis, MN	Training	Recreation

This course contributed greatly to my development of conceptual spatial design and process. I worked heavily with programming spaces and associations between program specific spaces. No doubt this was very influential to all of my design work following.

2012 Spring **Stephen Wischer**

Twin House	Fargo, ND	Housing	Narrative
Music Hall	Fargo, ND	Music Hall	Music

The focus of this semester was designing beyond conventual methodologies and designing within the academic context. We did this in a variety of ways, but foremost this emphasized the importance of the intentional narration of design. It was here additionally where I learned and pressured myself to push my personal boundaries of design through construction of physical models.

2012 Fall **Frank Kratky**

Hopperstad Church	Moorhead, MN	Church	Analysis
Faith Methodist	Fargo, ND	Church	Ceremonial

It was in this course I explored design opportunities for renovation projects and the advantages of presenting with architectural diagrams.

Appendix - Past Studios

2013 Spring David Crutchfield

Boutique Hotel	Upham, NM	Luxury Hotel	Hospice
Chicago Folk Art	Chicago, IL	Museum	Educational

It was in this course we were really challenged to pursue an acknowledgement of the physical requirements of composing buildings in an aesthetically beautiful manner. How can we as architects use the programmatic requirements we were given in combination with the physical requirements to yield a creative solution? Navigating the required with the conceptional became a very unique design opportunity challenge.

2013 Fall Bakr Aly Ahmed

High Rise	San Francisco, CA	High Rise	Commercial

In this course I took away two key aspects. First being, how to work in coordination with a design partner? Second being, how to develop a first swing at a cumulative design? Working with a partner and generating a booklet of our entire design was very influential toward my final thesis representations.

2014 Spring Paul Gleye

Masui Redevelop.	Brussels, BEL	Site Reuse	Recreation

My time abroad yielded a variety of unique experiences, one of which is designing within the constraints of a culture we're not totally in sync with, and understanding its importance on a world level. Whom will use this proposal tomorrow and what would they think?

Appendix - Past Studios

2014 Fall Regin Schwaen

Hello Nature Omnebeget, SWE Training Recreation

Here we explored the opportunities for designing for competitions. This further allowed me to explore the worldly context of buildings and the people involved with commissioning them.

2015 Spring Mike Christenson

Thesis St. Paul, MN Research Educational

Thesis has been an invigorating and extraordinary experience which will carry for many years into my career. It has forced me to not only research and propose a unique and personal design, but truly push my design boundaries.

As my father always says "school is not a place to only learn facts and figures and where to find them. It is ultimately a place where we each learn how to learn and find ways to push ourselves."

No doubt have I managed to push myself over the past 9 months and learn not only a great deal of information on my thesis, but most importantly gain an infinitely greater knowledge about where in life I would like to go. It has been an exceptionally enlightening experience.

Appendix

Figure 14.1

Ronald John Brinkman

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North Dakota State University

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Wyoming, MN 55092

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http://ronbman.wix.com/
ronbrinkmandesigns

Hometown: Forest Lake, MN

"Years of friendship, growth, education, and exceptional professionalism have molded many of my finest memories and experiences. I found nothing short of unparalleled excellence from my time at NDSU."