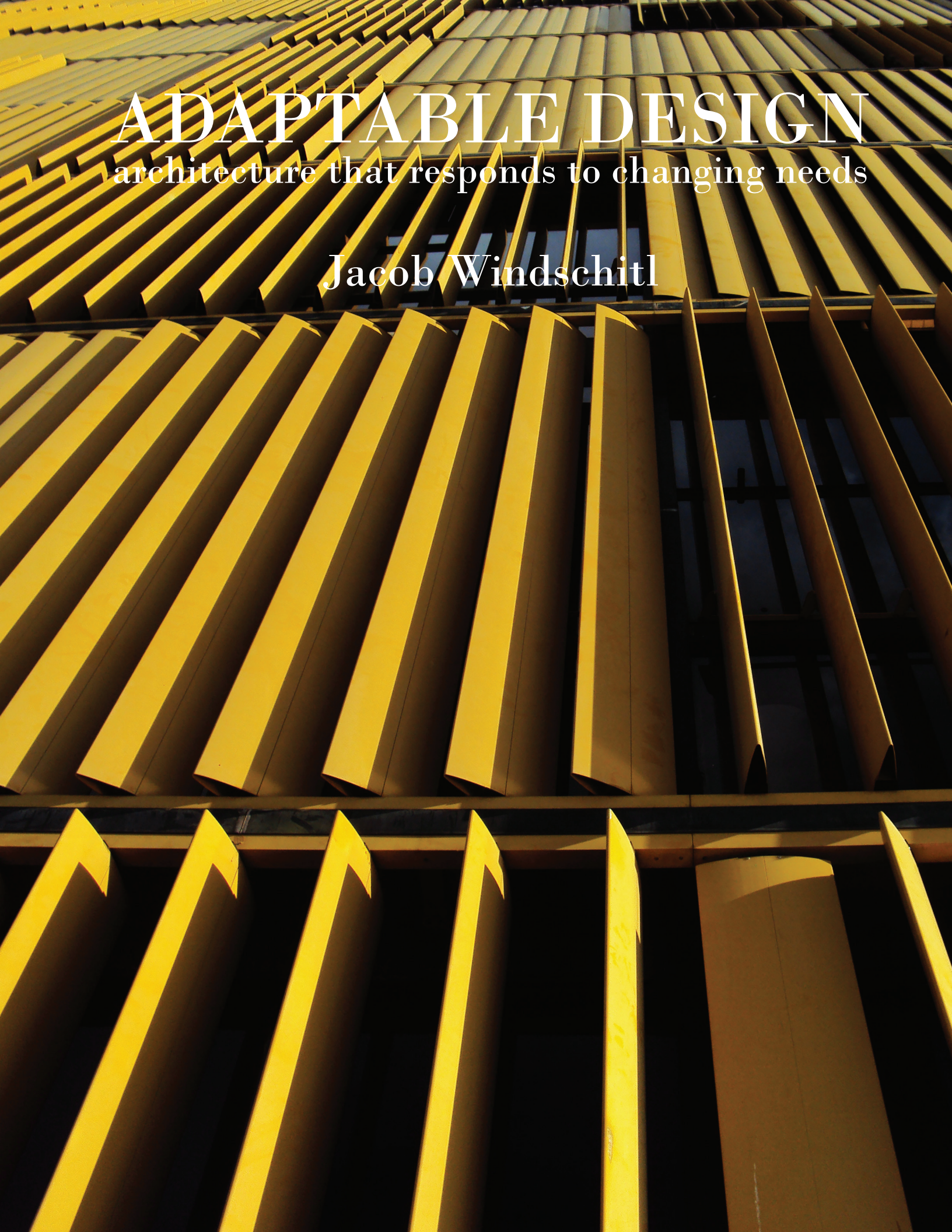

ADAPTABLE DESIGN

architecture that responds to changing needs

Jacob Windschitl

Adaptable Design

Architecture that Responds to Changing Needs

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

By
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In Partial Fulfilment of the Requirements
for the Degree of
Master of Architecture

Primary Thesis Advisor

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Thesis Abstract

This thesis explores the use of adaptable architecture and its ability to change to diverse program and user needs. By using flexible and kinetic components in the design of a performing arts center, it can expand the functions of the structure for the client, to provide for todays need and tomorrows. The infrastructure of the building is designed to provide longevity. This theater is a display of adaptable architecture to the community of Duluth, Minnesota.

Key Words

Adaptable, Kinetic Architecture, Flexible Design, Performing Art Center

Problem Statement

How can architecture adapt to change in order to keep relevant, while embracing traditions?

STATEMENT OF INTENT

Typology

A performing arts center created with adaptable architecture.

Theoretical Premise

Claim

With the capacity to adapt to new uses a building will remain pertinent to its users, extending the lifecycle of the building.

Premises

Architecture shapes to the needs of the client. As these uses change architecture is in need of adjusting to remain usable to the client. If the client does not see the opportunity the building presents the life of the building is in jeopardy.

With the culture of replace anything outdated it has become expensive and unsustainable to continue replace buildings. Architecture that is capable of adapting to new needs extends the lifecycle of the building. A wide range of opportunities to use a building keeps intact the historical, cultural, and visual fabric of a community (Heehan, 2004).

Flexibility of architecture allows for adjustments to the program for a variety of uses and users. Performing art centers has varying programmatic needs that can change from day to day. With the ability to provide for a larger variety of users, it can create a larger appeal to the community.

Theoretical Premise

By adjusting to the socio-economical and programmatic needs of the users through adaptable architecture the structure will remain relevant, By not replacing or discarding piece of cities we can be more sustainable and economical, while maintain the sense of identity in the community.

Project Justification

Throughout a lifetime of a building architecture can exchange hands and uses many times. In order for a structure to continue on being an ‘authentic’ building as David Littlefield describes, it must find a way to continue to have meaningful engagement. In an era of ‘discardation’ old and unwanted things are thrown away to make way for a new solution. But new architecture can ward off this by promote itself to be redesign using adaptable architectural solutions.

PROPOSAL

Narrative

While studying an architect from the turn of the century, named Henry Klutho, I found out almost ninety percent of his commercial and institutional designs have been demolished or defaced beyond recognition. This architect's designs were structurally years ahead of its time. So why were all these jewels torn down in a time of construction booms?

The city, in the boom of post war construction during the 1960s, changed the model of what clients want from their buildings. A new style of city emerged, the suburbs. The downtown region that Klutho helped build was being vacated. Within the downtown region the buildings were being repurposed to be more like the suburb buildings, but this never went well for his works. Many of those that survived the initial repurposing lost the values that made the buildings great.

After the original client moves on the architecture has the difficulty of finding new clients looking for something other than its intended use. When a new client comes in and cannot find a way to work with their surroundings the structure becomes antiquated. The structure lost its value simply because the users never redefined their current habitat.

We live in a society where no one is afraid to discard something dated. There is an unwillingness to redefine architecture's uses around ones needs. "It is clear that the principles which contributed to past successes in architecture are inadequate for the speed, scale, and nature of change today. A new, adaptable architecture must be developed." (Zuk, V). If architecture is going to extend this modern thirty year lifespan it will need to be flexible to unforeseen needs.

The ability to adapt to new influences is crucial to sustain architecture's authenticity. The engagement of people throughout a buildings lifetime continues to give a reason to exist. The replacement of the city every few decayed has destroyed the sense of tradition in a place. With new uses coming into play throughout a buildings lifetime it can be difficult to adjust. With flexible systems and adaptable components a structure can be fit new uses.

By planning for the built environment to adapt the lifecycle of structures can exist within a community longer, promoting the sense of tradition. Challenging the limitations of initial design of a signal program, architecture has the potential to reduce the waste of demolition of what is seen as useless.

User/Client Description

The project is sponsored the Performing Art Center of Duluth. The building will function as a place to put on performances, provide rehearsal space, and hold classes to teach new generations the arts.

The public usage will be attending performances in the evening. There will need to be parking for the public at the time of performances and designated faculty parking. The theater must accommodate any disabilities. There will be classes and rehearsals that take part throughout the day and evening. The building has to provide space for the performers to store their materials and prepare for performances and rehearsals.

It will be used by the community having a variety of groups including University of Minnesota Duluth, the local government to host events and meetings, and the performing arts center. Multiple acts and performer will come to this venue from all around the region, state, and country. Classes and rehearsal will be held here by the performing arts center and University of Minnesota Duluth. The public will also be able to use it as a meeting space.

Major Project Elements

Theater — The theater will be used for a variety of performance, requiring an adjustable stage, seating, acoustics, and lighting.

Lobby — There will be a reception space for quest to enter the theater. There must be a coat room and ticket stand.

Classrooms — Rehearsal rooms will allow multiple performances to practice within the theater. These rooms will provide for different styles of performers.

Offices — The theater will have office space for administrative and managerial personnel.

Changing Rooms — The performers will need backstage changing rooms. These rooms will have spaces for costume and instrument storage.

Storage — Storage for sets, production materials, and costumes.

Rest Rooms — Rest rooms must be provided for the public use during events.

Parking — On site parking will accommodate the visitors and faculty of the theater. Parking must include ADA accessible parking.

Site Information

Fig. 1

Minnesota is located in the upper Midwest portion of the United States. The state is bordered by North Dakota, South Dakota, Iowa, Wisconsin, and Canada, as well as Lake Superior. The state has an estimates that the population of 5.3 million according to the United States Census Bureau. The state climate is unpredictable ranging from hot summers to cold winters.

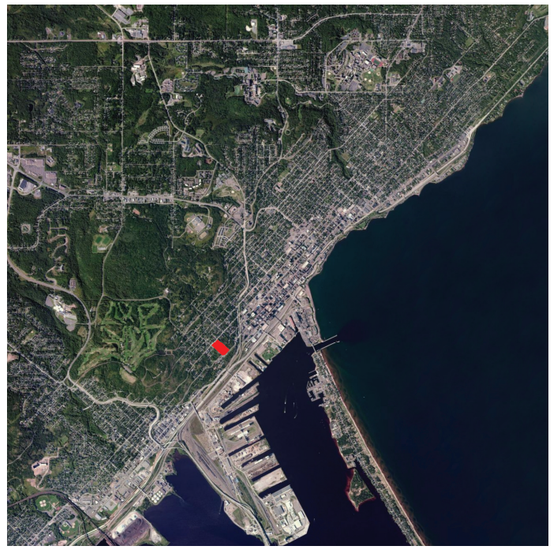


Fig. 2

The site is located in Duluth, Minnesota. Duluth is known as a port town bordering Lake Superior. It is the furthest in land port in North America connected to the Atlantic Ocean.

tand on the south east side of the site is W 1st St. The site is at the top of a rock outcropping overlooking the harbor and the business district of Duluth just to the North East. Currently the North West haft of the site has a baseball field and ice rink that is in need of an overhaul. On the lower South East haft of the site is a thick tree covered cliff. A bus line runs down W 4th St. giving people the opportunity to use public transportation to the theater.

Fig. 3

Project Emphasis

This thesis will be exploring adaptable architecture and its ability to change to the needs of its users. This is in an effort to create architecture that pushes the limitations of a structure after the completion of 'initial' construction.

Plan for Proceeding

Definition of a Research Direction

The research will focus on the theoretical premise, unifying idea, project typology, historical context, site analysis, and programmatic requirements.

Design Methodology Plan

The design methodology will utilize the mixed method quantitative/qualitative approach through the concurrent transformative strategy. The research will include graphical analysis, digital analysis, and interviews.

Quantitative data will include statistical data, gathered with archival research, scientific data measurements, experimentation, and analyzed.

Qualitative data will include observed information from survey, archival research, direct observation and interviews.

A Plan for Documenting the Design Process

The design of the project will be documented through scans of drawings, photos of three dimensional work, and images of three dimensional computer models and will be stored in a folder. The process information will be laid out in the thesis book to show the chronological progress and transformation of the design, informing the view of important design ideas.

Schedule

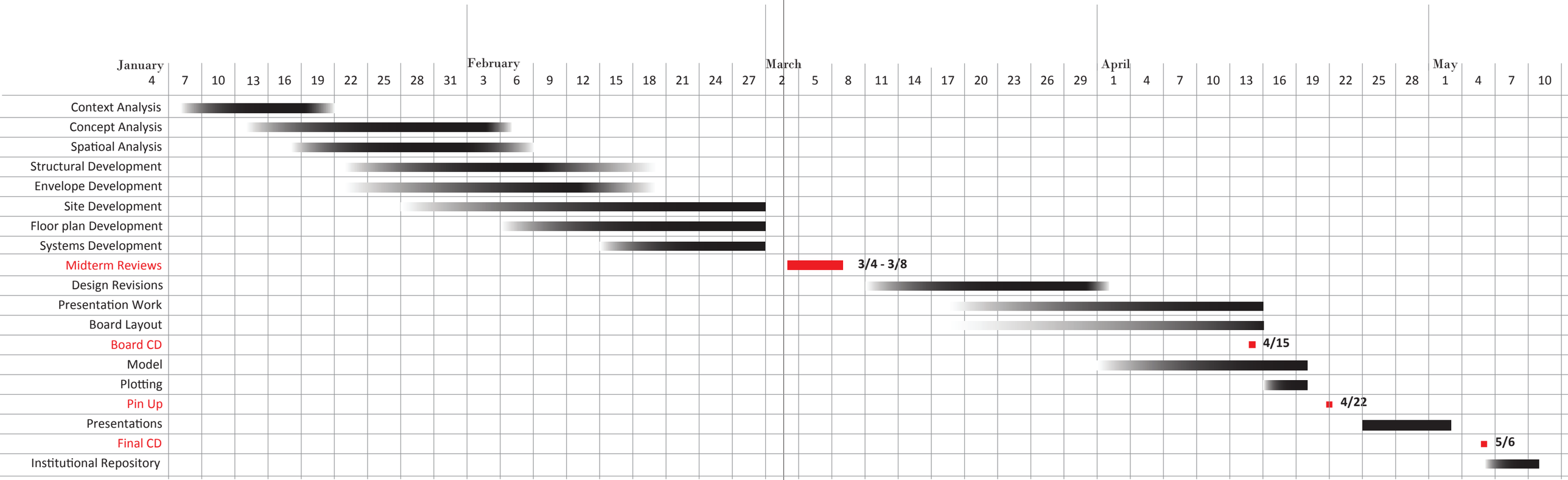


Fig 4

Previous Studio Experience

FALL 2009
Stephen Wischer
- Tea House
- Boat House

SPRING 2010
Phil Stahl
- Montessori School
- Hemmah House

FALL 2010
Regin Schaewn
- Hotel Project
- USBank Plaza

SPRING 2011
Mike Christianson
- House Project

FALL 2011
David Crutchfield
- High Rise

SPRING 2012
Ron Ramsey
- The Jewel Box

FALL 2012
Paul Gleye
- Fargo Urban Center

Program Document

Theoretical Premise

This thesis will explore architectures ability to adapt to the new needs of a changing program, with the use of kinetic architecture and flexible design. The built environment has the potential to provide solutions to wide variety of needs within a compact efficient space, without losing its sutability to the users.

In today's society the speed of which objects lose their value or interest is becoming faster and faster. The way in which computers are replaced every couple of years simply because they have dated and are obsolete is starting to transfer into other realms, including architecture. In the book Cradle to Cradle by William McDonough describes the lives of the everyday objects in everyone's lives. The common lifecycle of objects is the cradle to grave method where objects are born by the meshing of materials, live out there use, and are thrown away never to be used again. This method uses large quantities of resources and energy with no intention of being used again.

In the United States the construction industry is growing. From the year 2000 to 2030 the country is estimated to add 131 billion square feet of buildings, plus an additional 82 billion square feet of buildings will be according to Franklin Associates (Guy & Ciarimboli, 2005). By the year 2030, over 50% of existing building will be newer than 2000 and 27% these building will be replacement to previously existing buildings. In the act of replacing existing structures there is a large amount of waste. The construction industry according to the US Geological Survey in 2002 consumed 60% of all material flow, excluding food. The US EPA estimates 92% of all construction waste every year comes from renovations and demolitions. This totals 30% of all waste in the United States (Guy & Ciarimboli, 2005). Within the renovation business most old materials are not reusable, adding to the amount of waste.

Architecture has found itself in a state where changes could be made to new construction techniques to improve the lifecycle of the build. There is an opportunity to apply new technologies so future generation can continue using existing structures more efficiently. As William Zuk wrote in Kinetic Architecture, "It is clear that the principles which contributed to past successes in architecture are inadequate for the speed, scale, and nature of change today." Architecture is being built for the first purpose of the first client. The issue with this comes when programs change or ownership changes a buildings first purpose has lost its relevancy. To counter this architecture is in need of the ability to look ahead to future change. The idea of flexibility in architecture is nothing new. It was the way in humans lived in the beginning.

Humans are flexible creatures that move about, living in a variety of conditions, and by manipulating the environment and materials have found ways to survive (Kronenburg, 2007). Tribal communities would build mobile housing to migrate with the local food supply. Most societies have stopped using this model of nomadic living and begun to live in a permanent way. With the growth in economic and demographics in cities, there needed to be an answer to providing for everything. Architecture built to last for generations became the answer so cities could continue to expand. Monumental architecture (architecture not meant to be manipulated) has come to be the norm in society. Throughout time these permanent structures have adapted to new uses. But to change this monumental style to a new purpose brings with it large expenses and waste.

Adaptive reuse projects can bring with it large expenses due to the amount of labor and wasted materials in the deconstruction phase. The initial materials in existing structures often need to be replaced as things are rearranged or refinished. Brad Guy describes why materials have become difficult to repurpose in Design

for Disassembly. Materials have become difficult to reuse because the shift from natural or organic fibrous materials such as wood and stone to materials with difficult chemical makeup based on petroleum such as plastic or vinyl. The process of attaching material with glue in addition to nails and staple make it difficult to detach without ruining the material. On top of that the cost of removal from both the labor and tools need is an additional expense most owners are unwilling to pay for. At one time materials were joined by skilled craftsman to create aesthetic qualities that were also functional. With the loss of such craft, most construction relies on covering up with finishes that are almost always unusable. During initial construction the owner has no consideration to redo the building, so materials and construction techniques are not chosen to allow for adaptability. Nor do the original owners' bear in mind demolish costs and wastes.

In renovations many out dated systems will need to be brought up to code or to the needs of the users. Looking into the ability and cost of expanding or adding utilities such as gas, electrical and sewer are a specific question that is important to ask in order to see if a building is worth maintaining for future use (Heehan, Woodson & Culbert, 2004). On the other hand demolition is a large fee just to obtain a site for further construction. Demolition brings with it the end of an existing structure's life. Often times the materials are never reused.

These difficulties in the ability to change architecture have come from the way buildings are mass produced to be sealed up. There is no capacity to reopening a wall or a floor. Flexibility of the constructed product leads to the opportunity to make these changes fast and cheap. Flexible layout and structure by the use of removable or mobile partitions allows clients to restructure their environmental needs easily, instead of having to remove conventional load bearing walls. The structure must be made to accommodate these partitions. This structural style can provide the ability for a longer lifespan and the ability to be used for multiple purposes (Sassi, 2006).
In the Glencoe National Trust Visitor Centre in Glencoe, Scotland designed by Gaia Architects the floor boards are minimally screwed down using a joint technique to allow for the entire floor to be taken up and put back in place in roughly an hour (Sassi, 2006). By not nailing the boards down it prevent the potential of ruining the boards. And because few boards are screwed down it is a fast process with little labour. This has provided the building to move a flexible electrical system around, giving the clients the ability to change layouts of plugins.

Buildings are often being refurbished. The ability to remove a component such as flooring, wall partitions, or exterior cladding with ease makes the process much less expensive. The remodeling process is seldom effortless. Old buildings made of materials, such as brick, have load bearing walls that need to be worked around. Contemporary buildings now remove the function of structure from these components and left them to serve as weather protection, such as vinyl siding and asphalt shingles. These pieces are made to wear out and be replaced. But they lack the durability or physical makeup to be recycled or even taken off to be reused somewhere else.

The capacity for components to be replaced and exchanged could change the way architecture is mass produced. The exterior cladding of a building could be sold by the owner to someone else through eBay instead of giving them over to be disposed of. Or this exchange of parts could create an economical structure that is used with cars. The car is made, it is used, it breaks or a person wishes to change it, the person goes and finds a new or even used piece and unbolts the old and reconnects the new in a few simple hours. This requires a universal system to allow all necessary components to fit to a structure. Walter Gropius compared the house to the car in the way it is a set of components put together to make a complete produce. A standardized system could create

less hassle to change or add to a building post completion (Schneider, 2007).

The Pompidou Centre in Paris uses a system of bolting to the floors and ceiling to connect all the walls to the structure within the building. The entire structure of the building is constructed with exposed components allowing for access. The opportunity to arrange the interior spaces has given the clients a facility to host anything in the space.

The future needs of clients or new clients can never be predicted. Architecture is often thought of as a solid unchanging object. Described as 'frozen music' most architecture moves to slow for the eye to see. People look at it though it is a picture stationary in a stationary environment. But in the fourth dimension architecture and the environment can be seen as something that evolves, grows, and decays. The process of construction, reconstruction, and demolition are short moments in the lifetime of a building. As William Zuk portrays it in Kinetic Architecture, "These changes occur through time, the fourth dimension is an added element to the form response." Flexible design and kinetic architecture free up the process of movement and change permitting for more changes to be made on a regular basis. The stimuli influencing the building are given an instant influence of the structure.

Kinetic Architecture can be defined many ways. It is simply architecture that moves, whether by the manipulation of man or machine. In contemporary architecture a common example is stadium roofs that open up or sliding partition walls. Or can be something simple like movable blinds or louvers. Kinetic architecture removes the idea of a building being stationary (even if the notion is not true) and presents the movement.

These movements can have to be an artistic effect or practical use. The Milwaukee Art Museum by Calatrava uses kinetics making the structure a large piece of mobile art. It is an interesting draw for the building but does not provide for much function, other than a small environmental change on the inside, it instead lies in the realm of experience for the views.

On the other hand kinetic and flexible design can change the way a building is used programmatically, sustainably, and culturally. Architecture is always in danger of losing its capability to be continually used. Programs are always changing. The Plug-In City concept by Archigram structures has the ability to build themselves and replace existing pieces if needed. It is a self-contained structure that holds all the construction equipment to make changes and life support for the inhabitants. The concept became the idea of living within an environment that is a machine created to respond to the needs of the occupants. In the need of an addition the flexibility of the design would allow for something new to easily be attached or if no long need could be taken out.

Kinetic architecture has the power to contain multiple programs in the space. With some level of effort whether it is a few persons performing manual labor or a flip of a switch turning on hydraulic pistons the space can be changed to fit a different need. The capability to use a space for multiple purposes expands the extent the spaces can be used.

Theatres come in many different styles. This means there are numerous arrangements of stage and seating configurations, acoustical and lighting needs, and individual needs for each performance. Performing Arts Centers often have several local resident companies and an array of touring productions (Hardy, 2006). All theater spaces have a level of flexibility, but there is room to expand that level of flexibility to provide the opportunity for the performances to shape space as they wish.

In the AT&T Performing Arts Center Wyly Theater in Dallas designed by Joshua Prince-Ramus, the artistic directors have the ability to change the arrangement of the theater and the processions in and out of the theater. Also because of the material and joint connections objects may be removed or even attached to almost any surface in the performance space. The director can also control the audiences interact with the architecture and the performance by choosing how people may proceed in and out of the theater. Another benefit of the flexibility is the chance to rent out space providing added revenue to the clients.

One of the most important changes taking place is acoustics. Performing art centers host a variety of acts that may need spaces acoustically tuned a specific way or wish to have a small or large theater space to perform in. A large theater space like the one in Matsumoto can use the acoustical panels to shrink the space down for smaller performances, or just reposition them to create different sound effects.

Stage and seating arrangements have taken many different forms throughout the centuries. These arrangements include proscenium, thrust, flat, black box, amphitheater, and more. To have multiple configurations within a single space requires man and machine power. This is an added expense to have the equipment and labor provided by the theater (Hardy, 2006).

Due to the fast changing built environment, caused by the replacing of outdated structure, communities have had difficulty with the lack of a sense of tradition. Old cities have been moved away from and abandoned existing uses not to be returned to, while new developments have yet to define themselves. In places where structures are left without purpose communities are left with voids scattered throughout the landscape, where no one gathers anymore. Places that have yet to develop gathering places have the difficulty to link people within the community.

By extending the lifetime of buildings a community's tradition become deeper embedded in their history. Traditions are a sense of the people and how they occupy a place together. Architecturally, styles, activities, reoccurring events that bring people together are important for the purpose of identity to a community. Aldo Rossi, in The Architecture of the City, reveals that a city is a collective memory of its people. It is a collection of objects and places that people associate themselves with. This association is never stationary, but always evolving with the people and environment. In "The Architecture of the City" Rossi quotes Halbwachs' La Memoire Collective saying, "When a group is introduced into a part of space, it transforms it to its image, but at the same time, it yields and adapts itself to certain material things which resist it. It encloses itself in the frame work that it has constructed. The image of the exterior environment and the stable relationships that it maintains with it pass into the realm of the idea that it has of itself." (Rossi, 1982).

The style of architecture has changed because of the supply of material. "The visual character of preindustrial landscapes was shaped by necessity. There was no alternative but to accept the limitations imposed by nature, culture, and technology. The differences between one place and another, the sense of belonging, of being rooted to a particular location, have traditionally been achieved because there were few alternative options available." (Hough, 1990). Today supplies travel the world. These basic components can be found nearly anywhere. Architectural qualities by place is disappearing. Michael Hough addresses the uncertainty of the relationship of old and the new, identities made by local materials are gone replaced with an industrial and technological forms which have become a part of our cities because it is a necessity of our lives and an important direction for our future.

As a building role grows in a community, the culture of the place becomes a part of tradition. Buildings with deep meanings, due to past events, fall into the realm of 'sentimentality' as David Littlefield says in Architectural Voices. Buildings with historical merits are preserved, not allowing the building to continue to function as something useful. A building value "lies not in the fact that something notable once occurred, but in the fact that notable events might continue to occur." (Littlefield, 2007). The use of histrorical buildings connects the past and present through experience.

An example David Littlefield discusses is the Young Vic Theatre. The theatre was an offshoot with little budget. It was constructed to exist for five years and then it would be redone in a more respectable level of construction. The theatres aura has made it irreplaceable to the locals. The rain on the thin tin roof and the traffic outside places people into reality, unlike most theatre that are made for people to escape reality. The theatre remains a place for the community to come and arts to express themselves. It is something they identify with.

Buildings look to survive and evolve like the people who use them. Architecture cannot retain its original character forever. The users of a place like the Young Vic have required the structure to grow along with them. Shifts in usage require shifts in program. More flexible space is entailed to house the needs of users.

The desires of the local culture to make buildings that will continue to use is important to structures of place. The presence of place has been defined by what is there and has become an important part of the culture the local place. The 'Genius Loci' or the protective spirit of a place is what provides communities an identity they can associate themselves with.

Summary

The research is an exploration of past and present theories and ideas that influence the theoretical premises. The ideas presented in the theoretical research are an informative exploration of the questions raised that are being addressed by the thesis. The information will help build the wealth of knowledge and will be influential in the design.

The research looks at the interest in society's way of discarding material goods, including architecture. The problems caused by these actions will be addressed in the design solution. The research looks for ways the building industry try to deal with the issue. The construction continuing today plays a big part in the way the future will be shaped. The questions of how do buildings survive people's new needs becomes important. Because of the fast changes within the built environments traditions have loosened in cultures. The notion of identity has begun to change in the post-industrial construction area. The research looks to find how architecture is now looking to combine the industrialization and tradition.

Buildings are always changing to clients' needs. The opportunities the structure has to evolve into something useful again are important in building a sustainable future. Architecture is in need of reformulating itself because of the large amount of waste being produced by destroying potentially useful structures or the amount of energy it takes to reconstruct a building to be useful. The embodied energy of the environment is shrinking, meaning objects serve out less. In pre-industrialized Europe, buildings would last hundreds of years, providing for generations. Today with the ease of manufacturing and modern construction equipment it is easy to think of having a new building. We have not brought the reconstruction up to the speed of the industrial produced buildings. And it will have to start with new construction to bring together these products to allow users to have a chance at making a building continue for generations.

Flexibility started out as an important part of everyday life for people to move where nature guided them. As man began to shape the natural surrounding monumental architecture tied down man. Contemporary man attempts to free himself he finds the constrictive environment difficult to work with. Architecture has always been shaped for the user. But users will always coming and going. Today some architecture is trying to reach out a hand to the forecoming of new purposes. Technologies and craftsmanship give birth to opportunities for structures to live fully.

The importance in the lives of structures in our environments comes from the need of tradition in communities. How people have come to associate themselves and others to where they are is a part of everyone's identity. Place exists to house. What builds a community is housed in architecture. For places to grow and strength architecture must continue to be useful in housing the needs of a community.

As Walter Gropius state architects need to learn to view the design as a collection of parts as well as a whole. The technology is providing the opportunity for architecture to progress. Kinetic architecture that can affect light, temperature, spatial arrangements, and many other options give clients a building that transforms to their needs. With Flexibility and kinetics architecture has the potential to progress for the client needs. The ideas from the 'Plug-In City' by Archigram where structures can change or rebuild when the users need it to are becoming possible. Multiple program buildings, such as a performing arts center, can utilize space more efficiently.

"To be sure, the bridge is a thing of its own kind; for it gathers the fourfold in such a way that it allows a site for it. But only something that is itself a location can make space for a site. The location is not already there before the bridge is. Before the bridge stands, there are of course many spots along the stream that can be occupied by something. One of them proves to be a location, and does so because of the bridge. Thus the bridge does not first come to a location to stand in it; rather, a location comes into existence only by virtue of the bridge."

– Heideggar "Building, Dwelling, Thinking"

Case Studies

Case Study: Dee and Charles Wyly Theater at AT&T Performing Arts Center in Dallas
Architect: REX & OMA, Joshua Prince-Ramus & Rem Koolhaas
Built: 2009

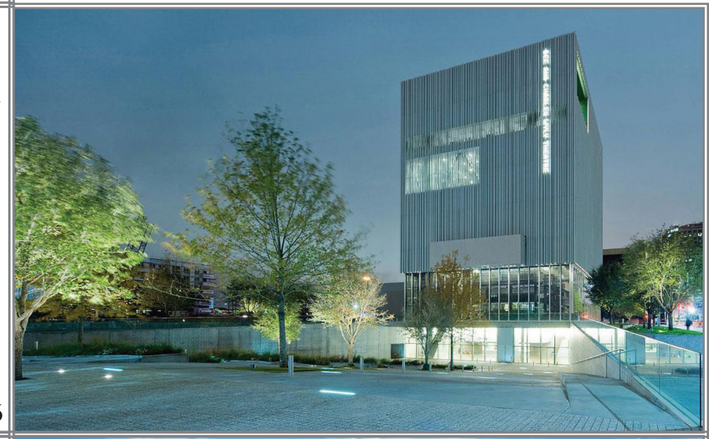


fig. 6

Case Study: Matsumoto Performing Arts Centre
Architect: Toyo Ito
Built: 2004

fig. 5

Case Study: Centre Georges Pompidou
Architects: Renzo Piano, & Richard Rogers
Built: 1977

fig. 7

Case Study: Dee and Charles Wyly Theater at AT&T Performing Arts Center in Dallas
Architect: REX & OMA, Joshua Prince-Ramus & Rem Koolhaas
Built: 2009

The Dee and Charles Wyly Theater was built to replace the old theater for the AT&T Performing Arts Center, in Dallas. The previous theater it replaced was an old warehouse converted into a performance space. The warehouse allowed productions to alter the building, stage, and setting because of the lack of precious materials and it had no formal stage setup so every production could change it to their liking. The mentality towards the old warehouse shell had to be brought to the design of the new theater.

The architects Rem Koolhaas and Joshua Prince-Ramus had to convince the clients to invest in infrastructure instead of finishes. Close to seventy percent of the buildings budget went towards the structure and the systems to run a production. Usually this infrastructure only take thirty to forty percent of the budget and the finishes make up most of the costs.

The Wyly Theater had to bring to it the ability to adapt for new performances. The architects twist to create an adaptable theater was to take the traditional front house and back house and turned it into above and below house. This resulted in the chamber being on its own level with exposed walls on all sides, several of which could open to the outside so people and material can move in and. To accommodate the changing of theater arrangements, the seating can be moved in or out with the use of a lift taking them above the stage. The clients required the process of arranging the theater to be done with as little as two people within an hour to keep personnel costs down and provide the opportunity to have multiple productions in a single day. All the materials within the chamber are cheap and have the potential of altering by cutting, screwing, bolting, etc. The flexibility of the materials allows productions to adjust the space to the needs of the performance.

The structure of the building is a concrete shear wall on one side with the other sides having two concrete

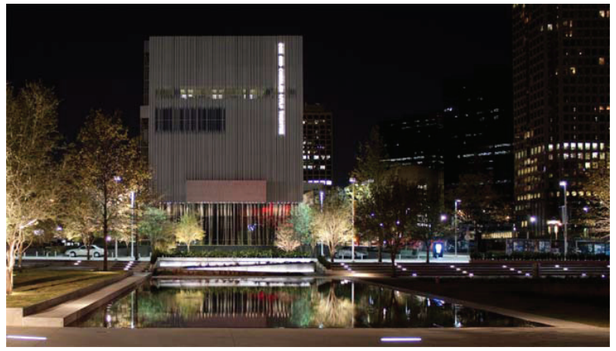


fig. 8


fig. 9

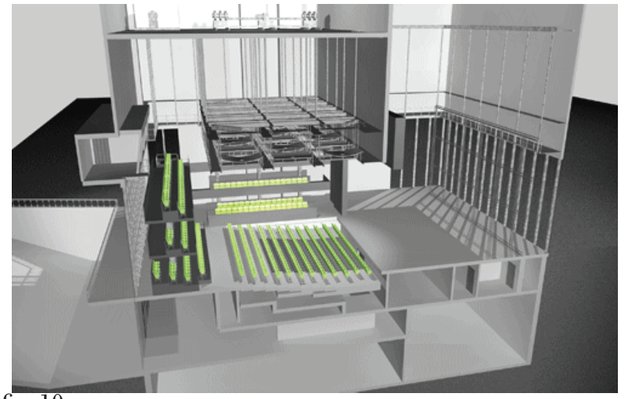


fig. 10

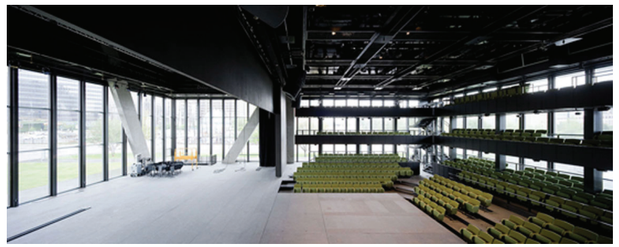
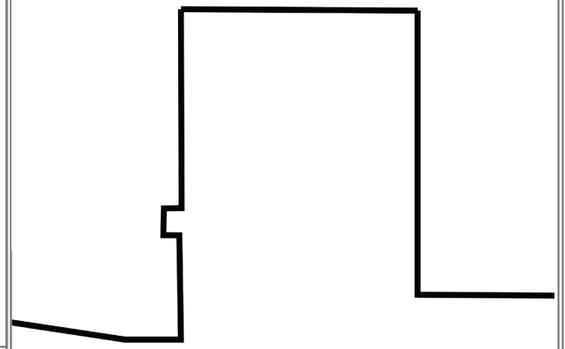
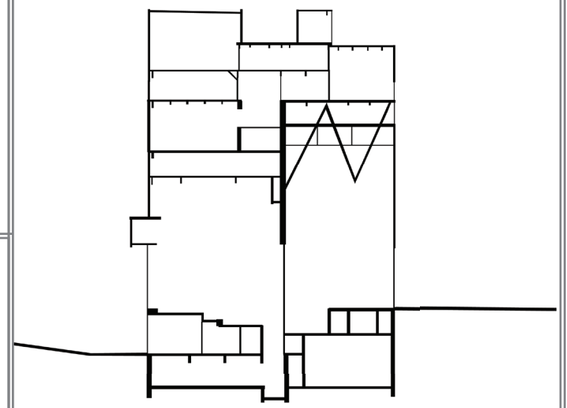


fig. 11


Hierarchy fig. 12


Massing fig. 13


Structure fig. 14

columns to support the floors on each of the other three sides. The floors are slabs on metal decks, the steel floor plates then connect to a belt truss. Around floors 4 through 7 the belt trusses attach to the columns. The 2nd and 3rd floors are suspended by belt trusses to the upper floors instead of the columns and the 8th floor uses the belt truss to sit on the lower floors. This has made the chamber space able to have little obstructions around it. One wall is capable of opening to the exterior to provide access to people directly into the chamber or set materials can be brought in. If the production wants to black out the theater there are aluminum blinds built into the glass walls that move down. With the ability to access the chamber from the exterior directly the director can change the flow of entry and exit. The lobby sits below the theater and below grade. There is a cut away ramping down to the lobby outside. There are also backstage spaces on this level. Above the theater is storage for the sitting, costumes, and sets along with the lift system to move them. The rehearsal space, offices, and lounges are above the theater.

The building is divided into nine floors. Large portions of the 3rd and 4th floor are used for storage. The theater is capable of housing an audience of 600 people. Due to the flexibility a multitude of events can take place in the chamber. This has helped generate revenue faster. The building can lend itself out to hosting dinners or even car shows.

Conclusion

This case demonstrates kinetic architecture and flexible designs ability for the users to expand the use of the structure. It has become an example of technological solutions and modern building materials to free to change when needed. The architects focus on the buildings structure and material well suited for the purpose of adapting has given the building opportunities to perform for multiple users.

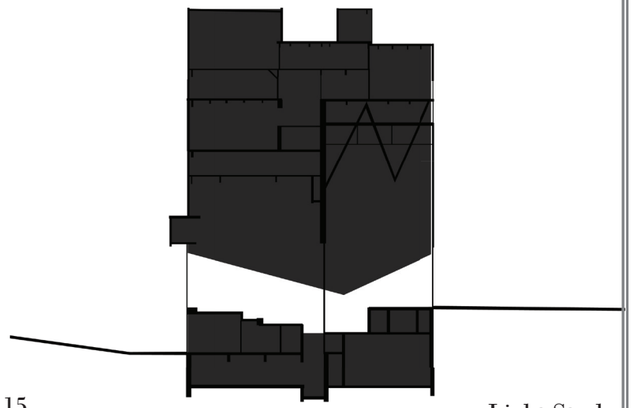


fig. 15 Light Study

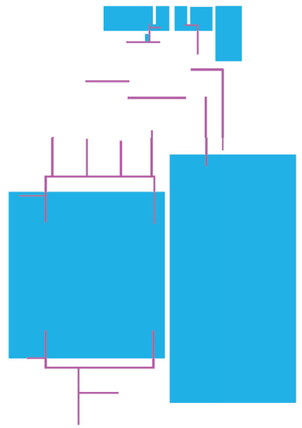


fig. 16 Usable Space and Circulation

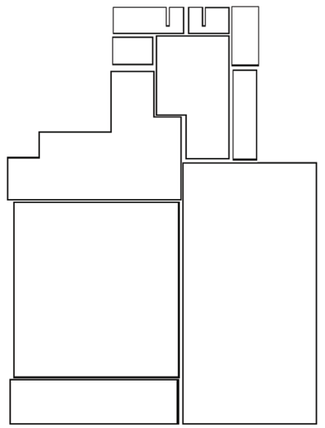
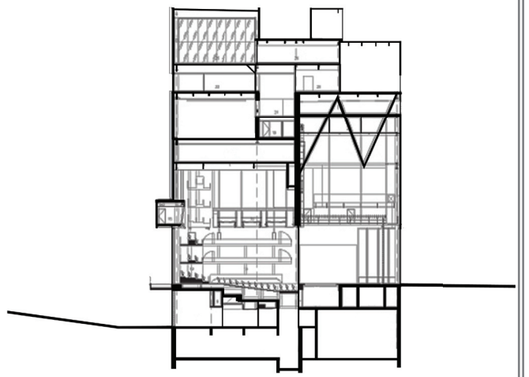
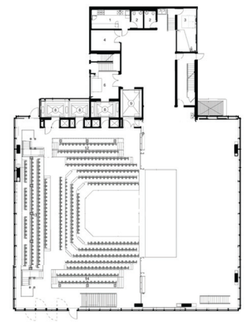


fig. 17 Geometry





Floor Plan to Section fig. 18

Case Study: Matsumoto Performing Arts Centre
Architect: Toyo Ito
Built: 2004

The Matsumoto Performing Arts Centre is located in the heart of the city. It was built to replace the old performance center. The site is a long narrow bottle necking site. The design had to fit many site constraints. On one end of the theater there is a busy road producing high amounts of noise. The major façade of the building faces an old residential neighborhood. It is trapped by the roads and buildings around it.

The architect Toyo Ito won the competition for the building by designing the building that could fit the site. The large performance space took up too much on the front side of the site so he moved it the back and turned the stage and seating around to provide a noise barrier from the noise of the major road.

The audience enters the building from the front of the site as they did in the old building. They then move up a grand staircase after the lobby to go up to the second floor. The spectators then walk around a horse shoe shaped passage around the chamber and in. The stage is turn backwards putting the backstage facing the interior of the building. On the ground floor under the audience circulation is circulation and rehearsal space for performers that mimics the circulation path. To move performance equipment and sets in the ground has a separate entrance at the far end of the horse shoe underneath the backstage.

The center has two theater chambers. The large chamber used for operas, plays, and other large performances seats 1800 people. Behind the backstage is an experimental glass wall to provide viewing of the performance from behind, in this space behind the stage are seats giving the viewers the opportunity to view the performance from a different perspective. A second stage in the back of the theater is setup for experimental multiple stage performances or chores.


fig. 19

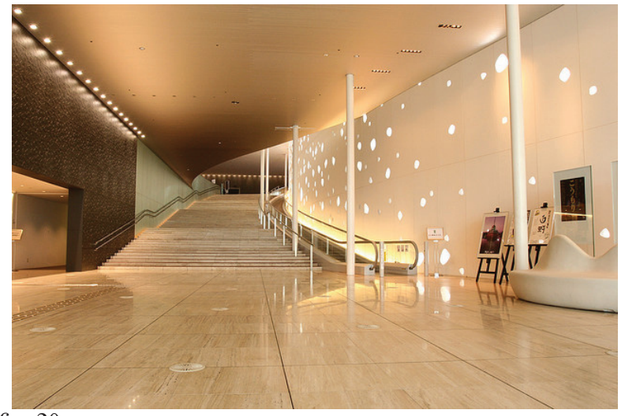


fig. 20

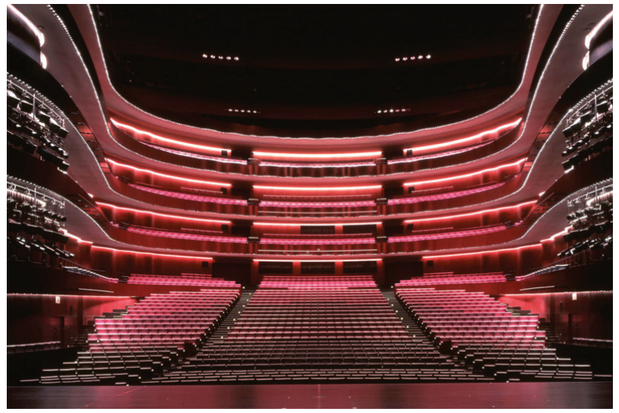
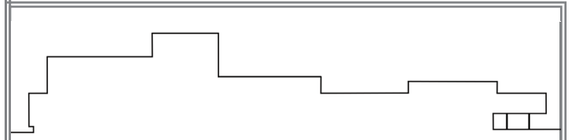
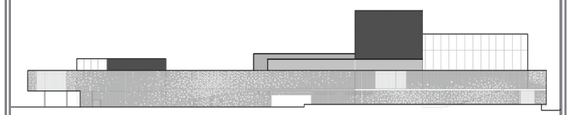
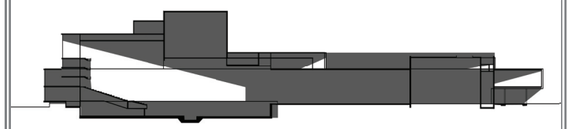


fig. 21


Hierarchy fig. 22


Massing fig. 23


Light Study fig. 24

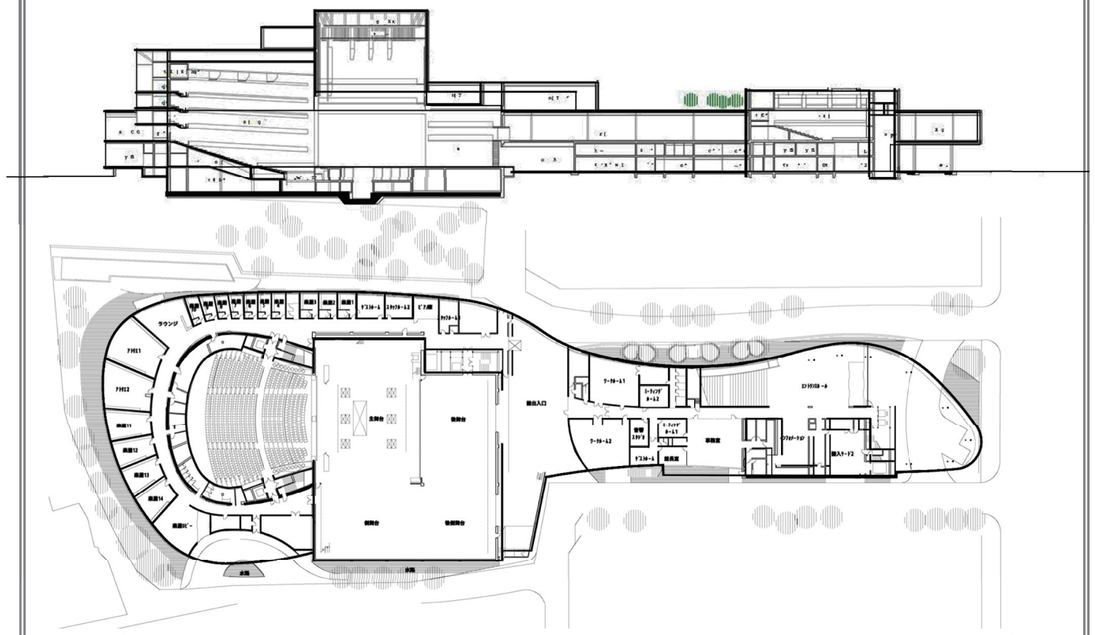
The acoustical panels along the ceiling are made to be raised and lowered. It provides multiple acoustical conditions for an array of performance types such as opera, symphony, and plays. It also is used to accommodate for different volume of the theater depending on crowd sizes. For smaller performances the panels are lowered to provide a more intimate space.

The smaller 240 seat chamber is a black box style theater giving a flexible stage arrangement located directly above the lobby. It is used for small performances and community meetings. It is mostly used by local performers who do not require such a large amount of seating.

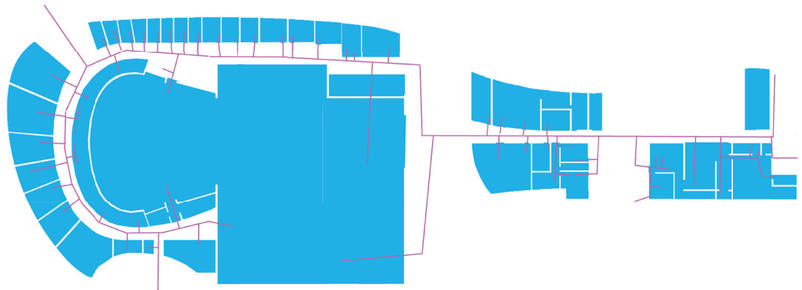
Toyo Ito had to provide a space for religious ritual to take place within the building and also intended it to contain plays outside of the theater space. He created an open space on the second floor behind the grand staircase. This space gives the users freedom to make the space what they want. This space has been unsuccessful in being a flexibly used space. The religious ritual has applied its own strict structure to the space and has varied little. Also the intended pop up plays has rarely taken place. The space's freedom to use has also been a down fall. The open space that is seen somewhere between a lounge and a hallway has not provided the structure for a performance or any definition of space. Areas can be arranged for private events or public exhibitions with the use of partitions..

Conclusion

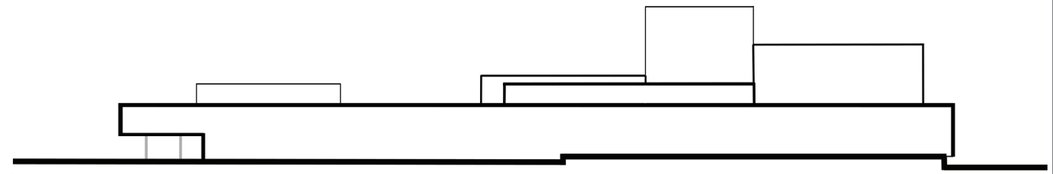
The Matsumoto Performing Arts Centre is a demonstration of traditional style theaters with nontraditional arrangements. The building has allowed the performers to transform the spaces to their needs. It also demonstrates that the theater building itself can be an experiment and teach inform new performances.



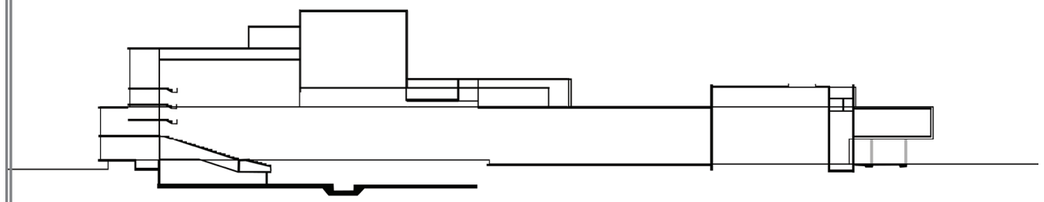
Plan to Section fig. 25



Usable Space to Circulation fig. 26



Geometry fig. 27



Structure fig. 28

Case Study: Centre Georges Pompidou
Architects: Renzo Piano, Richard Rogers
Built: 1977

The site was formally a deteriorating neighborhood that the city leveled and turned into a parking lot till something could come along to fill the space. Georges Pompidou the Prime Minister of France decided to build a cultural and learning facility that would be a monument in Paris. The Centre Pompidou was designed to house multiple functions within a single building. Its four main purposes are art museum, library, design center, and an institute of music. The building also needs to contain offices to direct these functions. To provide for changing and permanent installations the building was engineered to have an open and flexible floor layout.

The architects Richard Rogers and Renzo Piano designed the building inspired by industrial styles. It turned the building inside out to give freedom of space. The inversion of structure, mechanical, circulation, and usable space created large open floor plans that have been capable of rearranging to fit new exhibits. They designed a court yard by lowering the elevation on one side of the building. The building draws people in with the exterior escalators.

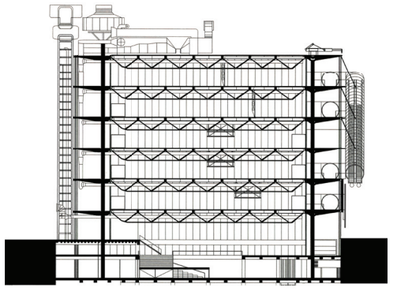
The open space is created by using a structure that carries all vertical loads outside the building. For each floor the structure is a large truss. At the ends of the truss are gerberettes that connect to columns. For stability they add a large tie rod to the opposite side of the gerberettes. There are six of these levels to each section and fourteen sections make the length of the building. To add stability and more length structure and bracing cables are attached to the exterior.

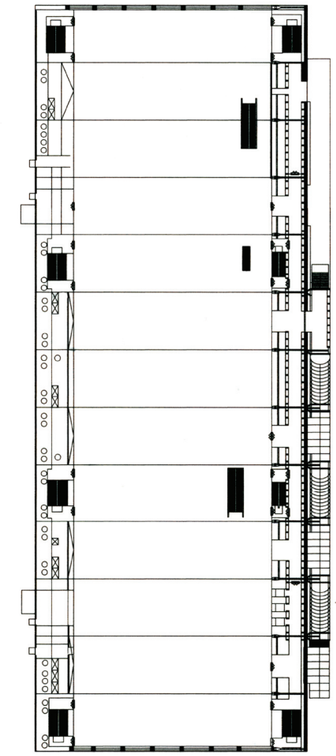
The interior has no permanent walls. There are removable walls and partitions to hang art on, divide up space, house toilets, and give people offices. These all are mobile fixtures that can be unbolted and moved if needed. To keep it easier to move the taller partitions they made them narrower so a single person can lift into place while another person bolts them together. This dimensionality is important so personnel can easily and quickly arrange spaces. The mechanical fixtures of the building such as air ducts and electrical can be brought down from the ceiling into a specific space when required. Fire screens drop to the floor if necessary.

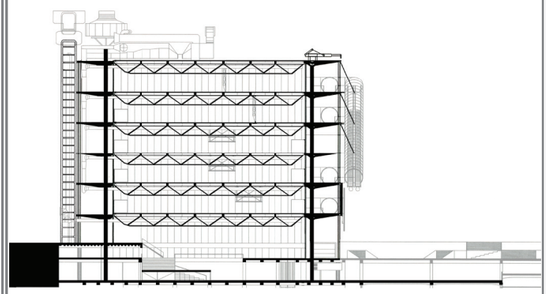

fig. 29


fig. 30


fig. 31




Plan to Secion fig. 32


Structure fig. 33

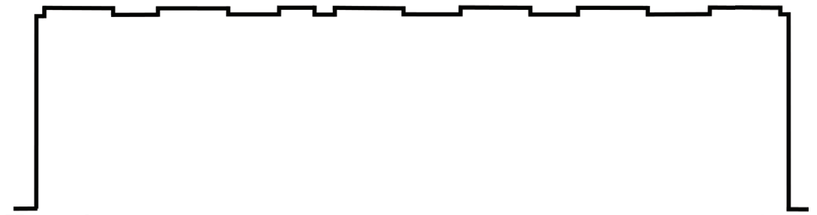
All the mechanical systems sit on the outside of the building within the structure or on top of the building. The architects had the mechanical color coated according to the function. This played on the expression 'a house is a machine for living' by Le Corbusier. It shows people the life support moves and is used by the building. The mechanical then runs along the ceiling between the trusses keeping interior space unobstructed. Circulation happens on the outside of the building. An escalator is hung from the structure and is the only component outside of the structure of the building. On the other side elevators for moving materials are mixed in with the mechanical systems.

To make sure the structure could be constructed without interference of numerous pieces coming together in a single area they used circular plates to pin or bolt to. The use of pins or bolt to connect objects gives a small level of flexibility in the construction process in order to provide a larger margin of tolerance in the assembly. If any damage happens to a single component it can be replaced. The building relies on repeating structural elements, even though these elements vary from side to side.

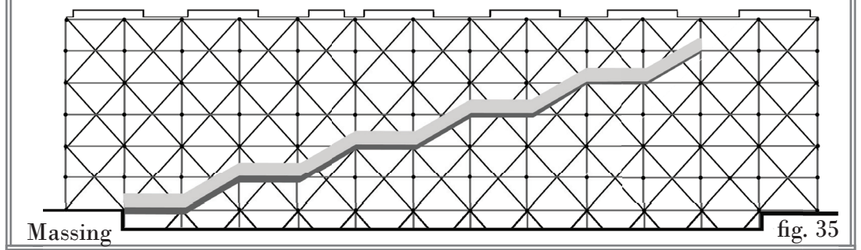
The design was not without issues when it came to the permanent art gallery. The direct sunlight into the building was affecting the permanent art installations and the open floor plan had a lack of flow in the gallery. In order to fix this, a structure was constructed inside the building in order to house the art.

Conclusion

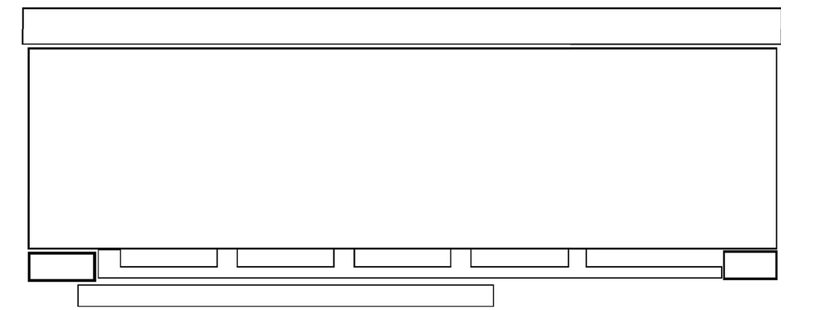
The Pompidou Centre demonstrates how bringing a building down to the component level and rearranging it different than a traditional building allows for a greater use. The structure of this example is very large and more labor intensive than most, but this has to do with its large scale. Its use of movable partitions with alternative scale has given every space within the structure to be rearranged. This is an extreme example of flexible space, as it has no definition of spaces.



Hierarchy fig. 34

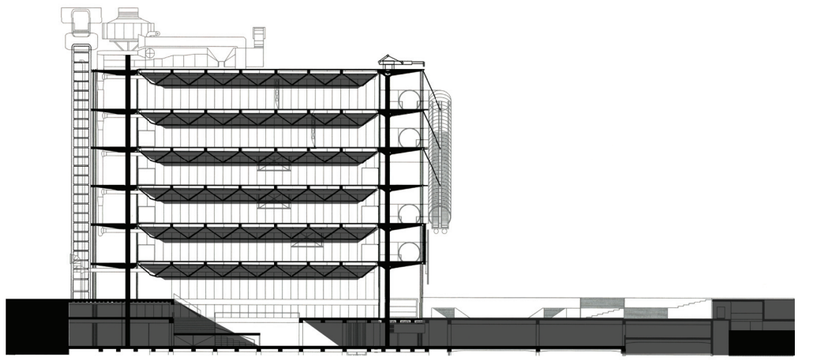


Massing fig. 35



Geometry fig. 36

Usable Space to Circulation fig. 37



Light Study fig. 38

Summary

When observing each of the case studies to see how they address the theoretical premise one thing immerges, the unique idea of flexibility in each. The Matsumoto Performing Art Centre, Wyly Theater, and Centre Pompidou each bring with it solutions and technologies to allow alterations to the building by users' for their needs. Also the theoretical work of Archigram in 'The Plug-In City' influences on the theoretical premise because of itsmajor part in the history of kinetic architecture. Each of these studies helps find precedents within architecture on how technologies can be used to adapt buildings.

Starting with the Matsumoto Performing Arts Center, a theater made to work on a difficult site and provide a place for an entire community. It, like the other projects, is giving the clients and users the chance to influence the design over the life of the building. It was built to house multiple functions in a single structure. It creates an identity within the community and a cultural connection. The neighborhoods and religious use of the building forms a structure of roots linking it to the community and the traditions around it. The unique aspect of this building is its sensitivity towards the site and how it has informed the design. The layout of the theater came from the constraints of the site. In return it yielded an arrangement displaying the requirements of the building. This project associates with the theoretical premise with how a building that generates opportunities for a community begins to create an identity and traditions.

Next the Wyly Theater brought high-tech solutions to meet the design requirements. It use of kinetics and flexible materials and layout demonstrate flexibility like the other cases. In this case the clients had a desire to bring their old traditions with them to a new building. This generated a need for solutions. The theater illustrates the theoretical premise with its use of kinetics to give the client the possibility to host almost anything.

By addressing the need to keep operational expenses to a minimum the scale of these solutions had to be operable with as little as two people.

The Centre Pompidou worked at a large scale to give multi-usable spaces to the client. This like the others case studies is a building that allows the users to be able to shape the space to their liking. It is the oldest case study; its history has shown the ability for flexible design to work for decades, no matter the needs of the client. In this case the architects viewed the building as a set of components and removed the notion of the place these components belonged. The identity and level of use of this building has made it a major landmark for the city of Paris.

The Plug-In City concept made by Archigram in the 1960's was one of the early looks at using components that are interchangeable for the use of remaking structure on a fast paced large scale. The drawings showed a city that built itself. The structure contained the life support of the people within it and people inhabited the space between. It attempted to address how people change in their needs and architecture could adjust to their needs. It was highly influential in the design of the Centre Pompidou.

Each of these cases complements the theoretical premise by adding design solutions. These buildings show a building fitting into its context and how flexibility has strengthened their relationship with the area. The value of these buildings has proven the concepts and technologies can enhance the design of the built environment.

Historical Context

Historical Context of the Performing Arts

Performance Art Center is a contemporary design to house many different performances within a single entity. Most center are sponsored by none profit organizations within the community. “Different kinds of storytelling want different kinds of spaces. The job of the theater architect is to support the storytelling. If theater architecture is not conceived of from that point of view, it fails.” (Hardy, 2006).

Theatre and the other Performing Arts had another level to experiment on that the traditional forms of art such as painting and sculpture could not. Performance Art can work on many physical levels by using visual, sound, motion, and space all at the same time. The rules are much looser. And unlike the traditional visual arts, performance arts have a direct interaction with the audience. This has allowed artist to experiment and observe the audiences with the use of their participation and reactions (Battcock, 1984).

Performance art has a murky definition to what is contained within the genre. Performances came from rituals of religious ceremonies. It grew out into a way of explaining the myths of the world. Over the generations a structure of storytelling lead to what became the theatre. Performances provided a way for artists to articulate ideas in the form of actions, by setting them in motion and interacting with the audience (Battcock, 1984).

Pre 1960’s performances were often thought of as dance, music, poetry, among other styles. During the 1960s and 70s the Performing Arts began to try to adjust the definition and focus more on the artist. “By 1970, Performance Art was a global term, and its definition a bit more specific. ‘Performance Art’ meant that it was live, and it was art, not theater. Performance Art also meant that it was art that could not be bought, sold or traded as a commodity.” (Esaak). Even though it is not defined as theatre many of the performance arts are a part of theatre.

In the Chicago Art Magazine Gretchen Holmes interviews theatre artist Kristin Idaszak about the difference in theatre and performing arts. Idaszak explains theatre has a set of conventions and traditions it adheres to. In theatre there is a fourth wall between the audience and the performers a barrier. The performance arts the rules are there are no rules. This freedom of expression comes from Dadaism in the first half of the twentieth century. In performance art the audience is expected to be challenged (Born, 2010).

Dadaism was an anti-culture in art that throughout reasoning and focused on obscurity. It fought against the consumerism in art by attempting to make art unattractive. This was in hope to remove traditional views of aesthetic and traditional art in culture. Though the attempts to deconsumerize art were unsuccessful, as the public bought up Dada art.

Today theaters and performing arts center are evolving to contain as many different uses as possible. Just like sports arenas need to hold entertainment, events, and retail in order to pay for the venue, the arts need to bring in a variety of acts to remain economical. Challenges such as acoustic and special layout need to break the single purpose shoebox theater design (Hart, 2003). Performance Center like the Wyly Theater use flexibility to adjust to the difficulties of numerous acts taking place. Kinetic design allows for seats to be lift into the ceiling or arranged for the next performance or a in the wall curtain system can change blackout the theater in the push of a button.

Historical Context of Adaptable Architecture

Flexible design and kinetic architecture go back to nomadic lifestyles. Mobile structures brought the architecture with the people as they traveled to follow food or move because of changing weather. Architecture fit the user, not the user fits the architecture. Flexible buildings change to the situation (Kronenburg, 2007).

Today architecture starts out from manufactured components. Tatjana Schneider writes how Walter Gropius saw the house as a set of components rather than a complete product. This standardized component system "would also allow adaptation over time, with the possibility of elements being replaced or added to with the minimum of fuss." (Schneider, 2007). Gropius derived this idea from the manufacturing process of the automobile. A car is a collection of pre-manufactured parts assembled quickly with the possibility of replacing post completion.

In flexible design a large portion of the focus is on housing. Schneider states in Flexible Housing,

"Our broad definition of flexible housing is housing that can adjust to changing needs and patterns, both social and technological. These changing needs may be personal (say an expanding family), practical (i.e. the onset of old age) or technological (i.e. the updating of an old services). The changing patterns might be demographic (say the rise of the single person household), economical (i.e. the rise of the rental market), or environmental (i.e. the need to update housing to respond to climate change). This definition is deliberately broad. It includes the potential to make changes prior to occupation as well as the ability to adjust one's housing over time after occupation. Flexible housing thus works across the life of a housing development." (Schneider, 2007)

An example of component built house is the Eames house built in 1949. It took the idea standardized industrial building components to assemble in a sensitive manner to make a seductive 'art' house. It was a demonstration of economical production and assembly while being aesthetic. It kept the building elements of structure, cladding, and access, and services separate to understand that it was an assembled building (Kronenburg, 2001). It was one of the first building to use off the shelf industrial component to make a house.

In the 1960s and 70s Archigram Group a collective of architects produced a magazine publishing drawings of futuristic designs inspired by industrial technology. These drawings showed a future where cities are built around flexible and kinetic architecture. The Plug-in City was published in 1964 show a city that built its self with interchangeable components. Cranes on top of the structure of the city placed or removed pieces to change the functions of areas in a city. A lattice work became the structure and life support of the city. Peoples need became the input for the cities need to respond (Zuk, 1970).

Archigram heavily influenced architects Richard Rogers and Renzo Piano and the structural expressionism movement, also known as high-tech architecture. Rogers and Piano used the ideas of the structure and life support removed from the space people used to design the Pompidou Centre. The design used repeating structure that was on the outside of the building and moved all utilities and vertical movement outside of the enclosed space and placed it in then empty space within the structure. Also builds like Lloyds of London also designed by Rogers continue this work of exposing the pieces that make up the building.

Historical Physical Context

Duluth was first inhabited by the Sioux and Chippewa. European settlers came to the area because of the fur trade in the 1600s. The French fur traders setup post throughout the area. A settler by the name Daniel Greysolon Sieur du Lhut attempted to establish a peace settlement and trading agreement with the Native Americans in the area. He was unsuccessful in his efforts. In 1817, John Jacob Astor set up a permanent trading post called Duluth.

In the 1800's copper and iron mining and timber brought a new thriving life back to the city. Duluth's harbor used incoming rail lines to bring materials from all parts of Minnesota to ship. Northern Minnesota became a large supplier of timber. Copper and later Iron mining brought with it manufacturing jobs. The amounts of resources made it an industrials and shipping giant of the northern Midwest. This made Duluth a major harbor and economy within the United States. In 1887, Duluth was officially named a city with a population of 26,000 residents.

When the Minnesota Iron Range was discovered it brought with it corporations looking to profit from the large deposit. In 1907 U.S. Steel came to Duluth. This was at the time one of the world's richest corporations. It built a company town now on the south side of Duluth called Morgan Park. Company towns have historically been used to provide workers and their families all the necessary living arrangement to bring in workers. Most cities with large growth because of industries moving in didn't have the housing to put up all the workers. So the company took it upon themselves to build the houses and shops for the workers. Past company towns attempted to control the employees and keep all the money within the town. This type of setup led to conflicts between workers and the corporations. Morgan Park used a welfare capitalism approach to the town. U.S. Steel provided

benefits to the employees to make it more appealing (Alanen, 2007).

The large iron ore industry in Duluth created a strong economy for the city. At the end of the nineteenth and the beginning of the twentieth century Duluth was home to the highest percentage of millionaires per capita than any city in the world. Its big corporations and on top of the scenic qualities made Duluth a favorite place to live.

In 1959 the St. Lawrence Seaway opened. A 114 mile channel from Montreal to Ogdensbur, New York allowed ocean going ships to travel inland as far as Duluth. This has made Duluth the world's largest inland harbor.

But the city took a turn in 1970's when U.S. Steel shutdown the steel plant. Over the next couple of decades many other major industries moved out of the city. Duluth suffered a decline in jobs and population. Unemployment reached 15% in the 1980's. The city's population in the late 1960's was about 110,000 and by 1990 was only 85,000. Since then the city's population has remained stable.

As industries left it also left an abundance of abandoned industrial and harbor. The city in efforts to revitalize itself turned a stretch of theses piers into entertainment, shops, and tourist locations. It has become the identity of the city.

Thesis Goals

My goals in pursing this thesis are based on of farthing my education and understanding of architecture by exploring my interest in architecture capable of adapting to needs in order to extend its life expectancy. By setting academic, professional, and personal goals I will create a display of my skills I have developed through my academic career.

Academic

Academically, the thesis will question the way society builds and treats existing building. It is to challenge the way a building is inhabited and treated. To studying building techniques and technologies can inform potential future decisions for new construction that wish to have long life times for buildings. Buildings suited for the modern fast changing life cycle can provide a more material conservative and self-expressed culture that is lacking. Identity within a city is a complex question that has defined place and traditions for all cities.

This thesis tests the idea of a structure built with mass manufactured components can contain its sense of identity and also provide one for a community. It will also explore the outreach to multiple levels of community. This has come from my studies of buildings that have been deemed outdated and torn down or extensively and expensively repurposed.

Questioning adaptive reuse I feel can make better newly constructed buildings. By addressing these questions I believe I will better my knowledge for future use. By adding this project to the institutional repository others can questions question and learn from the use of mass manufactured components, flexible design, and kinetic architecture.

This project will represent and be a demonstration of my capabilities. I will develop a clear and evocative exploration of adaptable capabilities of architecture. This will be an exhibit of what I have learned through the years at NDSU. The research, design, and presentation will show my highest level of abilities. My work will be thorough, done in a timely manner, and present a holistic understanding of architecture.

Professionally

The work produced for this thesis will be used to display myself to professionals within the field. It will represent my capabilities as I move out the academic setting into the professional. It will teach me valuable knowledge that I one day can use in real world applications. I hope to one day become a licensed architect. Within the professional world I would like to continue to challenge issues within architecture. I desire to work with others who continue to persist on moving towards the future in the communities, industries, and cultures we work within.

Personal

On a personal level, I am looking forward to my career within architecture. By exploring these topics I hope to expand my views and understanding of architecture. I hope to find a never ending chance to learn and innovate. I am eager have new questions and seek out possible answer for them.

I have always felt design method is a growing thing and mine is still young. I intend on maturing and progressing it to strengthen my designs. Questions have many solutions. The ones we come up with tells a lot about who we are.

Site Analysis

fig. 39

fig. 40

Site Narrative

fig. 41

The day started in the early morning shortly after sun rise. I packed up the car and drove off. I was exploring a new territory on this journey to Duluth from Fargo. The drive was met with changing scenery through northern Minnesota. In the heavily wooded regions, snow still remained under the trees from one of the first snow falls of the year. With the sun unable to reach the ground the snow could remain even though it was still warm. The road began to feel empty; no one other cars around. Other than the scattered small town I felt lost within the wilderness. Upon the final approach to the city the roads began to crowd. Traffic was fast passed now entering winding hills. The road beings to work its way down the hillside. As I enter the Duluth on one side of me is Lake Superior and on the other Duluth sitting upon the hills.

Industrial plants cover the edge of the harbor. They are tall and worn from the years of use. The signs of an old well used city are apparent immediately. The highway cuts the harbor and the city apart. I turned my attention to reaching the site. I found myself climbing steep winding hills. When the car reached the crown of the hill I had arrived to the site.

I parked right in front of the site and began to look around. I walked the neighborhood to get a feel for the surroundings. The houses were patinaed with use. Down the street was an old school building. It hadn't seen the life of children in years. Political signs were hung in many of the windows and appeared to be a political outpost. In the other direction from the site a Church sat behind the cover of trees. Its dark stone was contrasted by the white covers enclosing were most of the windows would be. Looking down the street I see downtown Duluth.

As I begin to explore the site I first focus on the play area. The baseball field felt empty and unused for months. Two children show up to play basketball. The court has weeds growing out of it. On the other side of the fence at the edge of the cliff I see a bench. Even in my explorative fearless nature I am unwilling to try and reach this bench that has now path to reach it. With its back up against the fence it looks out directly at downtown Duluth standing above the brush.

Now excited to explore the rock outcroppings I begin to climb behind the baseball field. Journeying over a pile of boulders and through the thick brush I am released into the open standing atop the cliffs. I now see the city and harbor from what seems like the top of the world. I continue to try to climb further out on the rocks. The view has a panorama like quality; an endless 180° view. The town peaks around the sides of the cliff, the piers lay right in front of me, and Lake Superior fill the background.

As I investigate the edge I find graffiti and trash all over the rocks. This has clearly been a hangout for adolescence. Look down the site to see what is at the bottom I find a ruin. It appears to be from early settlers in the area. The stone shell is surrounded by thick brush with no visible way of reaching it.

The sun set fast on the site because of the tall hills to the west. Do to my love of the site I did not want to leave. My ideas of a project assembled on the site before my eyes. The idea of a theater interacting with the city in the background creating a draw next to the downtown had me exited to design.

The next day I work to explore the city and the harbor. From the piers the site pokes out of the trees at the edge of the cliff. In the background is the observation tower. The hillside is covered in flashing red lights by antennas. Light snow flurries and fog cover role into the city. The city hillside begins to blur into the white haze. I continued to explore the downtown region.

Distress
The site is currently a low maintained park. The surface of the baseball field has small weak grass with the dirt held in place with a plastic mesh meaning it suffers from erosion. The ice rink has many broken board and has lost the majority of its white paint. Basketball courts have weeds growing through the black top. The locker rooms for the baseball field and new playground equipment are the only man made object in good condition

Grid
The site follows Duluth's layout of rotated 45 degree Jeffersonian Grid. On the southwest end of the site the road curves around the cliff to remain level. Roads end as they reach the site. 8th 9th and 10th avenues and 2nd street all end instead of passing through the street.

Textures
Short grass covers much of the flat surfaces of the site. Other flat surfaces are covered in blacktop including the basketball courts and walking paths. A field stone retaining wall is used to elevate the baseball field from the sidewalk. In the southwest haft of the site is rock outcroppings and discarded bolders. The rocks are weathered and smooth with moss growing on them. Worn away graffiti covers a few. This is surrounded by thick brush with clear man made paths through. A row of trees surround three sides of the top portion of the site.

Utilities
The site has water, sewage, and electrical on the site already. They provide for the locker rooms and the lighting for the basketball courts. Three power poles bring the power onto the site.

Noise
There is a tornado siren next to the site. Interstate 35 makes a lot of noise once past the brush out on the cliffs. Small amount of noise from the roads next to the site.


fig. 42


fig. 43


fig. 44


fig. 45

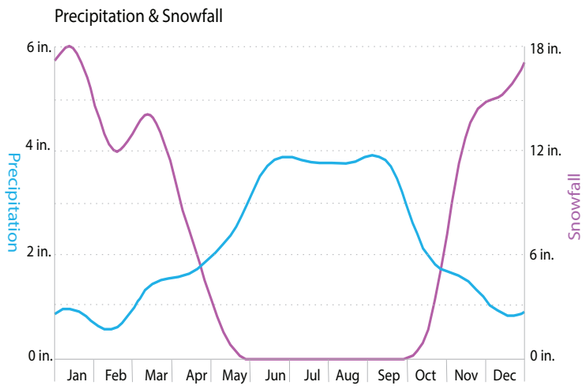


fig. 46

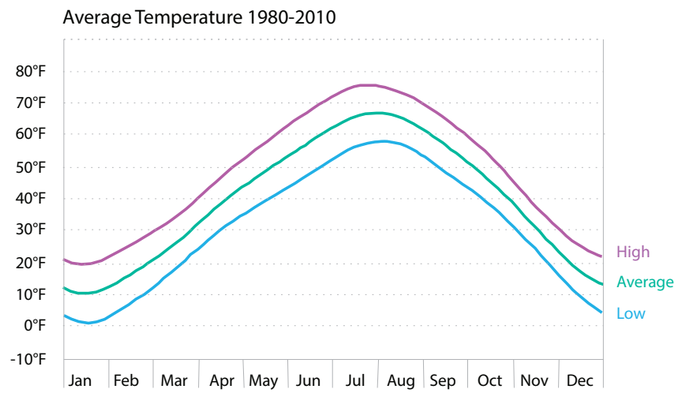


fig. 47

Topography
Duluth topography is characterized by steep hillsides that rise up next to Lake Superior. The steep ridges and rock outcroppings are characterize the city. The city is laid out it fit the sloping hill side. The city's grid is rotated so the roads run with the hill. The ridges rise up to 800 feet above the level of Lake Superior which is at an elevation of 600 feet. Because of the change in elevation and proximity to Lake Superior precipitation in the city may fall as rain whereas on top of the plateau will be snow. Often time on cool day the city will be covered in fog that moves in from the lake. (Natural Systems)

The sites elevation is on the low end 780 up to 920 feet above sea level. Because of the steep slopes the wind travels parallel to the hillside coming from the NE or the SW. Strong winds will come from across the lake. The city is sheltered from winds out of the NW. The site is highly exposed to winds from the lake because it sits unblocked at the edge of a cliff. The site has some protection from winds that move parallel to the hillside, but because it is at the summit of the high only the nearby trees provide protection.

Soil Types
The soils of Duluth vary from spot to spot. Duluth ranges from direct bedrock where rock outcroppings are all the way to deep soils in flat areas. The site is split into two soil categories. The first is a 'Rock outcrop Mesaba-Barto' is direct bed rock with some top soil. In some spots there are shallow deposits of loamy material over bedrock. This soil is a sandy red clay that is prone to erosion. The slopes of these materials are between 18 to 60 percent making them well drained regions.

The second soil type is 'Urban land Mesaba-Rock' that is made up of fill materials from surrounding gravel pits and blasted bedrock laid onto bedrock to create a flatter surface. The depth of the soil ranges from 20 to 40 inches

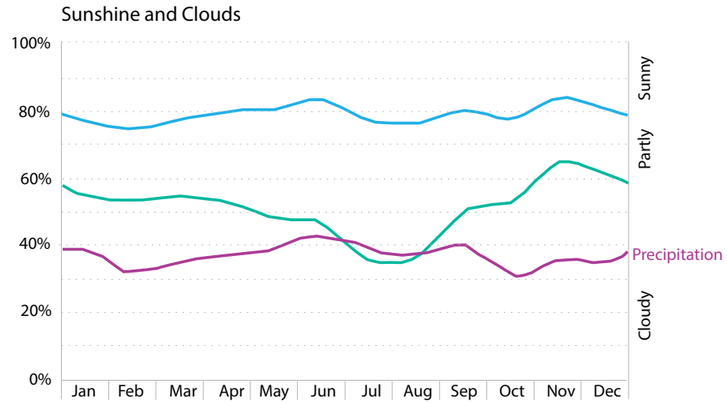


fig. 48

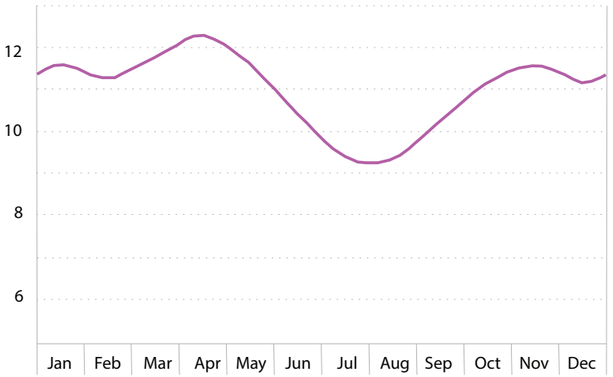


fig. 49

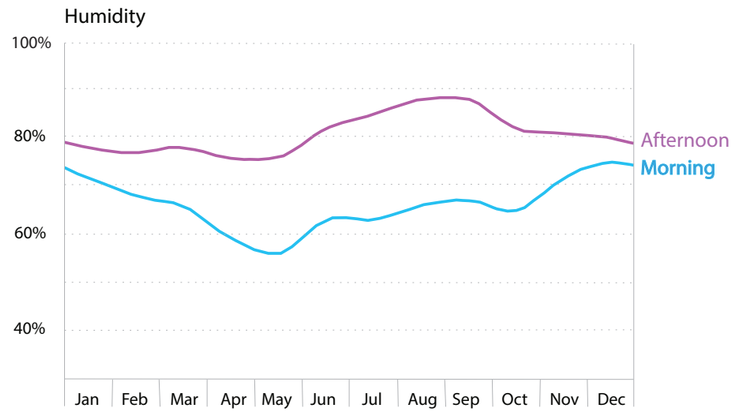


fig. 50

until they reach bedrock. The soil is a gravelly red clay mixture that drains well but is also susceptible to erosion. The baseball field currently located on the site uses a mess to retain the soil. The slope in this region of the site ranges from 1 to 18 percent. Any steep slopes are short in length. The region has a few instances of rock outcroppings

F160F: Rock outcrop-Mesaba-Barto complex
18 to 60 percent slopes 61 percent of site 5.2 acres

F163D: Urban land-Mesaba-Rock outcrop complex
1 to 18 percent slopes 39 percent of site 3.3 acres

Slope
The site has multiple slopes that need to be taken into account. 80 percent of the front half of the site are less than 5 percent slope and close to the same elevation throughout. The remaining 20 percent slopes downhill towards the street. This portion of the site is ideal to build on and parking. The back half of the street is a cliff with varying slope from 18 to 60 percent. It is mostly rock outcroppings that can support building footings but is also very difficult to build on. This portion is incapable of supporting parking.

Sunlight
The site will have no manmade structures who can cast shadow onto the site unless at sunset. Trees circle all but the NW corner of the site providing shade. Out past the trees on the SE side on top of the cliff there is no shading to morning sun. The sun sets quickly throughout the year because of the hillside all along the west.

Wind Speed and Direction

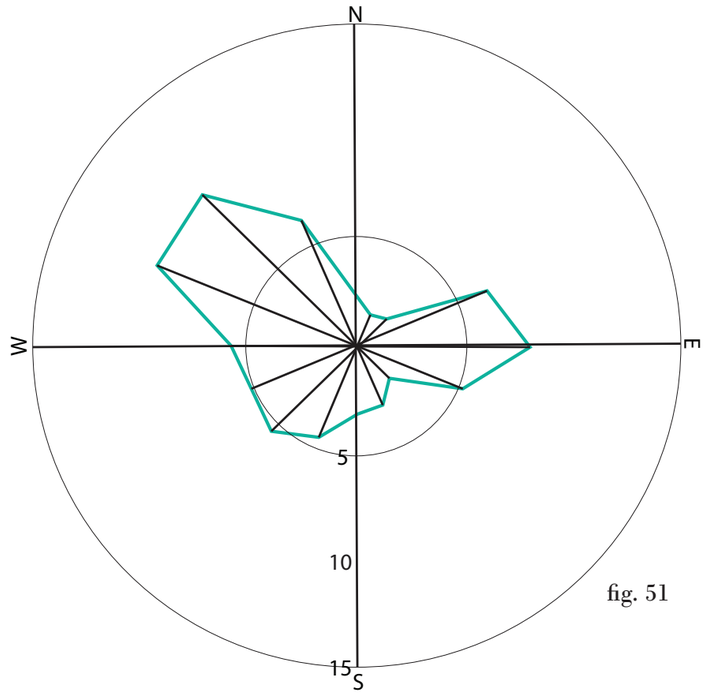


fig. 51

Solar Path Diagram

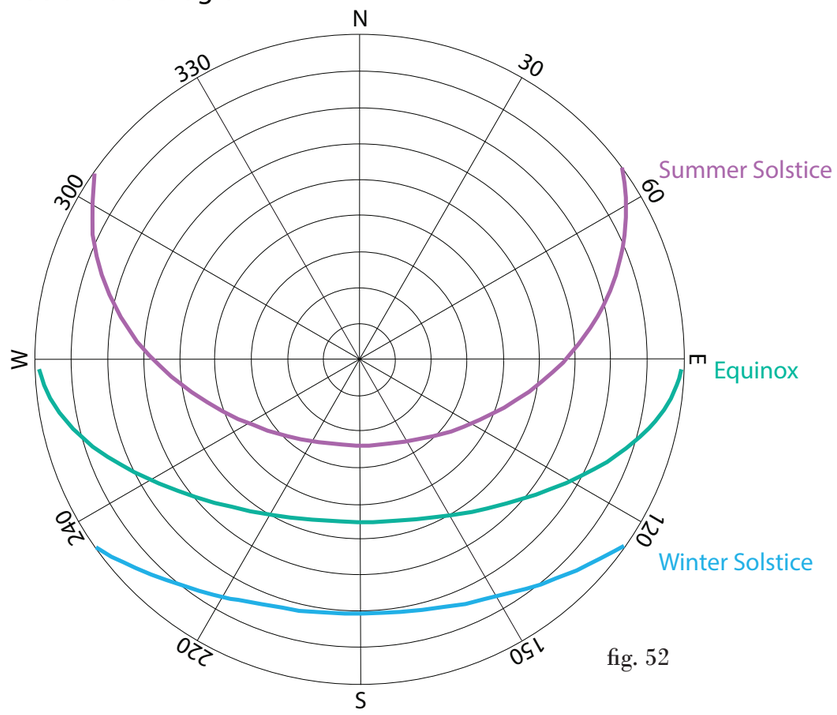
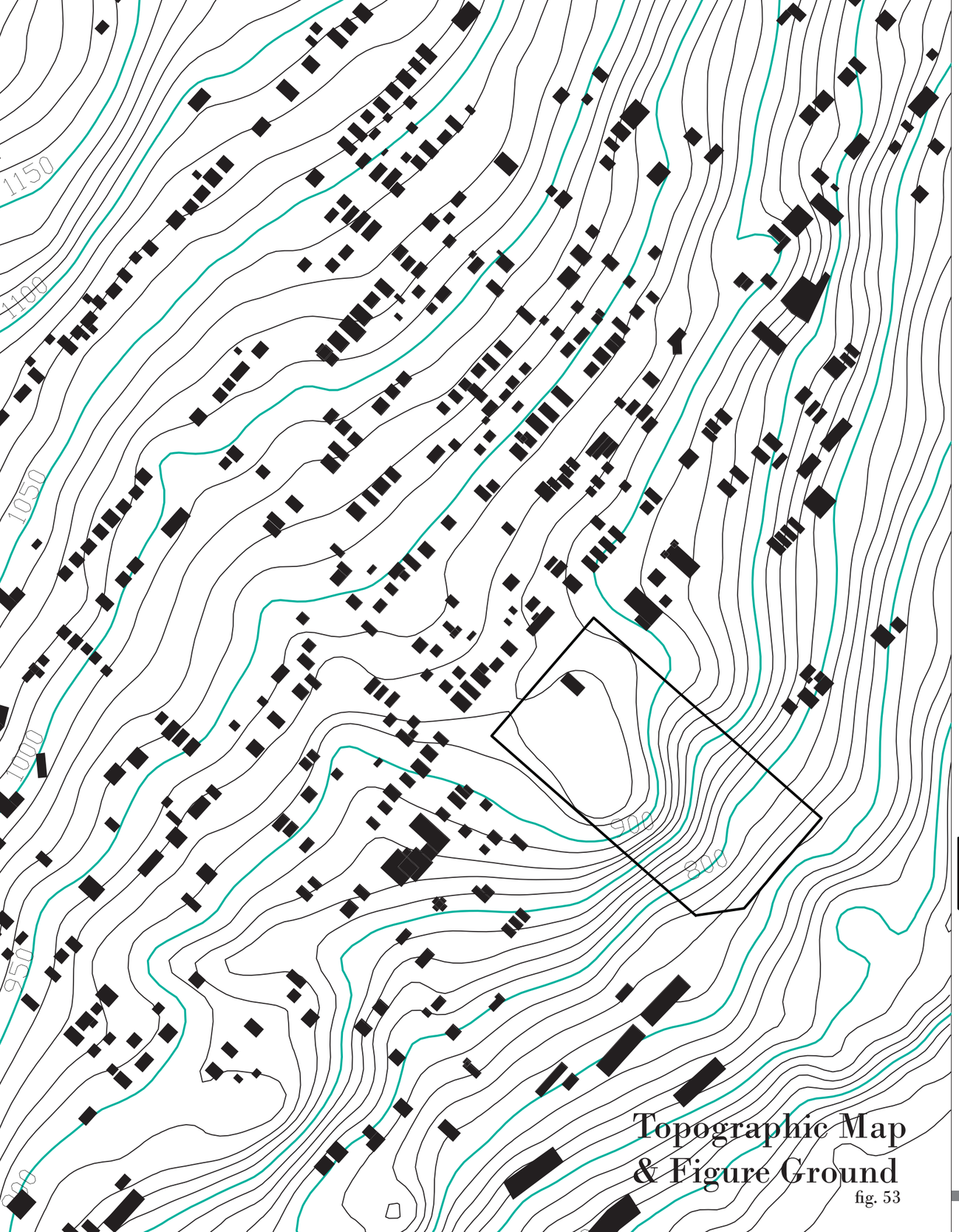
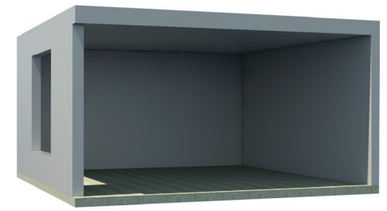


fig. 52

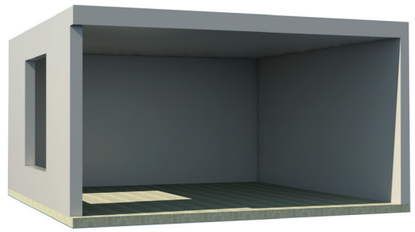


Topographic Map & Figure Ground

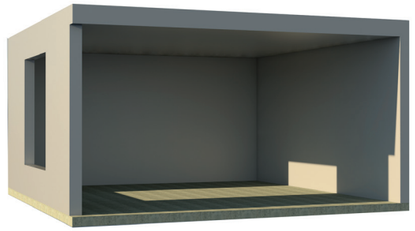
fig. 53



Winter Solstice



Equinox



Winter Solstice

fig. 54

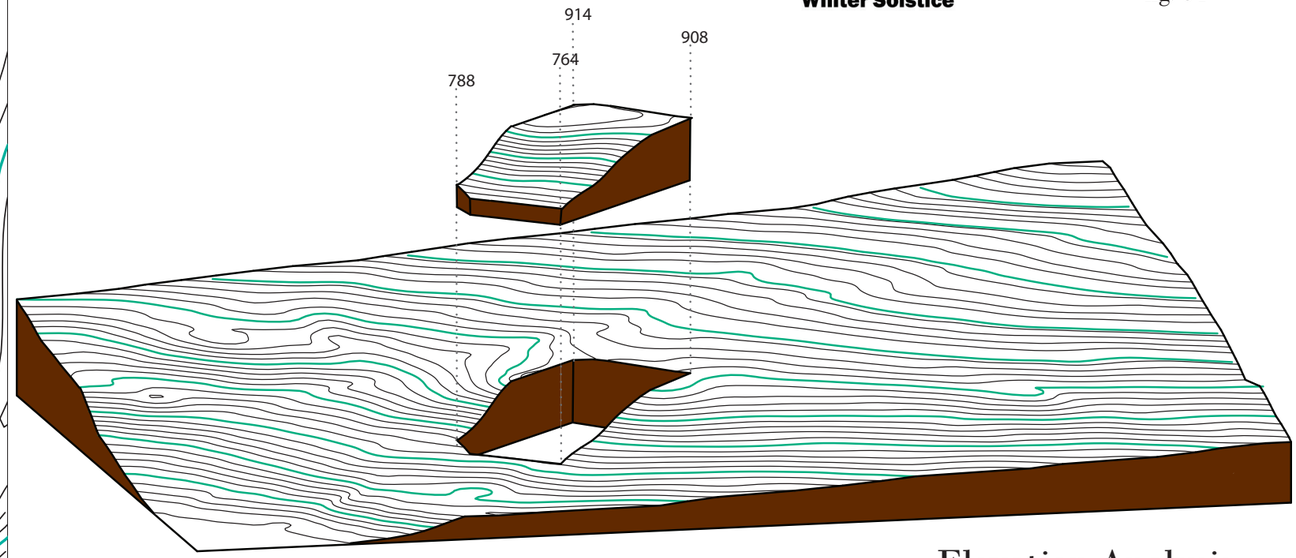


fig. 55

Elevation Analysis

fig. 56

Traffic
Utilities
Wind
Noise
Soil Types

F163D

F160F

Geology

Bedrock

Clay/Silt

Lake Superior

fig. 57

fig. 58

Slope Analysis

0-10%
10-30%
30-60%

fig. 59

Program Requirements

8640	Restaurant/Kitchen
5760	Greenhouse
3456	Gallery
864	Conference Room
180	Administrative Offices x 4
180	Directors Offices x 4
810	Technology Room
1728	Lobby
432	Bathrooms x 2
1080	Ticket/Coat Check
3312	Rehearsal Space
14400	Auditorium
800	Loading Dock Mechanical
504	Prop Storage
315	Instrument Storage
693	Costume Storage
360	Costume Repair
360	Greenroom x 2
900	Changing Rooms x 2
1950	Mechanical
74000	Total Square Footage

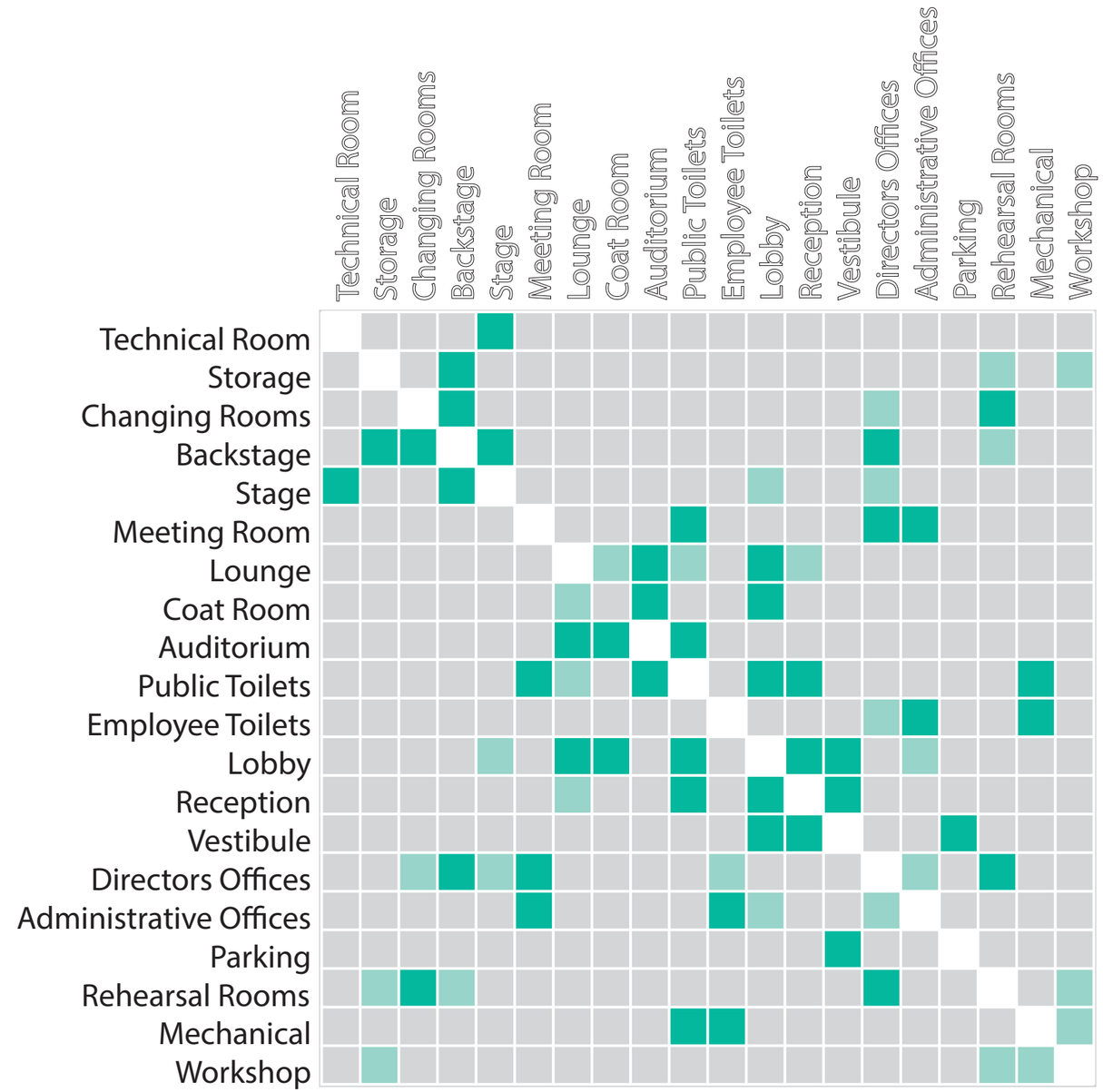


fig. 60

Interactions Net

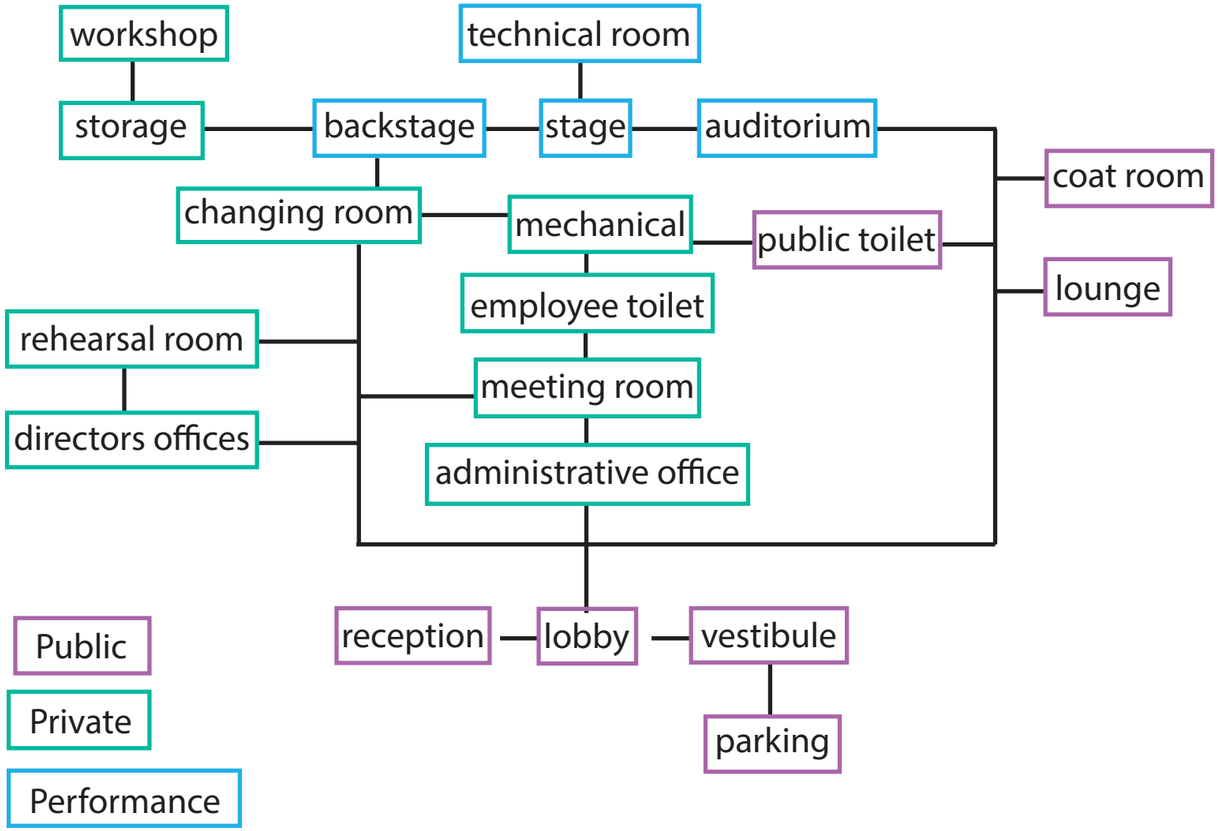
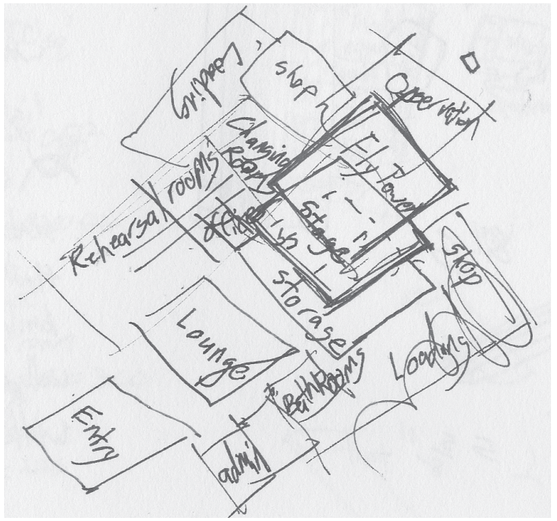
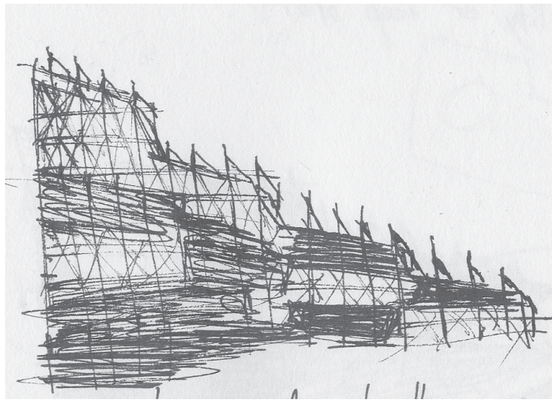


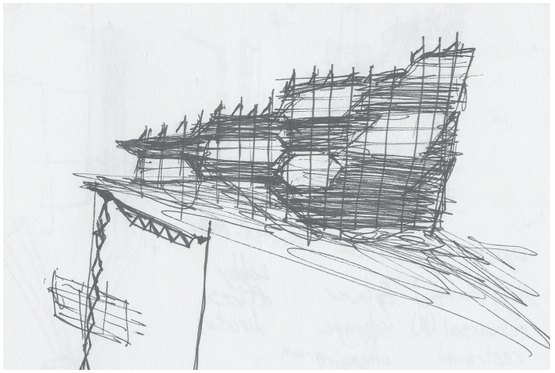
fig. 61

Design

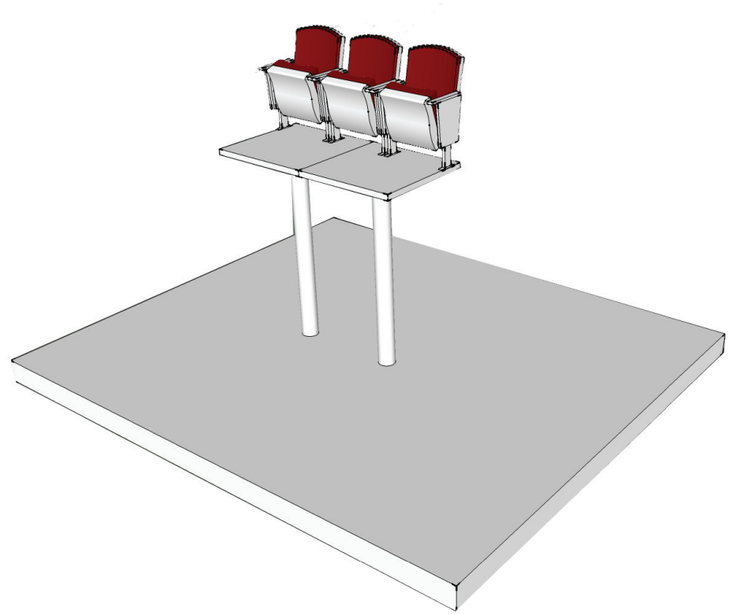
Process Sketches

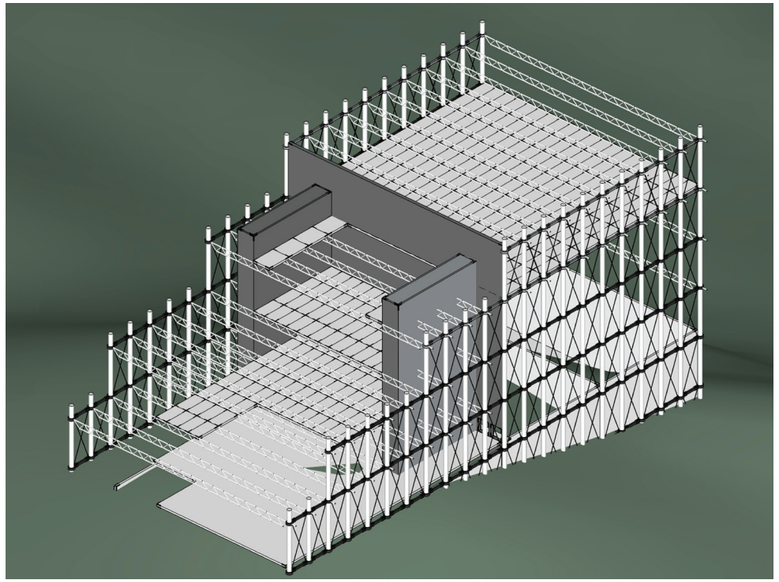




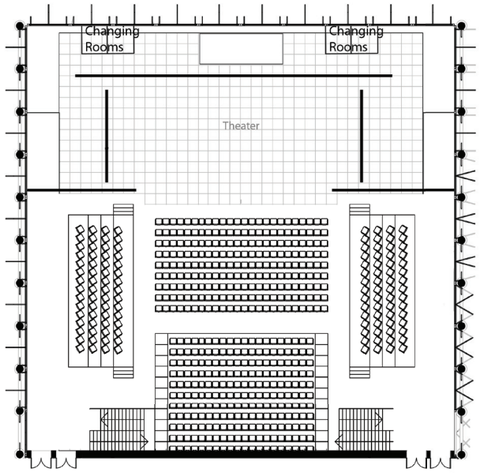


Proportion Development

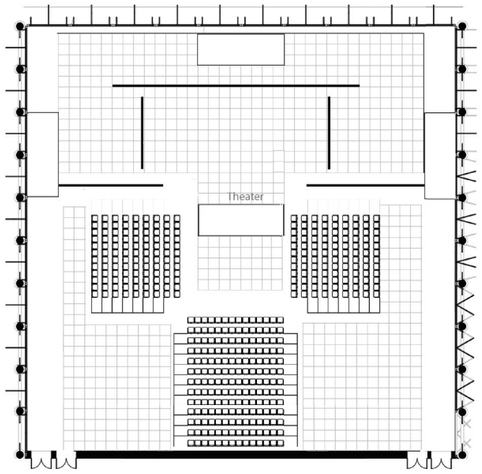




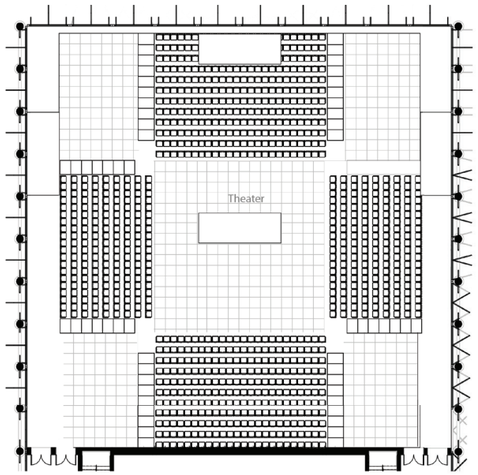
Theater Design



PROSCENIUM

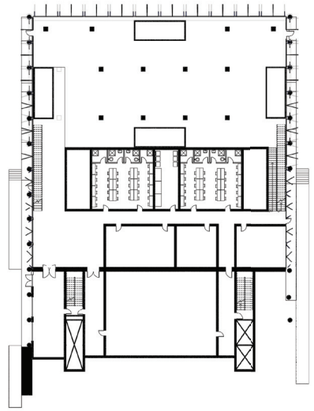


THRUST

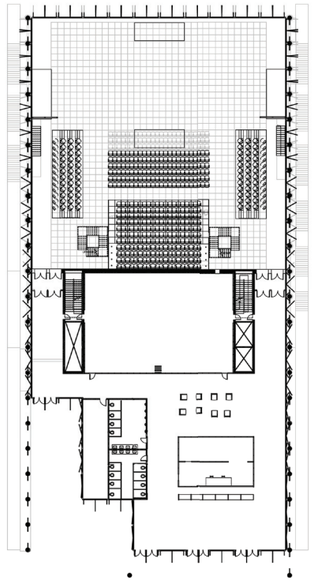


ARENA

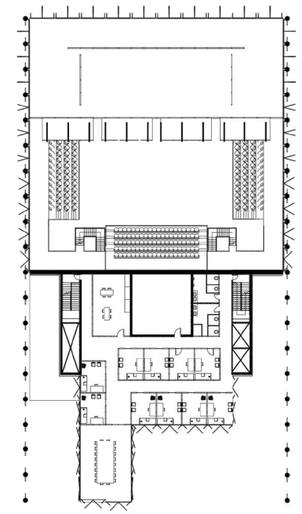
Floor Plans



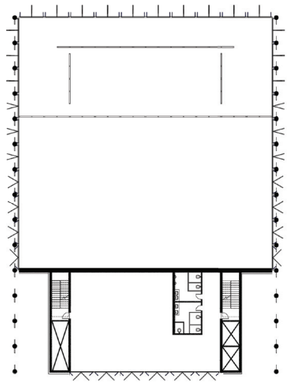
Lower Floor



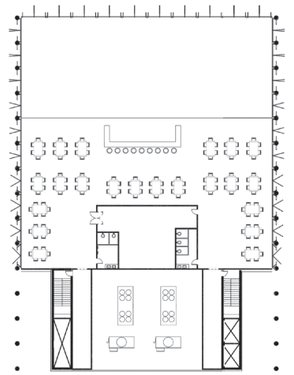
First Floor



Third Floor

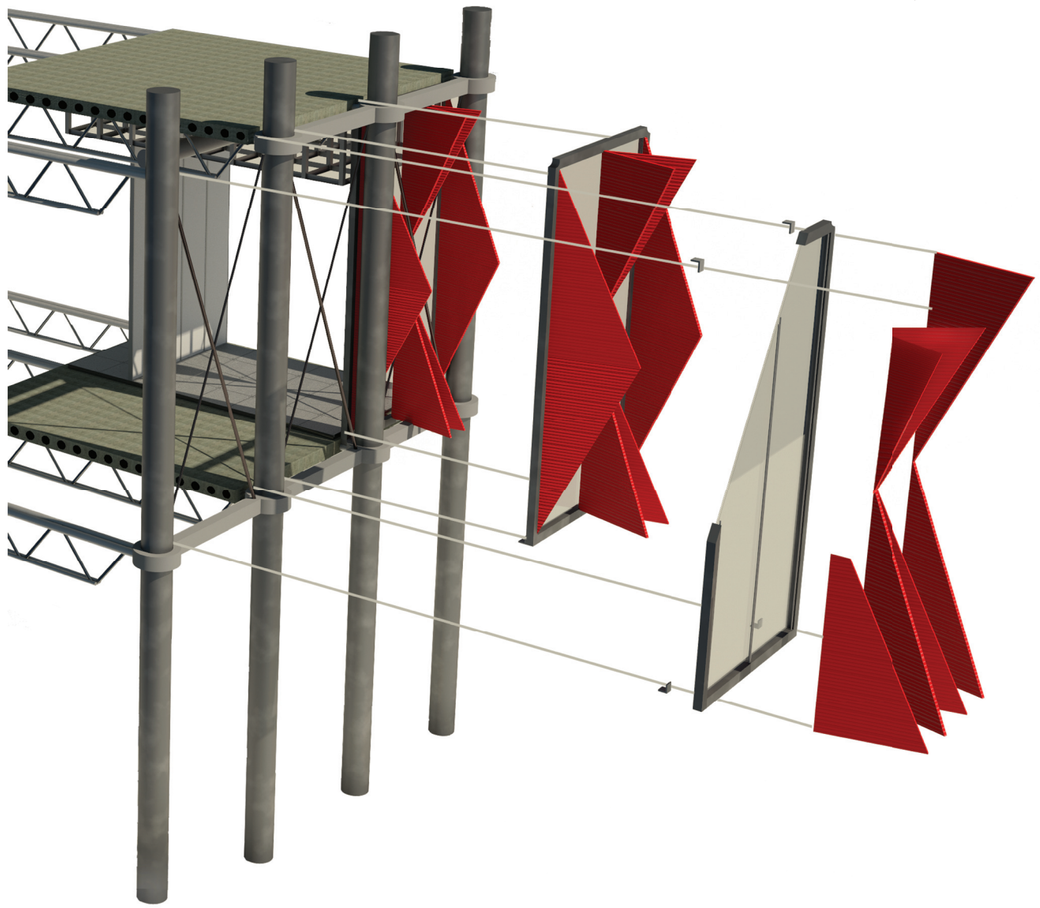


Four Floor

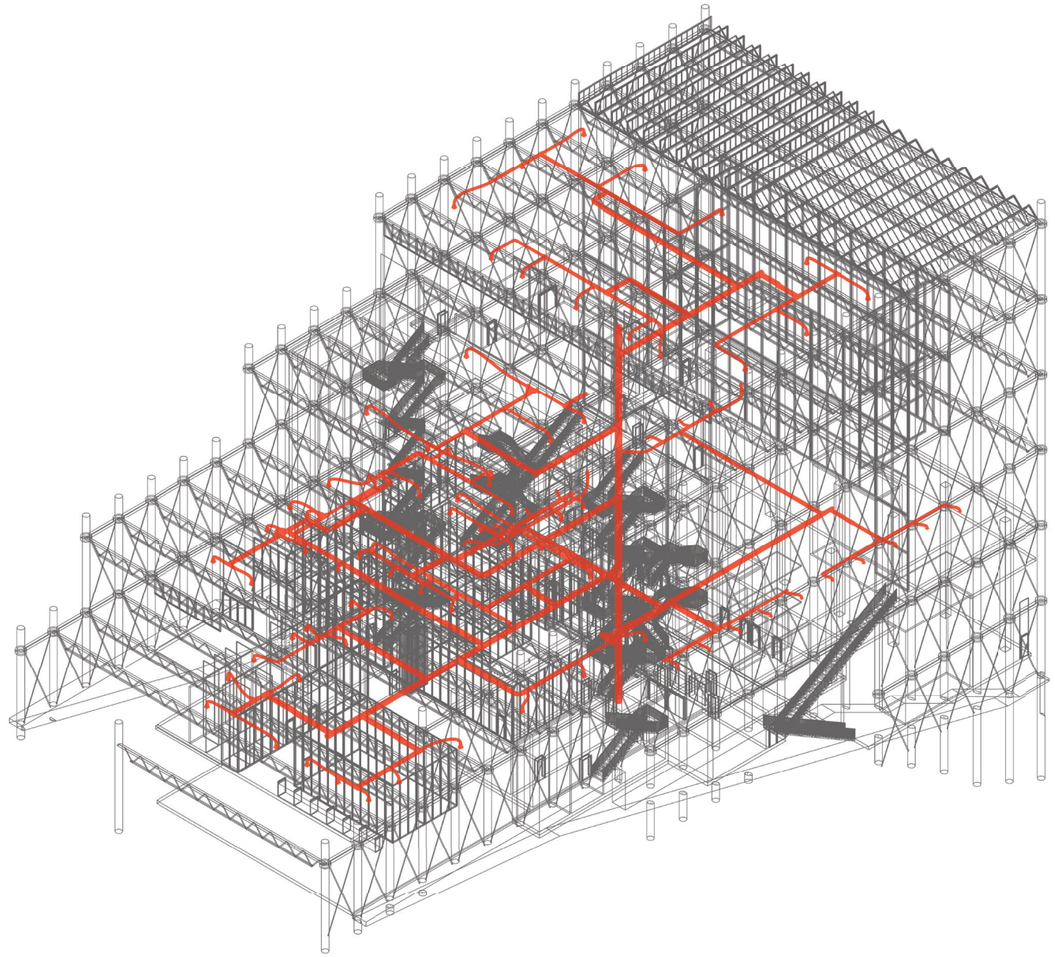


Fifth Floor

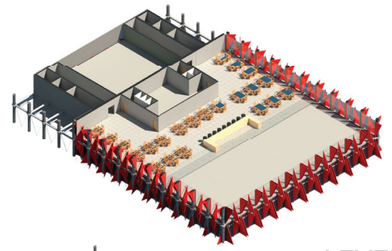
Structure and Louver Design



HVAC Diagram

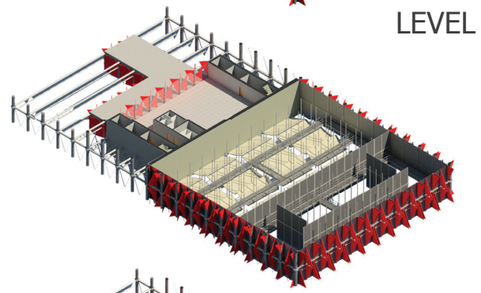


Site Plan



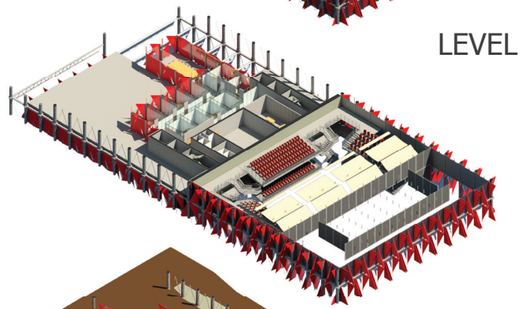
LEVEL 4

8640	RESTRAUNT KITCHEN BATHROOM
5760	GREENHOUSE

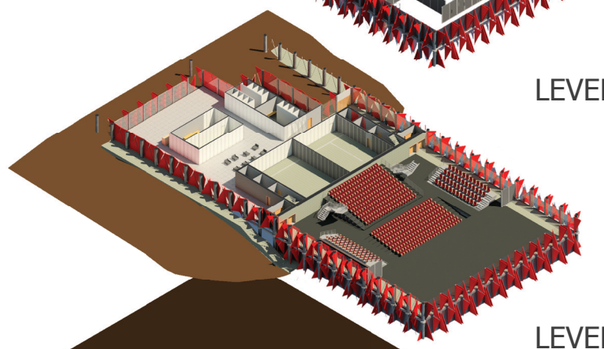


LEVEL 3

3456	GALLERY BATHROOM

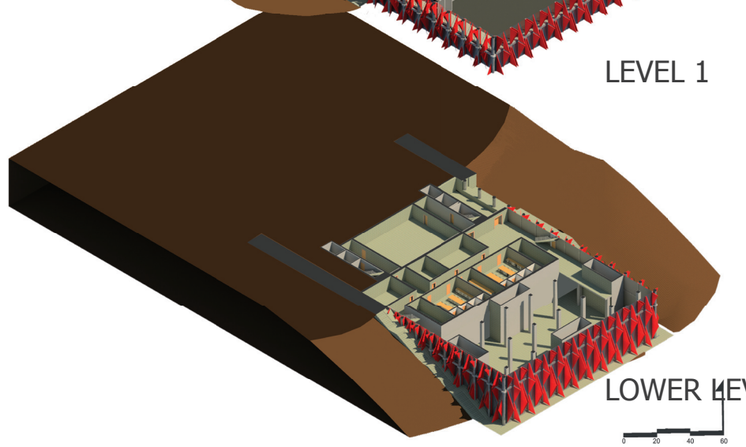


6000	CONFRENCE ROOM OFFICES BATHROOMS
	TECHNOLOGY ROOM



LEVEL 2

	LOBBY BATHROOMS
13600	TICKET/COAT CHECK REHEARSAL ROOM
14400	AUDITORIUM



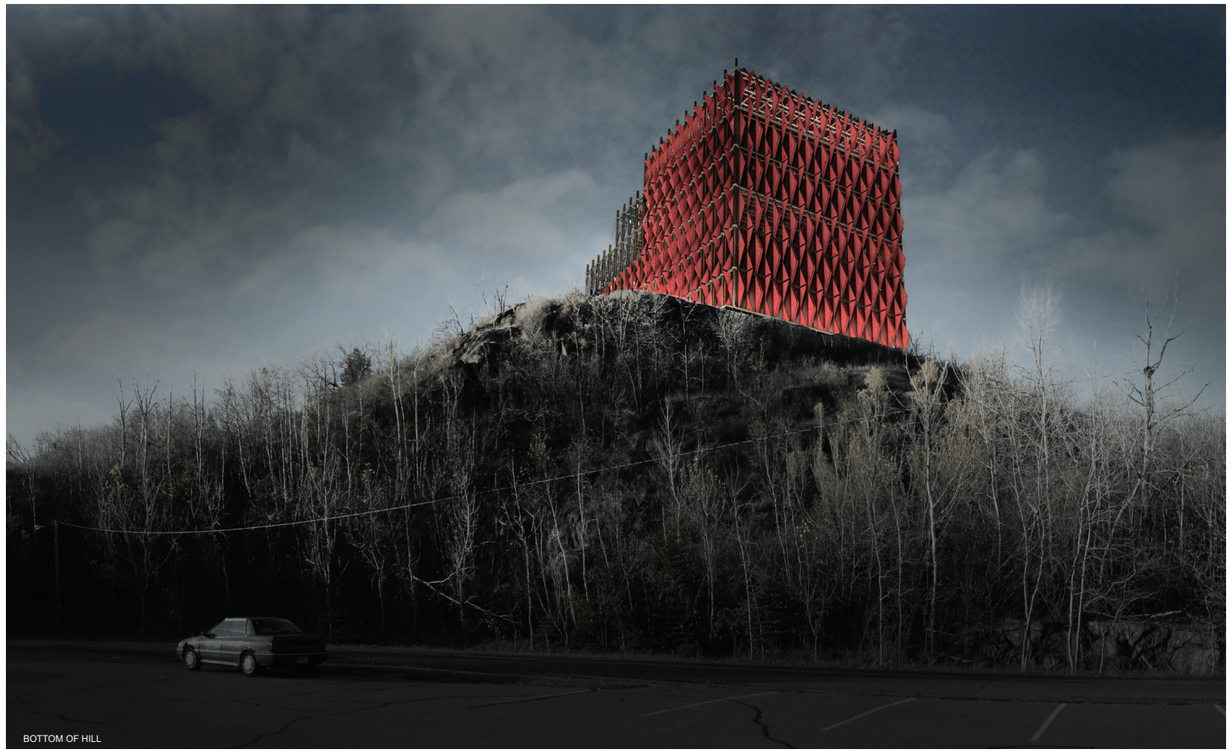
LEVEL 1

800	LOADING DOCK
1960	MECHANICAL
1533	PROP/INSTRUMENT/COSTUME
	STORAGE/ GREEN ROOM/
6450	CHANGING ROOM/GREEN ROO

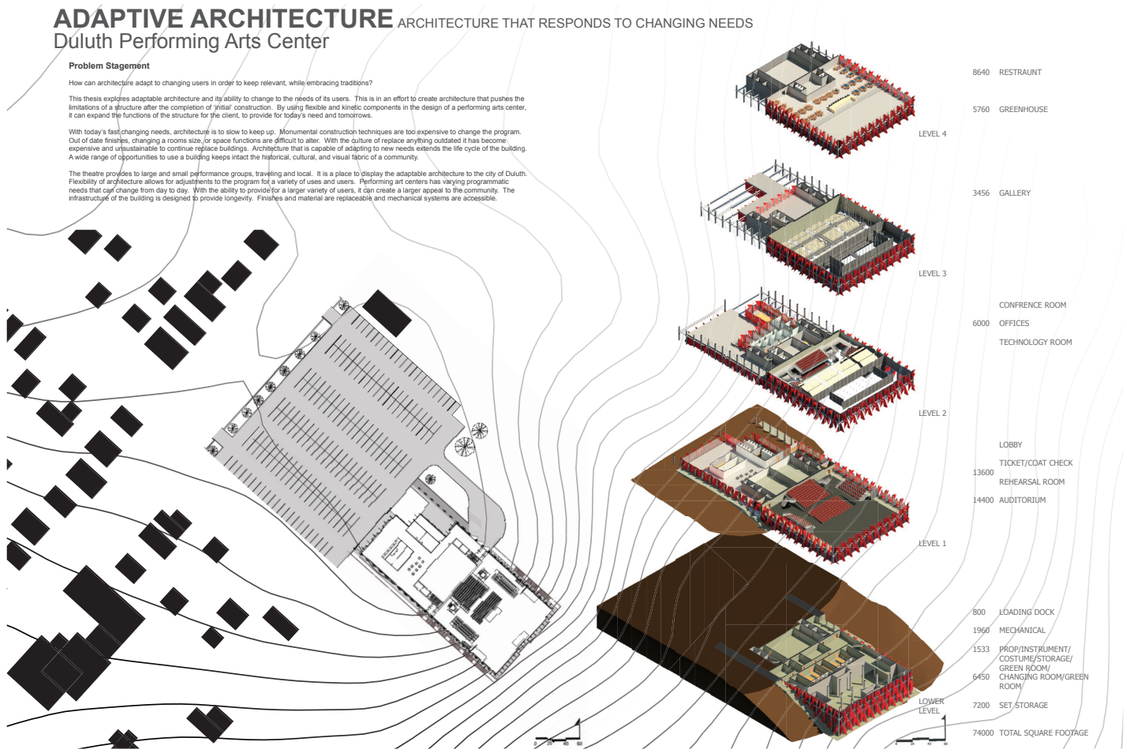
LOWER LEVEL

7200	SET STORAGE
74000	TOTAL SQUARE FOOTAGE

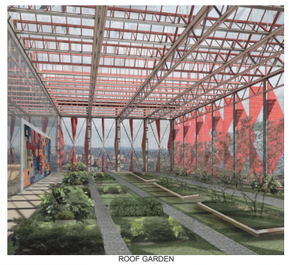
Thesis Boards



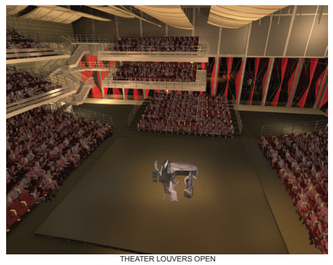
BOTTOM OF HILL



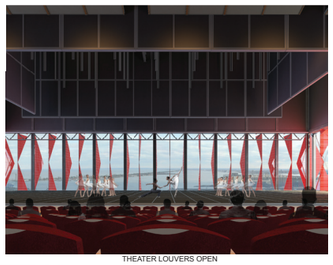
DULUTH



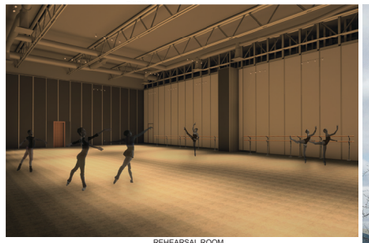
ROOF GARDEN



THEATER LOUVERS OPEN



THEATER LOUVERS OPEN



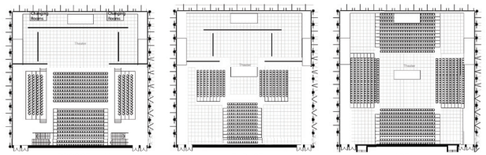
REHEARSAL ROOM

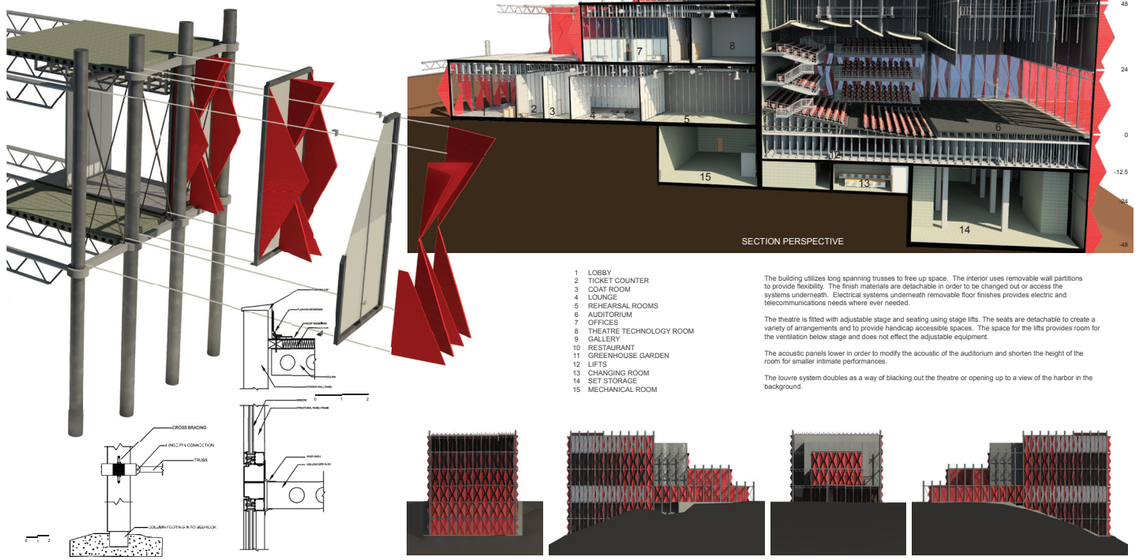
ARCH 772 DESIGN THESIS SPRING 2013 | JACOB WINDSCHITL | RON RAMSEY

| AUTOCAD, REVIT, SKETCHUP, PHOTOSHOP, INDESIGN, ILLUSTRATOR

STREET VIEW

LOBBY





1 LOBBY
2 TICKET COUNTER
3 COAT ROOM
4 LOUNGE
5 REHEARSAL ROOMS
6 AUDITORIUM
7 OFFICES
8 THEATRE TECHNOLOGY ROOM
9 GALLERY
10 RESTAURANT
11 GREENHOUSE GARDEN
12 LIFTS
13 CHANGING ROOM
14 SET STORAGE
15 MECHANICAL ROOM

The building utilizes long spanning trusses to free up space. The interior uses removable wall partitions to provide flexibility. The finish materials are detachable in order to be changed out or access the systems underneath. Electrical systems underneath removable floor finishes provides electric and telecommunications needs where ever needed.

The theatre is fitted with adjustable stage and seating using stage lifts. The seats are detachable to create a variety of arrangements and to provide handicap accessible spaces. The space for the lifts provides room for the ventilation below stage and does not effect the adjustable equipment.

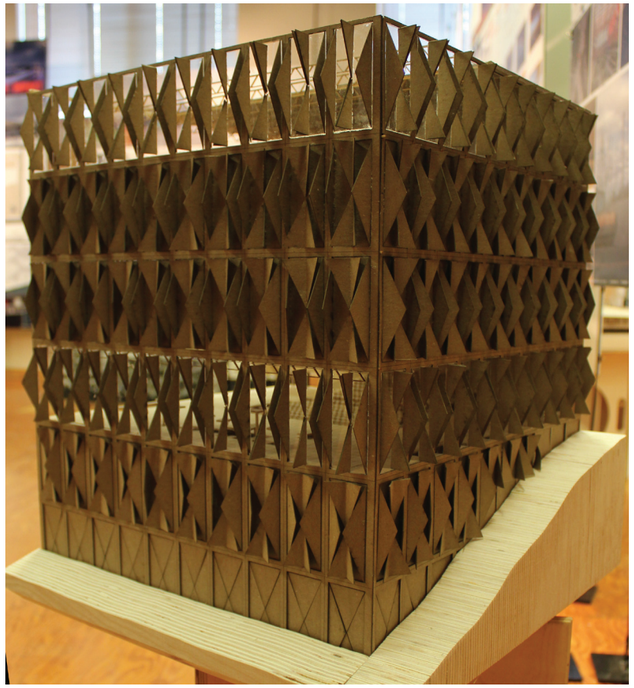
The acoustic panels lower in order to modify the acoustic of the auditorium and shorten the height of the room for smaller intimate performances.

The louvre system doubles as a way of blacking out the theatre or opening up to a view of the harbor in the background.

THEATER SIDE VIEW

Final Display

Model



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Figures 1, 2, 3
Windschitl, J. 2012. Image retrieved from Bing Maps.

Figures 4
Windschitl, J.

Figures 5, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28
Windschitl, J. 2012. Images and information retrieved from http://openbuildings.com/buildings/matsumoto-performing-arts-centre-profile-2816

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Image retrieved from http://www.azahner.com/portfolio/wyly-theater

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Windschitl, J. 2012. Image retrieved from http://www.archdaily.com/64028/ad-classics-centre-georges-pompidou-renzo-piano-richard-rogers/

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Windschitl, J. 2012

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Windschitl, J. 2012. Data retrieved from http://www.citydata.com

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Windschitl, J. 2012, Data retrieved from http://www.horca.net/graphs/sunplot.php

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Windschitl, J. 2012. Map retrieved from http://www.topodepot.com/

Figure 57
Windschitl, J. Data retrieved from http://www.duluthmn.gov/planning/comp_plan/compplanfinal/BackgroundProfiles/Natural%20Systems.pdf

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