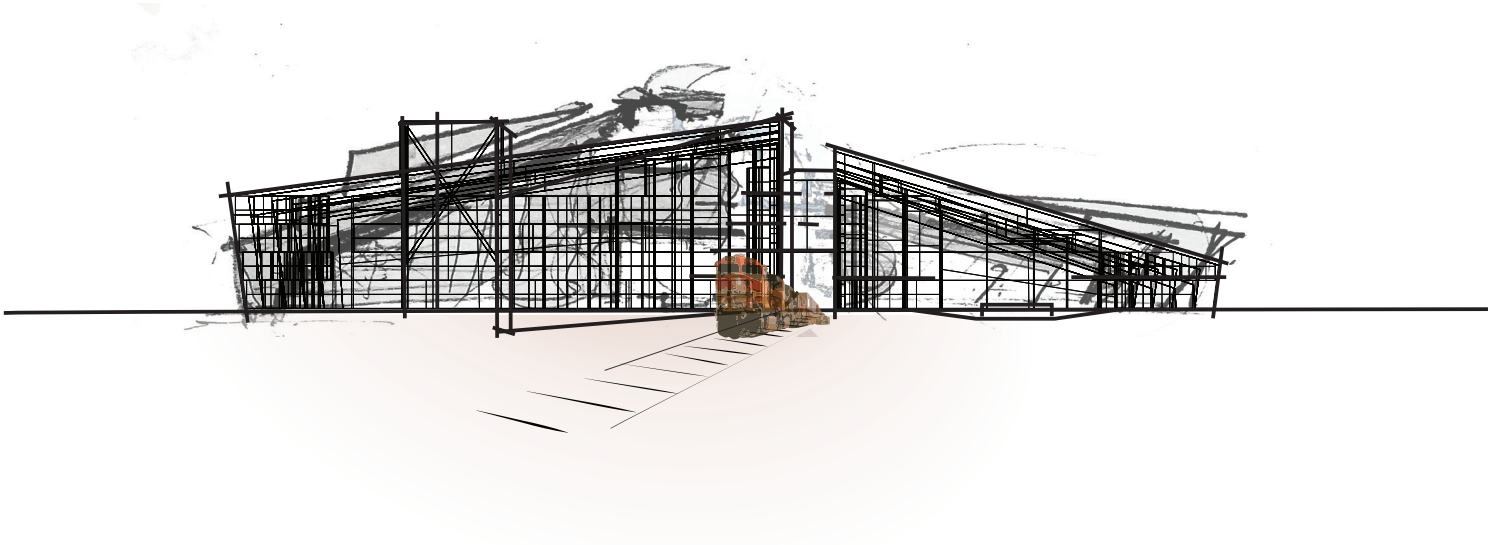

Caesura:

Enhancing the Culture of Fargo-Moorhead

CAESURA: ENHANCING THE CULTURE OF FARGO-MOORHEAD

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

By
Jennifer L. Eggen

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

Primary Thesis Advisor

Thesis Committee Chair

May 2019
Fargo, North Dakota

PROPOSAL

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ABSTRACT

The downtown area of Fargo-Moorhead is growing exponentially, yet the rapid boom in growth may result in a monotonous city center. Downtown needs an attraction—something other than shops, bars, restaurants, and apartments. Since the arts play a vibrant role in the FM community, a performing arts center could be the attraction to fight the mundanity.

Currently, the FM Symphony does not have a home. A performing arts center in the hub of Fargo would be able to house the symphony on a more permanent basis. The additional multipurpose theatre would be available for the multitude of smaller community theatre groups when a larger venue is needed. The design would include a proscenium theatre large enough for traveling Broadway shows to be presented in a proper theatre, instead of the Fargodome.

This thesis explores the potential of making connections between parallel avenues vying for consumers' attentions as well as adjacent communities separated by water. The site is situated crossing the railroad tracks between NP and Main Ave. Its proximity to the river creates a relation between the downtown areas of Fargo and Moorhead with hopes of influencing future growth of the dilapidated areas nearby.

THESIS NARRATIVE

Culture shapes the world. The sharing of culture is the sharing of knowledge, experiences and creative ideas. It gives insight into other peoples' lives. The performing arts play a large role in bringing the community together and telling these ideas. Fittingly, the arts community is vibrant in the Fargo-Moorhead area. Currently, the Fargo-Moorhead Symphony Orchestra does not have a home. Professional orchestral performances occur around town, with larger concerts being performed at NDSU's Festival Concert Hall. In addition to the concert hall, the Fargo-Moorhead area is also in need of a more professional environment for traveling Broadway shows, which are currently performed at the Fargo Dome.

The question being asked is how can the culture of Fargo-Moorhead be enhanced? A performing arts center in the hub of downtown Fargo could provide a larger, more appropriate venue with the intent of sharing culture with the community. It would provide a home for local musical and theatrical artists as well as promote environmentally friendly design through the integration of passive design strategies and on-site energy production. A performing arts center would be another step towards enhancing the dynamic culture of the Fargo-Moorhead community.

Challenges specific to entertainment venues will have to be faced. These challenges include potentially variable usage more contingent upon large events and providing seating and support spaces that are adequate for a large group of people. The external vibrations produced by the nearby train will present a challenge to acoustical performance. Such intense vibrations may be difficult to dampen.

Other things that need to be learned include how many people go to events like performing arts and how much energy is used by these venues? A deeper search into the needs and requirements for the design of a performing arts center to function efficiently to meet the needs of the clients will also need to be conducted.

PROJECT TYPOLOGY

The typology of this project is an entertainment venue, specifically a performing arts center, with a focus on energy conscious design.

Similar projects include concert halls, opera houses, drama theaters, recital halls, movie theaters, etc. Spaces that are designed specifically for acoustics and visual qualities. Other project typologies to look at are passive or net zero buildings and other design geared towards reducing the human impact on the environment.

PRECEDENT RESEARCH

The following case studies are auditoriums designed mainly for orchestral performances. These case studies will be referenced for the acoustical, lighting, finish material, seating, and other aspects for the design work of this thesis project. A comparison between the case studies shows the similarities and differences in seating arrangements, hall shapes, acoustic choices, and other design considerations that will have to be addressed in the designing of the final thesis project.

Included here are case studies on three performance venues. The first is the Ordway in St. Paul, MN which has adaptable acoustic capabilities for opera, orchestra, and drama. The next is Zankel Hall, one of three auditoriums that make up Carnegie Hall. The third is the Philharmonie in Berlin which was designed so that every seat has direct sound from center stage.

Future case studies will include more auditoriums focused towards drama as well as buildings focused on passive design principles and building acoustically vulnerable space near railroad tracks.

Future buildings to be researched:
Barbican Theater, London--venue with 2 halls, one focused on orchestral performances, one focused on theatrical productions.
Benaroya Hall, Seattle, WA--situated near many vibration inducing things including a train track
Bridgewater Hall, Manchester, UK--use of base isolation to dampen vibrations
Center for Performing Arts, Calgary--a center with 3 performance halls, each geared towards different performance types.
Swan Theater, Stratford-upon-Avon--similar to Shakespeare's Globe Theater, interesting ideas behind seating arrangements and practice spaces.
Aldo Leopold Legacy Center, Baraboo, WI--a carbon neutral building in a similar climate.
Waldsee BioHaus, Bemidji, MN--a passive house in a similar climate.

Other information to delve into deeper for each case study:
Structure
Natural light
Circulation
Passive systems
Mechanical systems
Acoustics
Seating

1.1 | Ordway above main entry

Ordway Center for the Performing Arts

Location: St. Paul, MN
Opened: 1985
Architect: Benjamin Thompson and Associates, Inc.
Seats: 1690-1815
Addition Completed: 2015
Addition Architect: HGA
Addition Seats: 1100

The Ordway in St. Paul was designed to be the home of three groups: the Minnesota Opera Company, the St. Paul Chamber Orchestra, and the Schubert Club. The acoustical necessities for the differing performance types made the requirement of adaptable acoustic elements. This need for adaptability resulted in a mobile orchestra shell. The shell takes about 45 minutes to move from its stored position to the position required for a show. It can be used to adapt the acoustics for chamber orchestras and choirs and even expanded for full symphony orchestras.

Even with the spread of adaptable acoustics, the Ordway aimed at concealing the movable elements and chose to emphasize the theatrical environment. The goal was to capture a spirit of celebration and festivity and have technical perfection that was obvious during performances, yet out of sight. This was unlike other halls of its time that used the necessary acoustic changes to alter the appearance of the space depending on the performance.

Existing program elements

Main hall seating nearly 1900 people
Secondary hall seating 1100 people
Multistory back of house including dressing rooms, green rooms, security, loading dock, etc.
Rehearsal room
Lobby and grand foyer
Offices
Rooms for reservation
Orchestra changing rooms
Chorus rooms
Orchestra pit
Orchestra shell

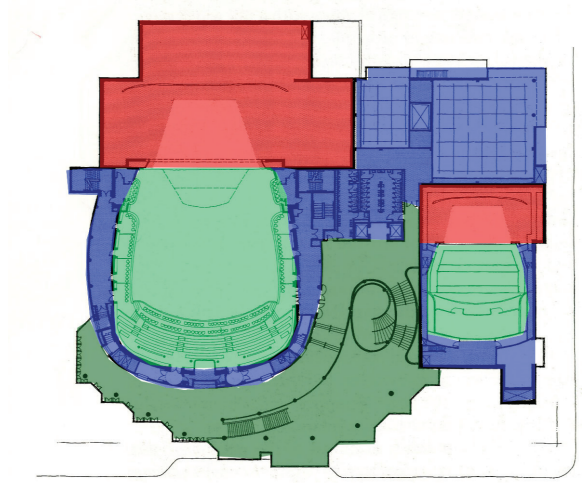
Findings

Commonalities: This auditorium contains movable seating similar to Carnegie's Zankel Hall. Other auditorium similarities include the general box shape of the hall, which was then modified internally to make adjustments to suit the acoustical needs of the space.
Uncommon: The Ordway is different from other case studies here due to hiding its flexible acoustics. Other auditoriums chose to keep the changeability visible, or not have the ability to change the acoustics at all.

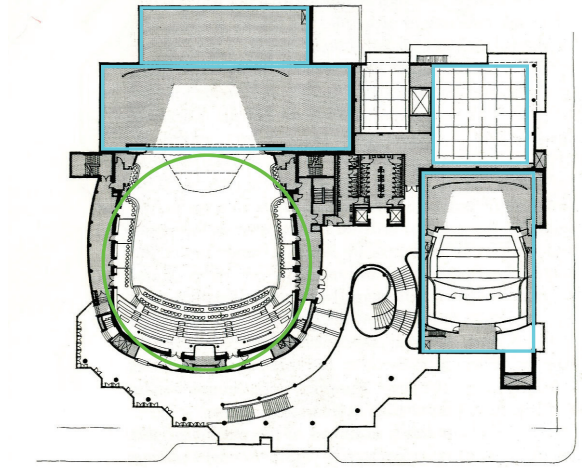
Response to site: The main entrance to the Ordway faces Rice Park, is next to the Roy Wilkins Auditorium and near the Xcel Center and RiverCentre. The Ordway's relation to these venues shows how the area became the entertainment hub it is today. The RiverCentre, originally opened 1973, and the Wilkins Auditorium, originally built in 1932, were probably influential in choice of the site. Later venues, such as the Xcel Center, were also influenced by these buildings and their uses in the local sharing of culture.

Conceptual underpinnings: I think the whole purpose of this building is to put on a great show. It's all about the performance, less about the place. Even with the highly stylized interior of the main hall, the space is not trying to overpower the audience. It has been designed to drop away from the viewer's mind and let the audience drift to where the music takes them.

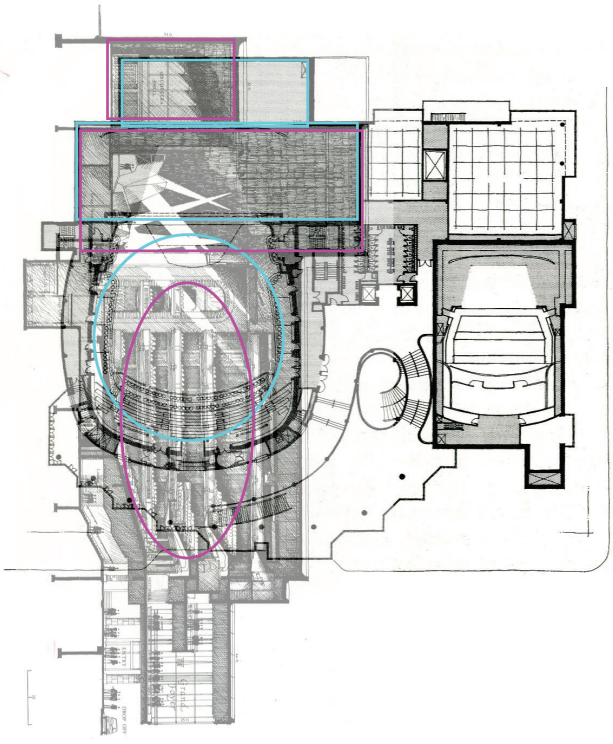
1.2 | Ordway site



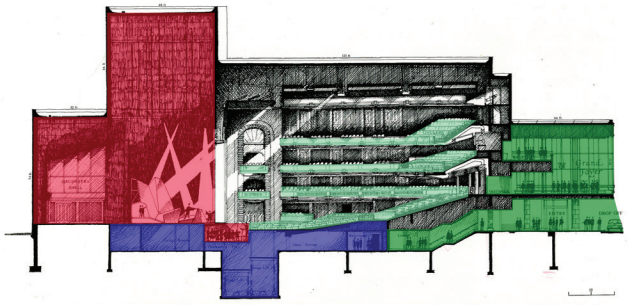
1.3 | Ordway plan showing uses



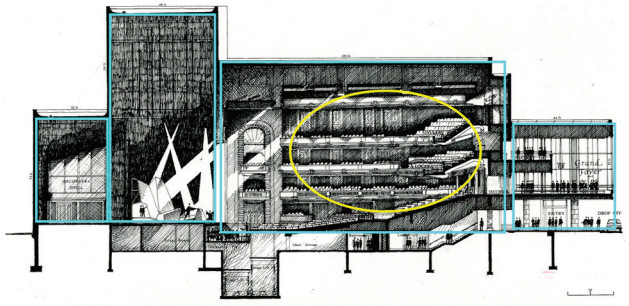
1.4 | Ordway plan showing geometry



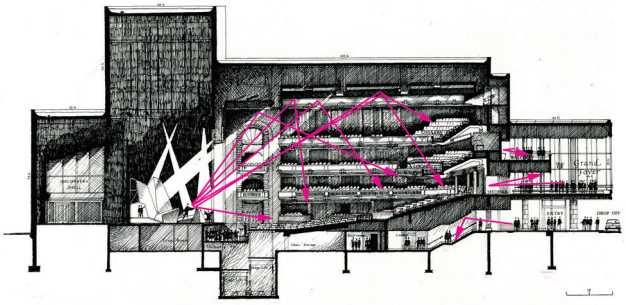
1.5 | Ordway section over plan geometry



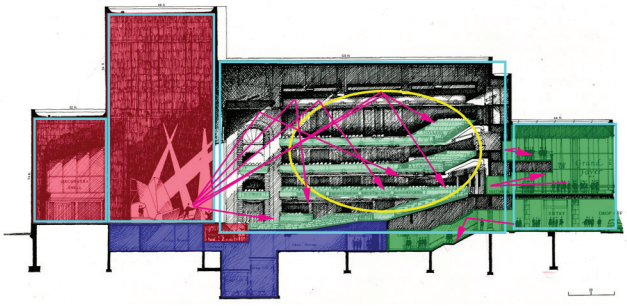
1.6 | Ordway section showing uses



1.7 | Ordway section showing geometry



1.8 | Ordway plan showing reflections



1.9 | Ordway section with uses, shapes, and acoustic

Left Top to Bottom:

Ordway spaces defined in plan by use (dark green: public, light green: seating, blue: supportive spaces, red: stage spaces)

Ordway plan broken into shapes

Plan compared to section in shape (blue: plan shapes, magenta: section shapes)

Right Top to Bottom:

Ordway spaces defined in section by use (dark green: public, light green: seating, blue: supportive spaces, red: stage spaces)

Section broken into shapes

Acoustic reflection in section

Overlay of acoustic reflection interacting with shapes in defined spaces

1.10 | Ordway interior--original hall

1.11 | Ordway interior--renovated addition hall

Conclusion

Looking at the Ordway provides an example of an auditorium space used for multiple types of performances. The theater shows the possibility to provide 1-2 auditoriums for orchestral, opera, or other performance use. The purpose of this case study is to get a better understanding of how spaces in performing arts venues are organized and operated when multiple uses are intended for the space.

1.12 | Judy and Arthur Zankel Hall interior

Carnegie Hall

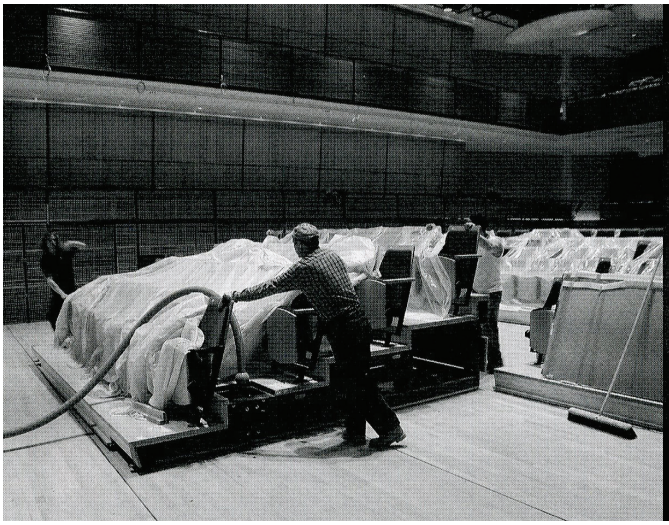
Location: New York, NY
Opened: May 5, 1891
Architect: William Burnet Tuthill
Seats: 599
Renovation Architects: James Stewart Polshek and Partners
Renovation Opened: 2003

One of three concert halls at the Carnegie, the Judy and Arthur Zankel Hall is a flexible, subterranean music hall. It is a venue for a variety of music ranging from classical chamber music to jazz to world music. It is also part of a center of music education.

Seating and technical system arrangement was developed early on in the process of the hall's design. This allowed for the ability to reconfigure the audience seating and stages.

Existing program elements

Isaac Stern Auditorium/Ronald O. Perelman Stage seating 2804 people
Judy and Arthur Zankel Hall seating 599 people
Joan and Sanford I. Weill Recital Hall seating 268 people
Education wing
Museum
Cafe
Banquet rooms



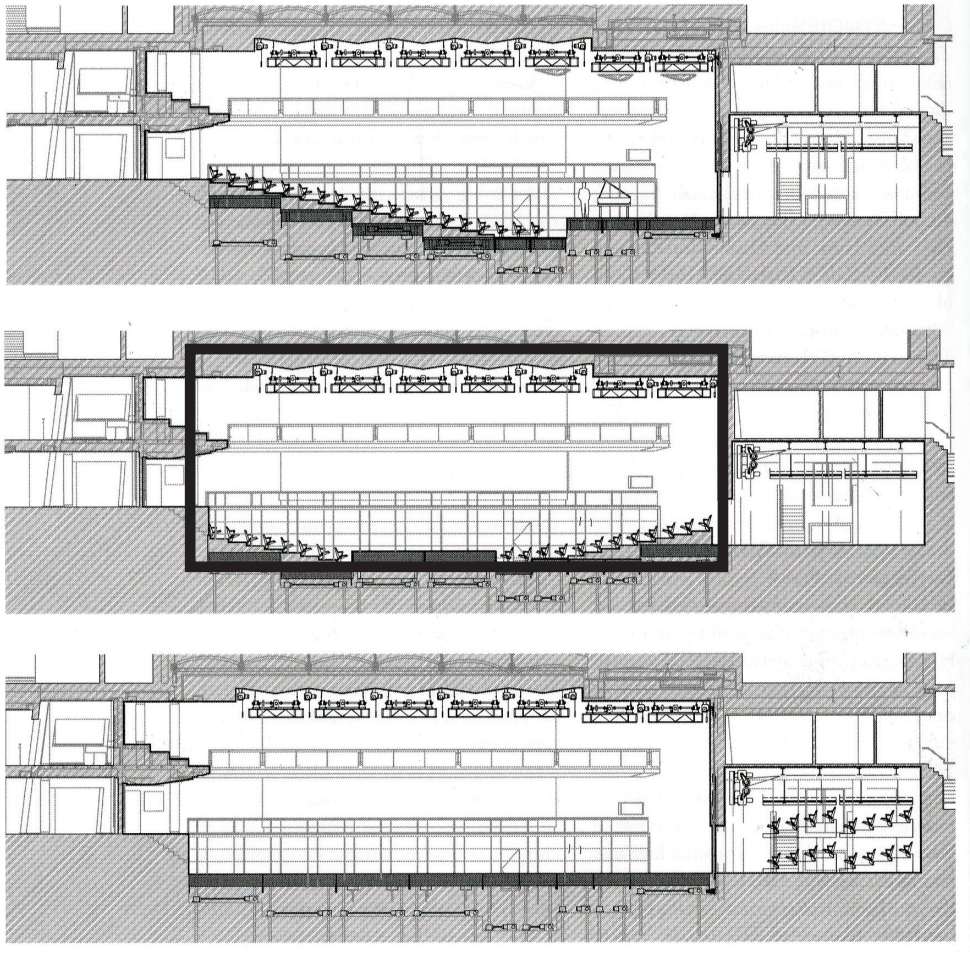
1.13 | Moving chair wagon

1.14 | Platform lift (for raising and lowering stage/floor

Conclusion

Similar to the Ordway, Carnegie's Zankel hall is changeable. The style and shape are more contemporary and rectilinear as compared to the Ordway, however. This case study will be influential in use of adjustable concert hall arrangements as well as the technology that makes the flexibility possible.

1.15 | 3 different arrangements of seating and stage; middle showing rectangular shape derived from auditorium form



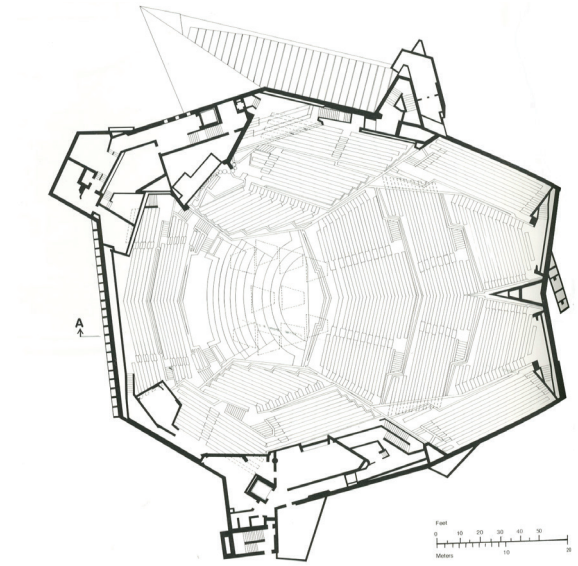
1.16 | Berlin Philharmonie exterior

Berliner Philharmonie

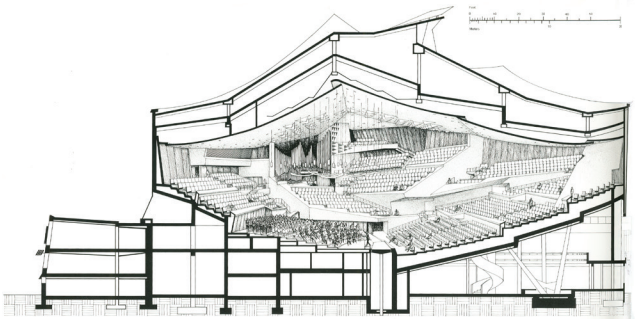
Location: West Berlin, Germany
Opened: 1963
Architect: Hans Scharoun
Seats: 2100-2200

The Berliner Philharmonie was designed to replace the concert hall of the same name destroyed during WWII. Its different shape made it possible for every seat in the auditorium to have an unhindered path for the sound to travel directly to it from the stage. There are some problems, however, regarding when soloists perform. A soloist's sound only travels in one direction and the audience behind the soloist has more difficulty in hearing them or determining what their words are (if it's a vocalist). It should be noted that other than an adjustable acoustic panel above the center stage, acoustical adjustments cannot be made. This concert hall is not intended for multiple uses and thus does not need the flexible acoustics.

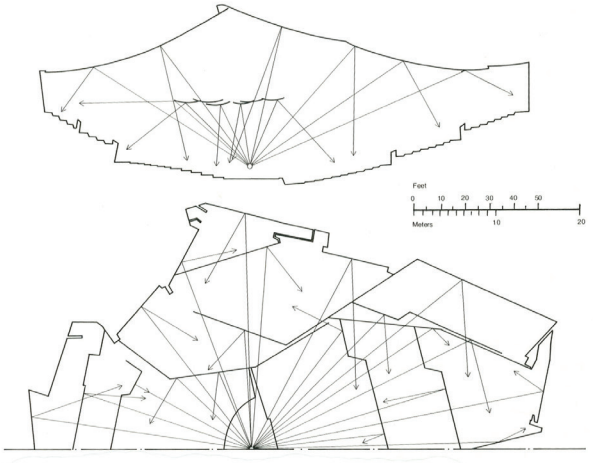
1.17 | Berlin Philharmonie interior



1.18 | Berlin Philharmonie floor plan



1.19 | Berlin Philharmonie section perspective through auditorium



1.20 | Berlin Philharmonie section and half-plan reflection analysis

Conclusion

Unlike the Ordway and the Zankel Hall at Carnegie, the Philharmonie has a more permanent set up with the only moving part related to acoustics being the panel above the center stage. The Philharmonie is a good example to look at for orchestra specific acoustic design with no intention of allowing flexibility in use.

MAJOR PROJECT ELEMENTS

Concert hall:
orchestra, band, or choir concerts put on by FMSO or local schools

Adaptable theater:
for use by FMCT or for school theater productions

Back of house:
storage, loading dock,

Dressing rooms:
for actors during show; for instrumentalists before show (lockers)

Rehearsal spaces:
for group instrumentalists and actors; group lessons

Practice rooms:
for individual instrumentalists and actors; private lessons

Lobby/waiting/gathering area:
both before and after purchasing tickets

Box office:
to purchase tickets in person

Offices:
for administration/employees

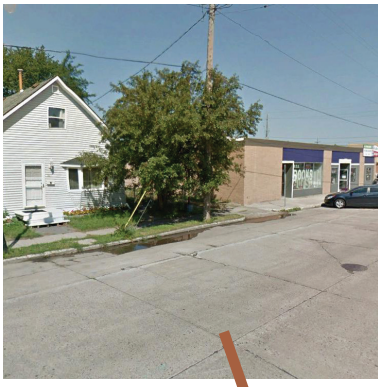
Concessions:
for snacks and refreshments during intermission or before show

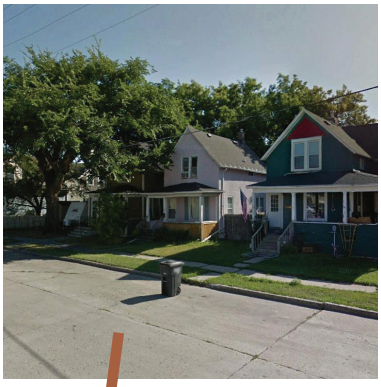
Support:
mechanical, maintenance, restrooms, cleaning, etc.

Restaurant/coffee shop/other:
to bring revenue other than performances

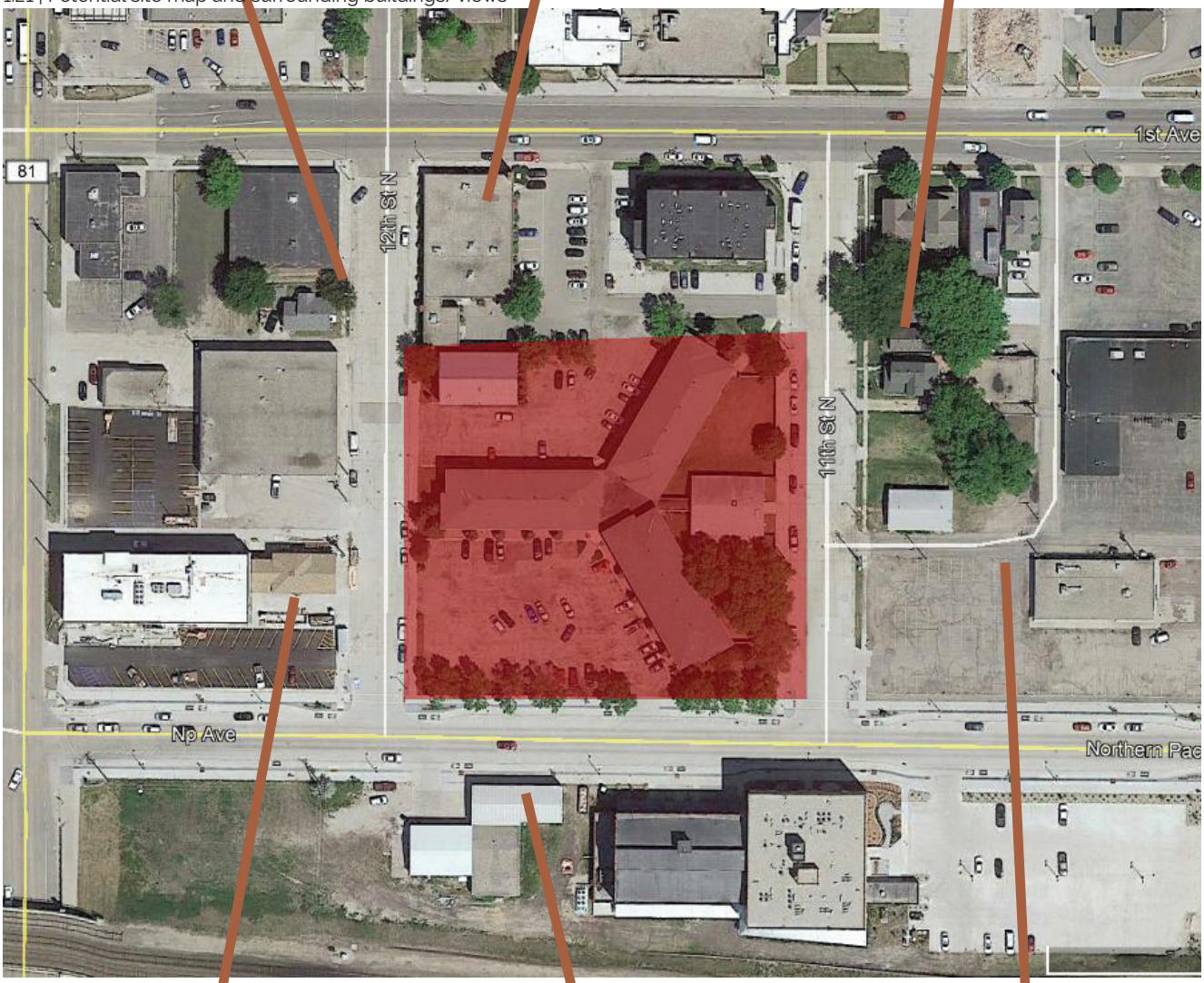
USER/CLIENT DESCRIPTION

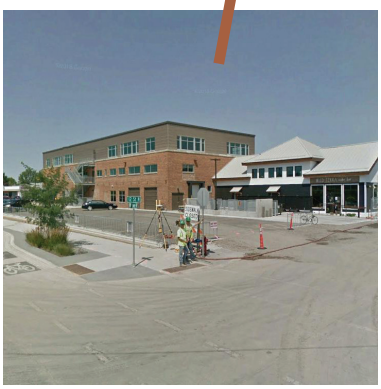
The client of this project will be a joint venture by the Fargo-Moorhead Symphony Orchestra and the Fargo-Moorhead Community Theater. The users of this design would be the residents of the FM area in addition to the orchestra and theater members.

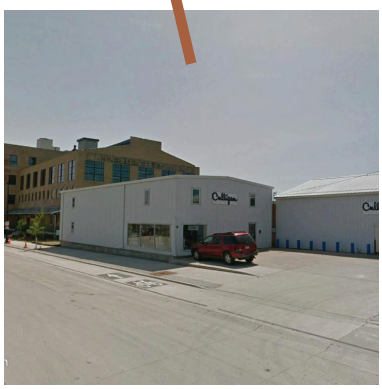


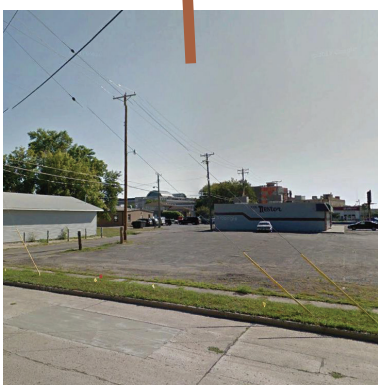


1.21 | Potential site map and surrounding buildings/views





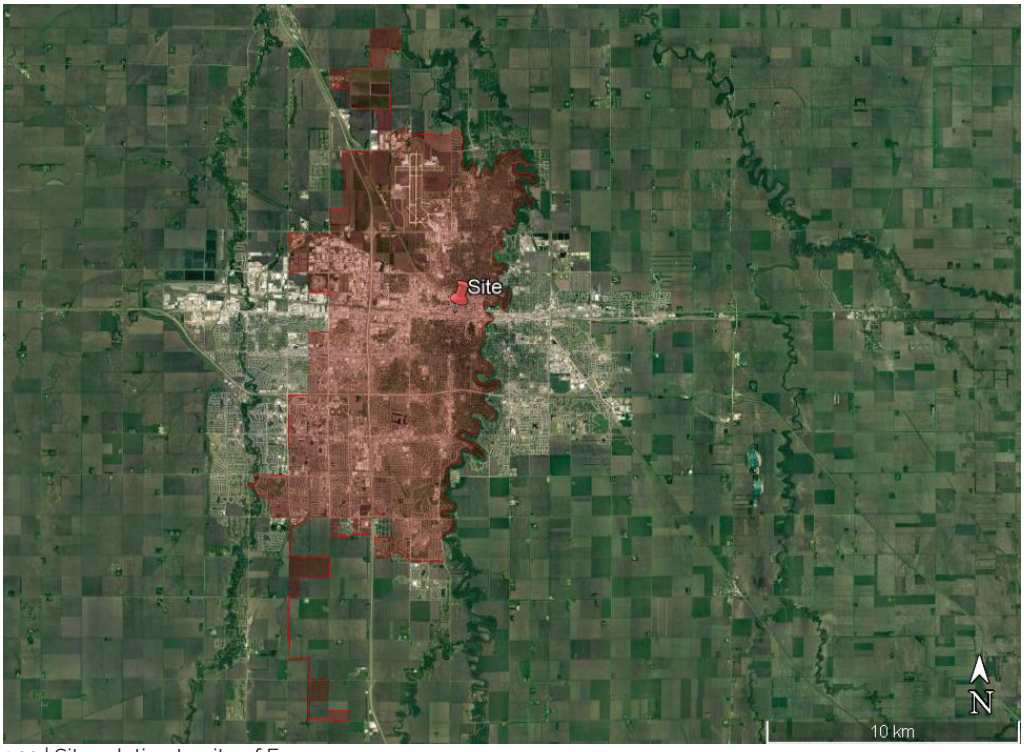




SITE/CONTEXT

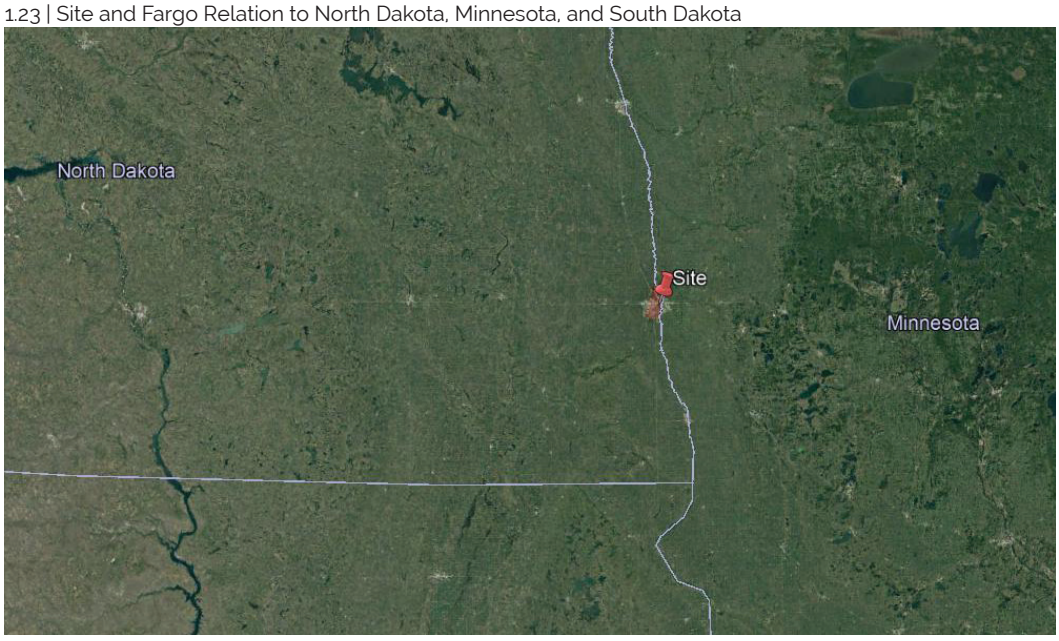
The site for this project will be near downtown Fargo, N due to the local lack of large, more formal auditorium spaces. More specifically, the site is located between 12th St N and 11th St N, just off of NP Ave. The site is undergoing a demolition of a hotel turned into apartments (Heartland Apartment Homes). Even earlier in the site's history there was a gas plant and this lead to some chemicals leaching into the soil. Concern for public health lead to Xcel Energy attempting to remove as much contamination as possible.

Not only would this site be ideal as a rehabilitated brownfield site, it is also in a good location to attempt to draw more people to the area. New businesses such as Wild Terra and Prairie Roots are moving in to the area and adding a performing arts center would improve the area's atmosphere. The site is in an ideal location to help draw people in to the downtown area, yet also attract movement from Broadway and Main St.



1.22 | Site relation to city of Fargo

1.23 | Site and Fargo Relation to North Dakota, Minnesota, and South Dakota



PROJECT EMPHASIS

Emphasis will be placed on this project's energy performance. It will focus on how to achieve net zero energy for a performing arts center in a drastically changing climate. Focusing on this will reduce the building's carbon footprint and encourage more projects to consider net zero.

THESIS GOALS

Academic
My goal is to focus more on the details with this project. I feel that many of my projects have ended up lacking in technical detailing. I would like to work out more of the specifics of renewable energy production, passive strategies, and MEP and end up with a crisply defined project.

Professional
I wish to prove my professionalism through the coherence and practicality of my project. I also hope to show that incorporating renewable sources and passive design and attempting to achieve net zero for an entertainment venue is possible and should be attempted more frequently.

Personal
By completing this thesis, I hope to gain valuable insight on how to integrate passive design strategies and renewable energy into the design of a whole project in the Midwest. I also hope to prove to myself that I can create an in-depth, complete, professional project.

PLANS FOR PROCEEDING

Definition of a Research Direction

Before the possibility of creating a net zero performing arts center in Fargo, ND can be explored, research on multiple topics must be done. Examples of how buildings consume energy, how the acoustic needs of different types of performances are met through architecture, how seats are arranged for the optimal number of audience members as well as optimal sound and view for the audience, what the history of the proposed site is as well as the culture of the area and history of performing arts centers must be looked at. Other items to researched are what are the usual program requirements for this typology and how passive and active systems can work together to reduce energy usage in Fargo's climate.

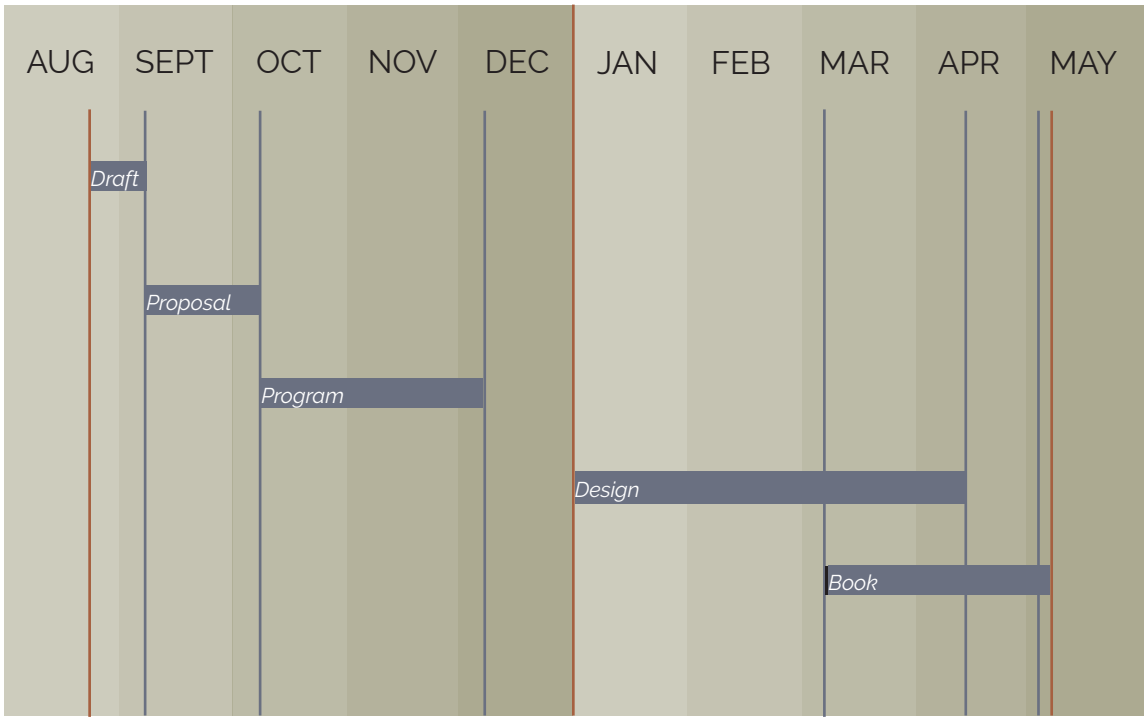
Design Methodology

Design methodologies to be employed include quantitative and qualitative approaches to research. A quantitative approach to research will be used to determine the optimal equipment and design strategies for low energy consumption. Optimal seating will be based on the needs of the local organizations and analyses of existing auditorium acoustics and sight lines. One-on-one interviews with members of FMCT and FMSO will impact the program requirements, flexibility, and general aesthetic of the spaces. The history of the proposed site will be researched and analyzed qualitatively.

Documentation of the Design Process

Documentation will be compiled along with the proposal, research, and final design in a completed book at the end of this thesis project. The design process will be preserved through photographs of changes in the various physical models and other work, drawings (sketches and digital), and drafts of digital models. The compiled book and digital version of the final presentation will be available to future scholars through the NDSU Digital Repository on May 10, 2019.

Schedule



1.24 | Schedule

Dates and Deadlines

Fall Semester 2018

20 Aug. Thesis Begins
13 Sept. 1st Draft of Thesis Proposal due
11 Oct. Thesis Proposal due
12 Nov. Veterans' Day Holiday
22-23 Nov. Thanksgiving Holiday
12 Dec. Final Thesis Program due

Spring Semester 2019

21 Jan. Martin Luther King, Jr. Holiday
19 Feb. President's Day Holiday
4-8 Mar Mid-Semester Thesis Reviews
11-15 Mar Spring Break
18 Mar 4th year Introduction to Thesis Process
19 Apr-22 Apr Holiday Recess
19 Apr. Thesis Project Final Exhibits in digital form due 5:00 p.m.
22 Apr. Physical exhibits for the Thesis Project due 9:00 am on 5th floor
29 Apr-02 May Final Thesis Reviews
03 May Last day of classes, Awards Ceremony
06 May Digital copy of Final Thesis Documentation due
06-10 May Thesis Awards Finalist show in the Flakoll Gallery
10 May Final Thesis Document due at 5:00pm in the Institutional Repository
11 May Commencement at Fargo Dome

RESEARCH

The following information are reviews of sources to be referenced to design a successful project. Additional sources, such as the ASHRAE GreenGuide, will also be referenced in the future. Below are reviews on two sources focused on designing for this thesis's typology, a performing arts center, and two sources focused on sustainable and general architectural design.

Building Type Basics

Building Type Basics for Performing Arts Facilities is a book made of coordinated contributions from performance related consultants put together by Hugh Hardy, principle architect from H3 Hardy Collaboration Architecture. From program and codes to materials and operation and more, this book gives a quick overview of every topic that needs to be considered when designing a performing arts facility.

In Building Type Basics, each contributor wrote of a specific topic related to designing a performing arts facility. These topics cover the basics of everything someone would need to know about in order to design one of these facilities. The book begins with a wider introduction to the planning that goes into theater design and ensuring that the point of the building being a place designed for performance to occur is well understood. The book then progresses into more specific topics.

Auditorium and stage design is addressed by defining and comparing the common seating and stage arrangements and how the arrangements function in relation to the types of performance to occur in those spaces. Stage design is explained further with the ideas of introducing technology and flexibility into the theaters as well as the pros and cons of doing so. The book is also filled with examples of theaters with photographs, when applicable, as well as a handful of short case studies.

Additional information on backstage, or back of house, planning as well as incorporation of building codes, acoustic design principles, acoustic flexibility, and lighting design follow. The book wraps up with ideas to consider in renovating theaters as well as general information on the construction process and the business and operation side of theaters.
This book contains the basics of what needs to be considered when designing a performing arts facility. It brings attention to everything from predesign through design up to occupancy and operation. Additional sources will be needed for more specific information, such as structure, mechanical systems, etc. as this book only offers a brief overview or introduction to the principles.

Theatre Check List

The American Theatre Planning Board, Inc. prepared "A guide to the planning and construction of proscenium and open stage theatres" which culminated in the book *Theatre Check List*. Theater Check List is a compilation of lists, short case studies and quick insights into the planning and construction of theaters. The lists range from considerations for proscenium and open stage theaters, specifically, to considerations that could be applied to all theaters.

One list of interest is the considerations for the planning period. In particular, the consideration of conducting tape-recorded interviews with theater people involved in each department contains a list of questions to be adapted to this thesis. This feedback from these questions would provide a starting point for many design considerations for this thesis project.

SUMMARY

Most of the lists go into great detail of the design needs of theaters. The specific lists vary from seating and sight lines to sizing and number of doors. Some of the lists go into more detail than is probably necessary for this thesis but are important details to know when working on a real-life project.

A History of Sustainable Architecture

A History of Sustainable Architecture: Design Fundamentals, by Suzanne Sowinski, gives a brief overview of sustainable design. The book quickly gives an overview of the historic roots of sustainability, discusses building materials and design techniques, raises awareness to management of water and its relationships to buildings, and talks about sustainability issues and design examples.

This book is helpful when first approaching the topic of sustainable design. It discusses historic building strategies and material uses in relation to and incorporation of nature. It also walks through the reasons behind the necessity of passive design strategies. The book brings awareness to the harmful results of releasing carbon dioxide from not only the operation of buildings, but also their construction and demolition. From construction to daily use alone, buildings are responsible for 30% of greenhouse gasses released globally as well as 40% of energy use worldwide. As designers, architects can help mitigate the contribution of buildings to greenhouse emissions by approaching design sustainably and by using passive strategies to help them get there.

While the majority of the information in this book is relevant and applicable to this thesis, some of the topics are not as needed as others for the success of this project. For example, the book goes into "Green Legislation", which is relevant, but this thesis is aiming higher than current regulations. And while water management is an important aspect of sustainable design, that will not be the main focus of this project.

Additional information about sustainable architecture will be needed. Sources discussing specific passive design strategies and their integration into certain climates and building types will be useful in the designing portion of this thesis. Other information about the chosen project typology will also be needed for the success of this project.

Mechanical and Electrical Equipment

Mechanical and Electrical Equipment for Buildings is a 1495-page book, not including the appendices. The book was compiled by four authors and is a collection of information from the design process to HVAC and lighting choices and calculations and more. It contains information on almost everything an architect needs.

Part one focuses on design context. In part one, the design process is laid out from conceptual design to building occupancy. The importance, as well as underuse, of post-occupancy evaluations are stressed. The differences between energy efficient, green design, carbon-neutral design, sustainability, and regenerative design are made clear. Part one is not only an introduction to the book, but also an introduction to the design process.

The second part discusses thermal control. From solar geometry to HVAC systems, part two lays out specific information about thermal related design aspects that can be directly applied to any building project. The information in this section will be particularly informative for specific solar passive strategies and efficient heating and cooling design. These ideas will contribute to the overall goal of reducing energy usage.

Part three is all about illumination. This information will be useful for designing the lighting in the final project. It will also be useful in determining energy usage from lighting and other lighting design considerations. It is not, however, a major aspect of this thesis.

The fourth part, about acoustics, will be very informative for the chosen typology. In part four, all of the basics of acoustics, their measurement, and their design. This chapter will be referenced during the designing stage of this thesis.

Parts five and six, about water and waste and fire protection, are also important to building design and should be referenced during the design process accordingly, however the subjects of these parts are not the focus of this thesis.

Part seven is huge. It is all about electricity. Part seven discusses everything from the difference between direct and alternating currents to wiring design and photovoltaic systems. This section will be referenced for the electrical design and measurement aspects of the project.

While part eight is important to some projects, signal systems such as intercoms and televisions will not play a large role in this thesis.

The ninth, and final part before the appendices, is about transportation. Transportation is an important topic in building design. This section discusses everything about elevators to some degree as well as moving stairways and walkways.

This book is mind blowing in the amount of information covered. It will be one of the main sources of information referenced during the design phase of this thesis. Additional information about passive and sustainable design as well as specifics about theater design may be needed in order for this project to be successful.

PROJECT JUSTIFICATION

There were multiple ideas pointing me to this project. I am fascinated by how stuff works and pursuing a thesis that demands the knowledge of how two large topics in architecture work for the project to be successful seemed the best option. In my 8th grade class it was mandatory for students to create a science fair project. I chose to do mine on the vertical axis wind turbine because I wanted to learn how wind turbines worked and was also interested in how renewable energy could be made, in general. This yearning to know more has grown into the desire to learn how to incorporate solar, wind, geothermal, and other energies into buildings. More specifically, I wanted to be able to show exactly how these energies tie into the systems that buildings use every day.

The choice in typology, the performing arts center, is also of personal and societal importance. I started learning to play the violin in 2nd grade and have been amazingly fortunate to have been able to go to many orchestral concerts and theatrical performances from a young age. I have grown up to believe that our society needs music and theater to share our culture and ideas, to educate people in morality and point out the flaws in our societal norms. My typological choice was also influenced by my lack of knowledge of any net zero entertainment venues, specifically to do with the performing arts.

Thesis is the stage of academic development after our integrative design studio, which is supposed to consist of a culmination of all the things we'd learned up until that point. I felt like the one semester project I'd completed was not a good enough representation of all that I've learned and believe that thesis would be a great time to do better. This stage in my academics is also a good time to increase my knowledge of passive and acoustical design strategies, as well as how they are implemented, all of which should be beneficial in professional settings.

I believe increasing my competency with passive and acoustical design will help me stand out amongst other graduates seeking work in the architectural profession. With the knowledge gained from this project, I will be able to design more sustainable buildings as well as acoustically appropriate spaces. I hope to become part of a firm that works with the implementation of these ideas in their real-world projects and I see the knowledge gained from this thesis as a sort of early start to the professional learning process.

At this time, net zero design has been focused more towards residential and office buildings and has yet to be applied to a broader range of typologies. If successful, this thesis can show the professional world of architecture that it is possible to apply similar ideas to other typologies.
This project would be primarily funded by the clients, possibly the Fargo-Moorhead Community Theater and the Fargo-Moorhead Symphony Orchestra. Additional funding may be provided by members of the local community, the city of Fargo, and other occupants of the facility including funds from businesses using the spaces for lessons and other functions.

The major focus of this project is energy usage and production. The return on investment of this project is more about intangible results than monetary. The resulting knowledge of sustainable design application to such venues could increase awareness of, and potentially reduce, our environmental impact. By reducing our environmental impact, we are one step closer to ensuring sustainable living. Once implemented, the project will not need off site energy. This will result in no electricity bill which justifies the initial cost.

Post-occupancy impacts would be less energy use needs and more on-site energy production than typical performing arts centers to the point of net zero or better. The measurements of this energy would justify the project if the energy use needs would be equal to or less than the on-site energy projection.

Current energy production relies mainly on fossil fuels (natural gas, petroleum, coal). These fossil fuels take millions of years to form and contribute heavily to pollution. By bringing in on-site, renewable energy production, the reliance on these fossil fuels will be diminished and if these practices are brought into all building design, the reduction can be significant. This reduction on reliance on fossil fuels will lead us to a more sustainable future.

Technology used in designing this project will include 3D modeling programs like Rhino and Revit, energy modeling tools associated with these, and other programs like AutoCAD and some of the Adobe Creative Suite. Technology used within this project will include solar panels, wind turbines, geothermal, rainwater retention system, high efficiency windows, high efficiency lighting, SIPS, and other technologies geared towards sustainable design.

The knowledge of how to incorporate renewable energy into architecture, as well as passive design, in general, is not only advantageous to myself, but also our society. Currently, we live in a world dependent upon nonrenewable resources and our habits are not sustainable. By taking a step to reduce our impact on such reliance, I hope to prove that not only is the idea of passive design necessary, but that it is also achievable. If this project is successful, sustainable design solutions can be applied more widely to building typologies that haven't yet been looked at.

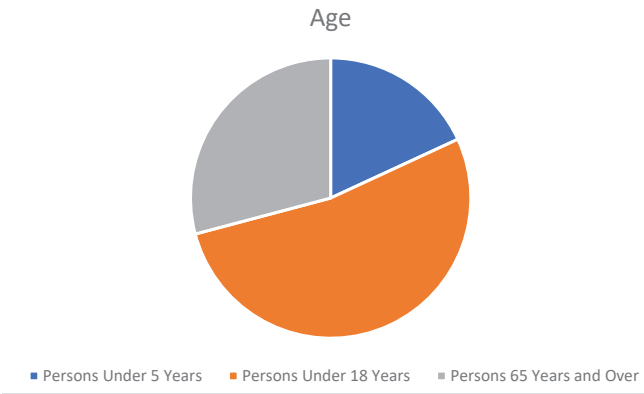
Artistic performances are coming to be a large part of the Fargo-Moorhead community. With nearly 20 performing arts groups listed on Fargo-Moorhead's website, the area's performing arts culture is booming. Of these groups, less than half have permanent homes. The Fargo-Moorhead Symphony Orchestra, for example, plays at multiple venues, including NDSU's Festival Concert Hall. Theatre B, on the other hand, has a permanent studio home. The proposed thesis project would allow for performances from local groups without permanent homes, such as FMSO, local groups looking for larger theater spaces, perhaps FMCT, and even visiting groups such as JAM Theatricals that do Broadway shows in the Fargo Dome.

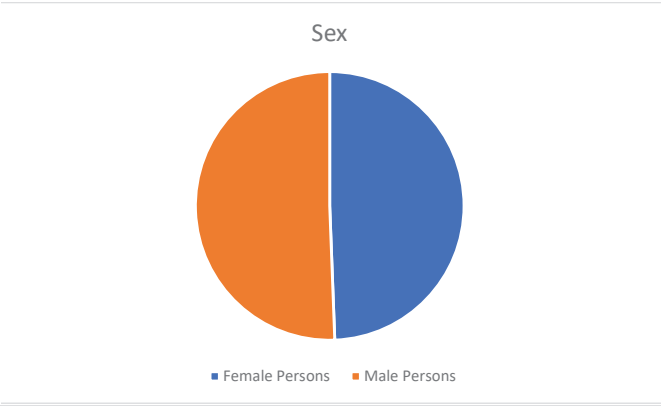
The chosen site is a remediated brownfield in Fargo, ND. It was chosen due to its large range in climate variation being one of the most difficult climate types to design net zero for. If this project is successful it will not only show that more sustainable design ideas can be applied to a wider variety of building typologies, but those buildings can also be located in such drastic climates.

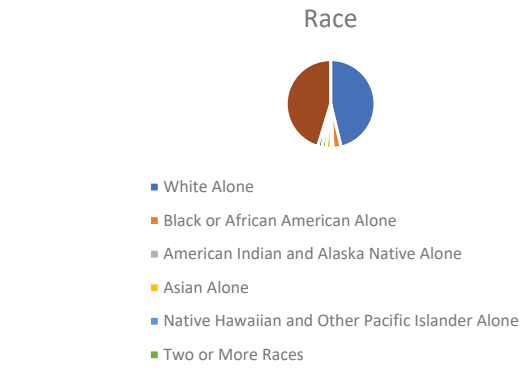
To some, working on this project may just be an option. As of right now, the professional world of architecture has its own work flow that sees a design through from initial concept to final building and sometimes even demolition or repurposing. Current trends, however, are not sustainable. When viewed with thoughts towards the future this project becomes more imperative. The goal is to persuade designers to consider more sustainable solutions to the point of net zero or better as a viable option for any project.

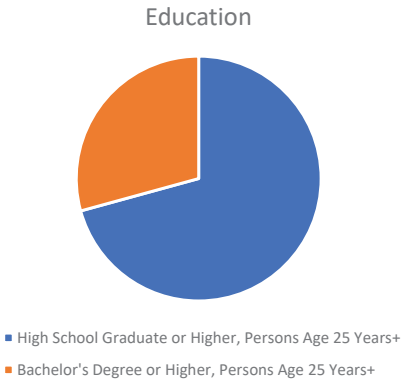
This project could be left for others in the profession, but I imagine it can be difficult to set aside the time while being an active design professional to dive deep into learning about large ideas, such as applying sustainable design to building typologies that have yet to break into net zero solutions. Also, if someone else works on a solution when would I learn this information that could improve my designs? With this thesis I aim to rectify the idea that net zero is unattainable for special venues like a performing arts center.

HISTORIC/SOCIAL/CULTURAL CONTEXT









Income & Poverty	
Median Household Income (in 2017)	$50,561.0
Per Capita Income in Past 12 Months (in 2017)	$31,866.0
Persons in Poverty	13.9%

Performance Groups in the Fargo-Moorhead Area:

Great Plains Harmony
Music Theatre Fargo-Moorhead
Fargo Moorhead Community Theatre (FMCT)
North Dakota State University Performing Arts
Fargo-Moorhead Choral Artists
Theatre B
Tin Roof Theatre Company
Harwood Prairie Playhouse
The Master Chorale of Fargo-Moorhead
Fargo-Moorhead Symphony Orchestra (FMSO)
Gate City Bank Theatre
Minnesota State University Moorhead Theatre Arts
Act Up Theatre
Bare Stage Theatre
Fargo-Moorhead Ballet
Concordia College Theatre
Gooseberry Park Players
Fargo-Moorhead Opera

750,000 Years Ago
8500 BCE
2600 BCE
1400 BCE
1300 BCE
800-600 BCE

Cave Dwellers

Dance as Entertainment

Primitive Tribal Dance

Drama

Great Wall of China

Wind Catchers

Theatre of Dionysus

Roman Comedy

Roman Aqueducts

Persians Use Wind Powered Grain Mills

Epidaurus

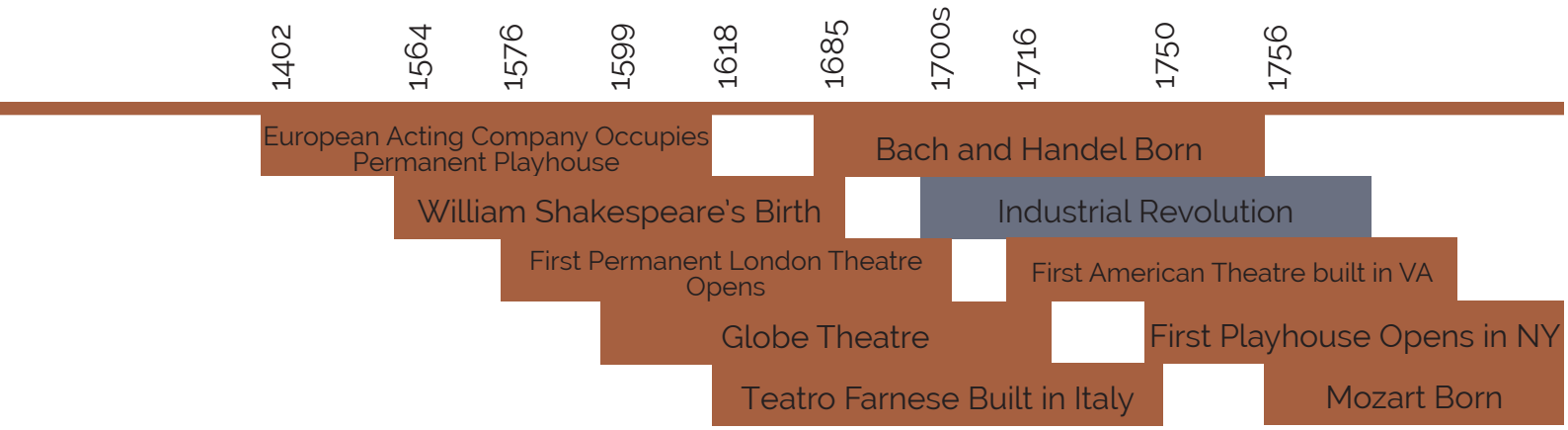
Colosseum

Tragedies and Greek Comedy

Hanging Gardens of Babylon Built

Roman Hypocausts

605-562 BCE
500 BCE
400 BCE
340 BCE
312 BCE
300-200 BCE
2000 Years Ago
70-80
500-900

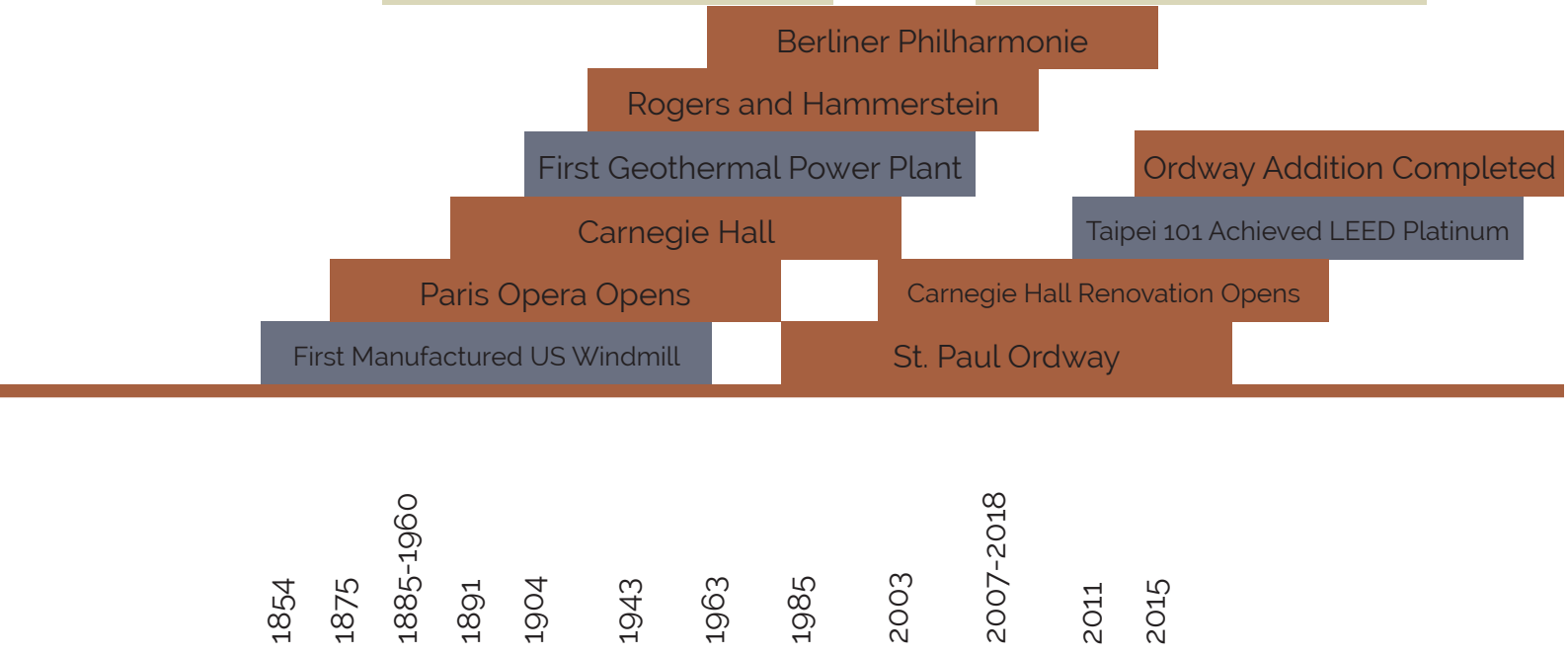


Coal Gas Power Plant:

The Fargo Gas Light and Fuel Company, the first utility company in Fargo, started up in October of 1881. The company built a gas plant on the intersection of NP Ave and 11th or 12th St N. The first gas from the company was delivered to the gas mains for street lights in 1885. Each streetlamp had to be individually turned on and off.

Heartland Apartment Homes:

In 2016 an investigation of the site's soil was conducted due to concern for public exposure. Though no public health concerns were noted, Xcel Energy erred on the side of caution. The company demolished the existing apartment complex to finish removing underground piping and material remaining from the previous gas plant on the site.



SITE/CONTEXT ANALYSIS

The site is between 11th and 12th St N on NP Ave in Fargo, ND. Recently the apartment building that stood on the site was demolished and the soil was dug up. The site is now a flat muddy/snowy plot of land.

The site is across NP from a building that was relatively recently renovated into an apartment complex. Across 12th St is a new cider place which is next to a new co-op. Across 11th St is a group of houses and a recently closed bar/liquor store. Just north of the site is another apartment complex and a small commercial building.

Overall, the site right now is a blank canvas. It is a flat, wide-open space with no buildings or plants on it. There are a few businesses, but most of the neighboring buildings are residential. The neighboring buildings are low-rises ranging from one to four stories.

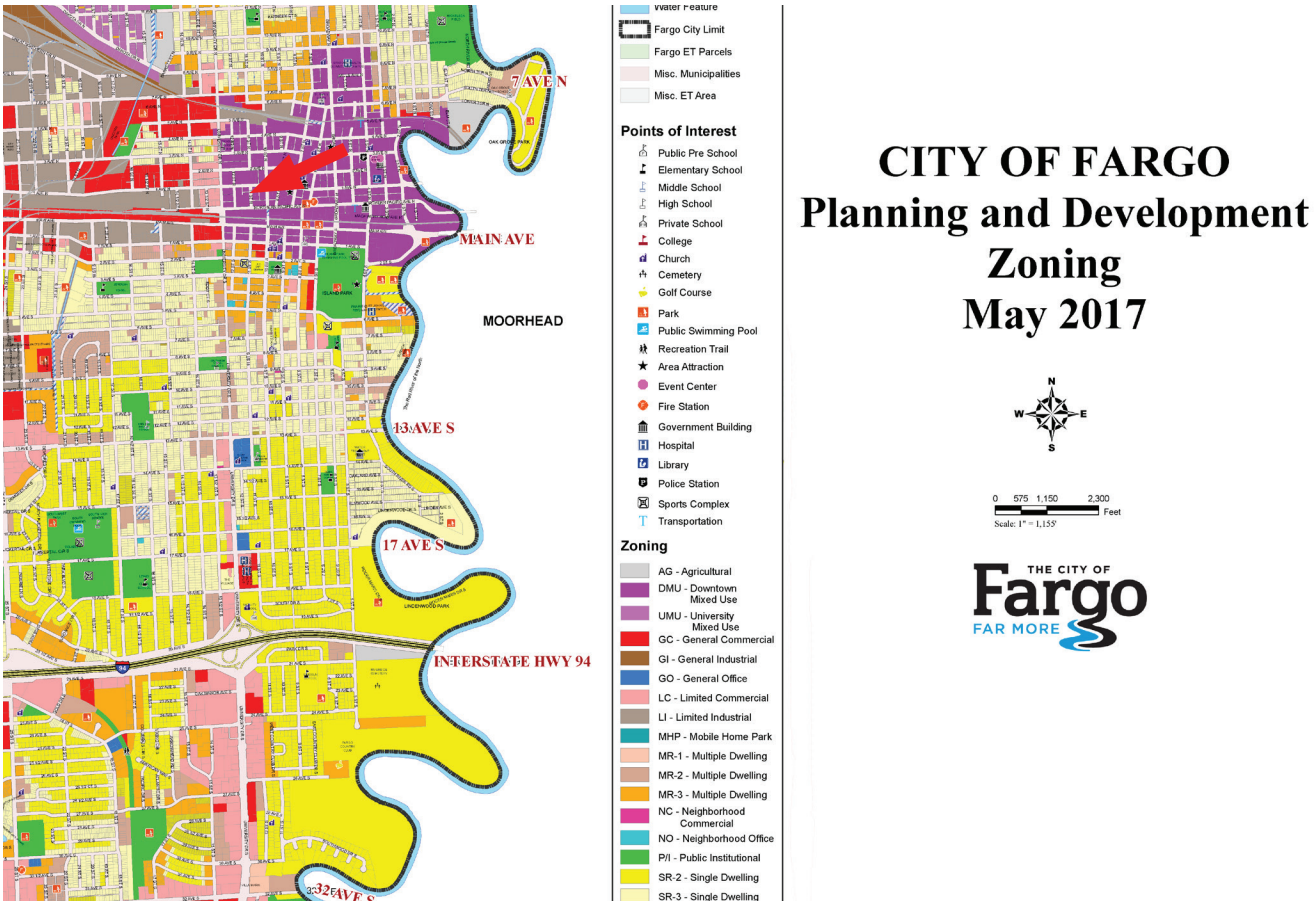
Just south of the lot is an often-used train track as well.

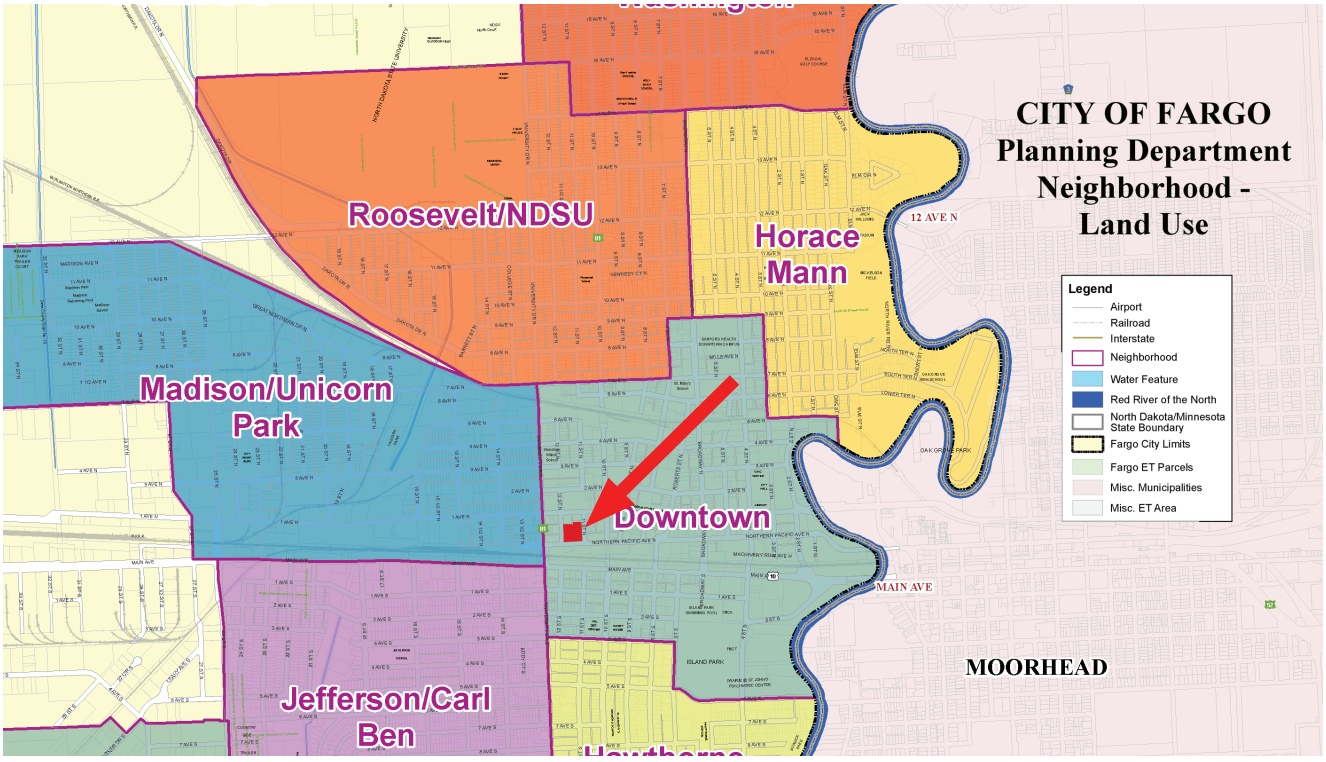
A small portion of the southernmost part of the site is covered by the shadow of the residential building to the south during the winter, but since the sun at the lowest angle at this time, the site should generally receive a fair amount of sunlight.

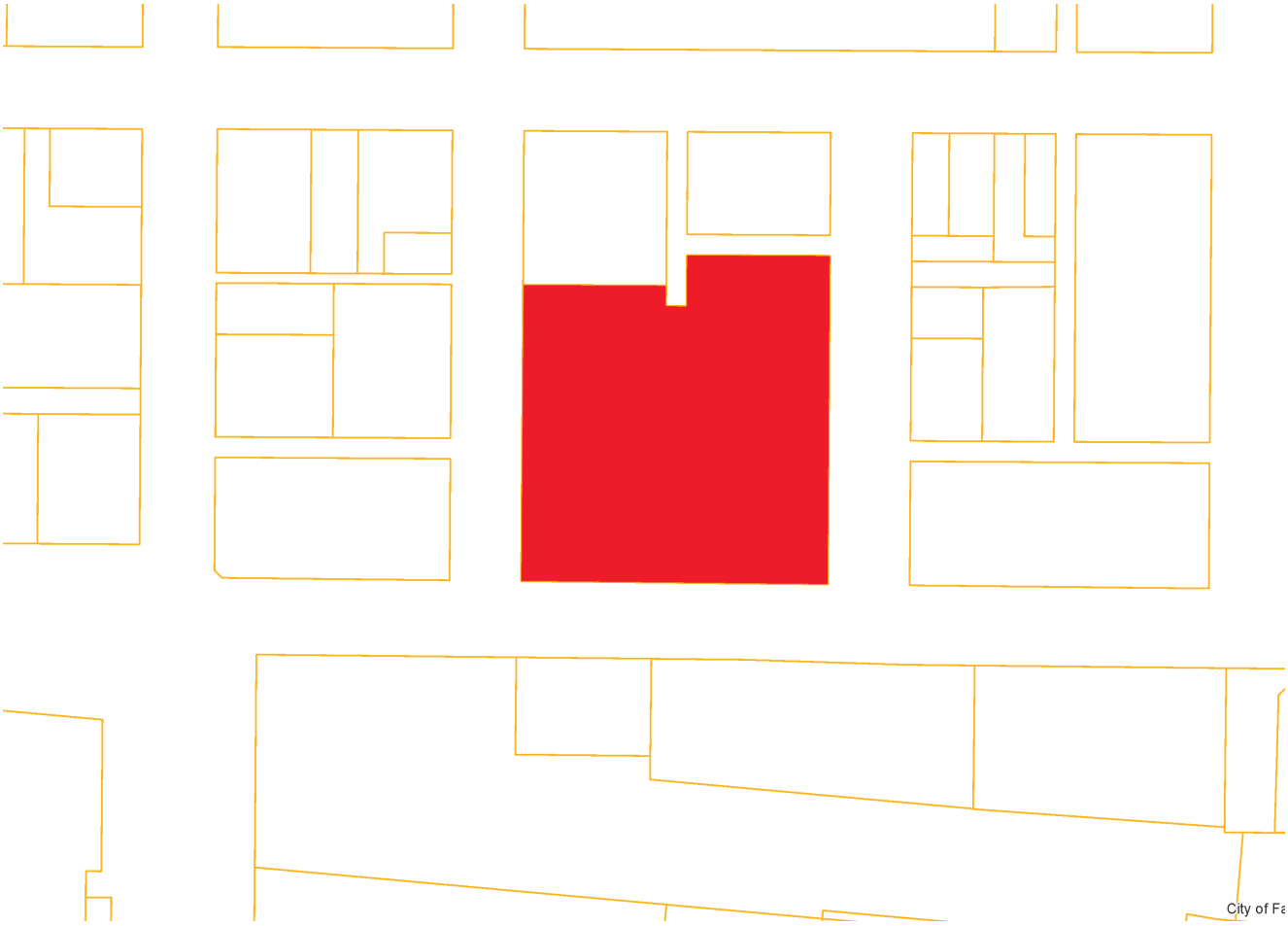
During my visits to the site, there was nearly constant light vehicular traffic a block over in each direction (University, Main, 10th, and 1st). There were a few customers at the co-op, cars in the commercial building's parking lot, some people moving some machinery to the south, and some residents walking into their buildings. Overall the activity level was low. The current activity on the site is none.

Maps:
Top Left: Zoning--Site=DMU (Downtown Mixed Use)--arrow pointing at site
Lower Left: Neighborhoods--Site=Downtown--arrow pointing at site
Top Right: Parcel Map--Site in Red
Lower Right: Site Map with imagery from 2018--site shown in Red

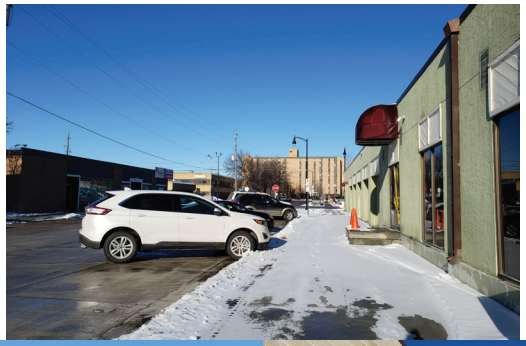
Base images from Fargo's GIS maps and City of Fargo website...

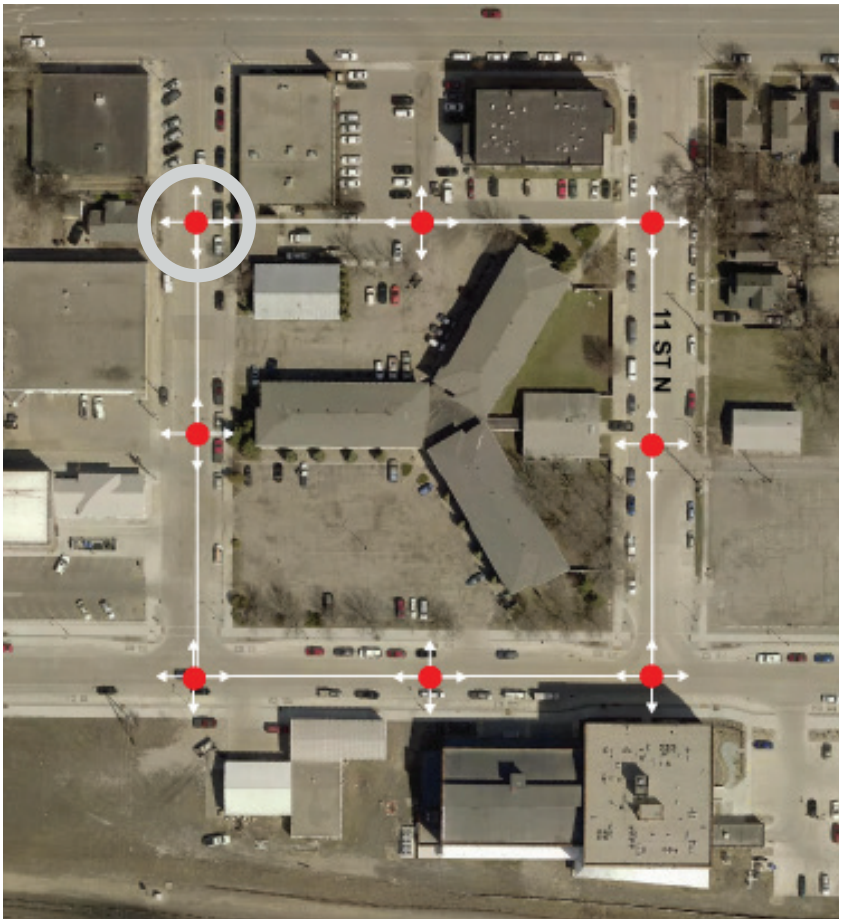





City of Fa


11 ST N
N
City of Fargo, N

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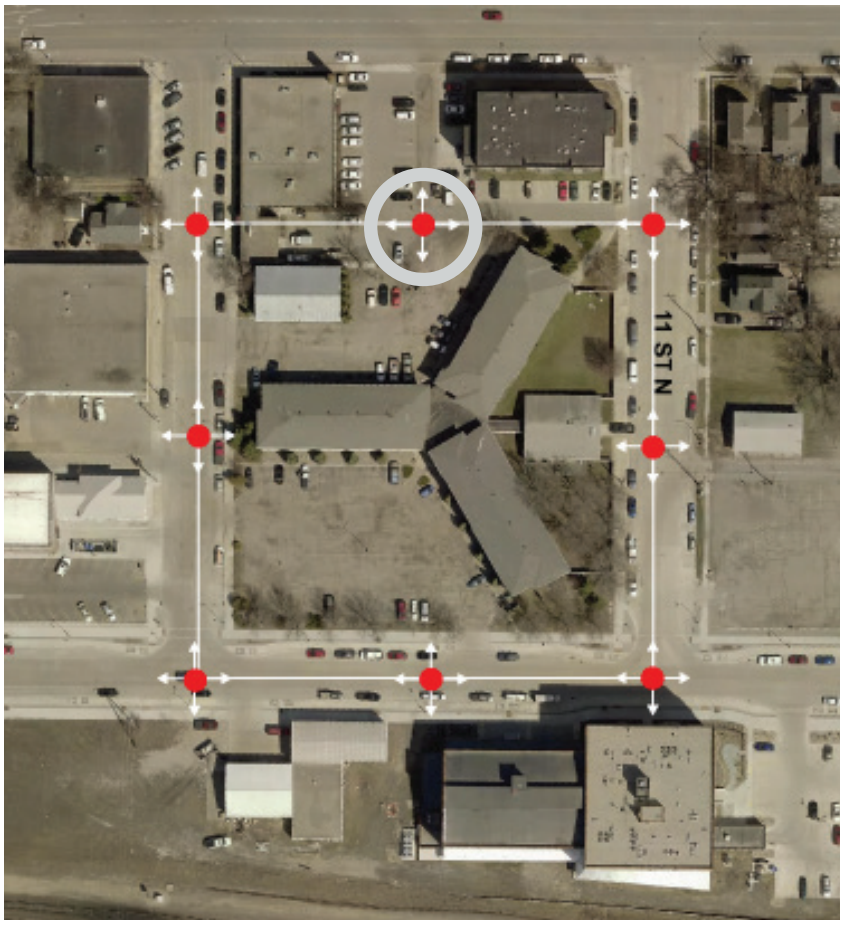
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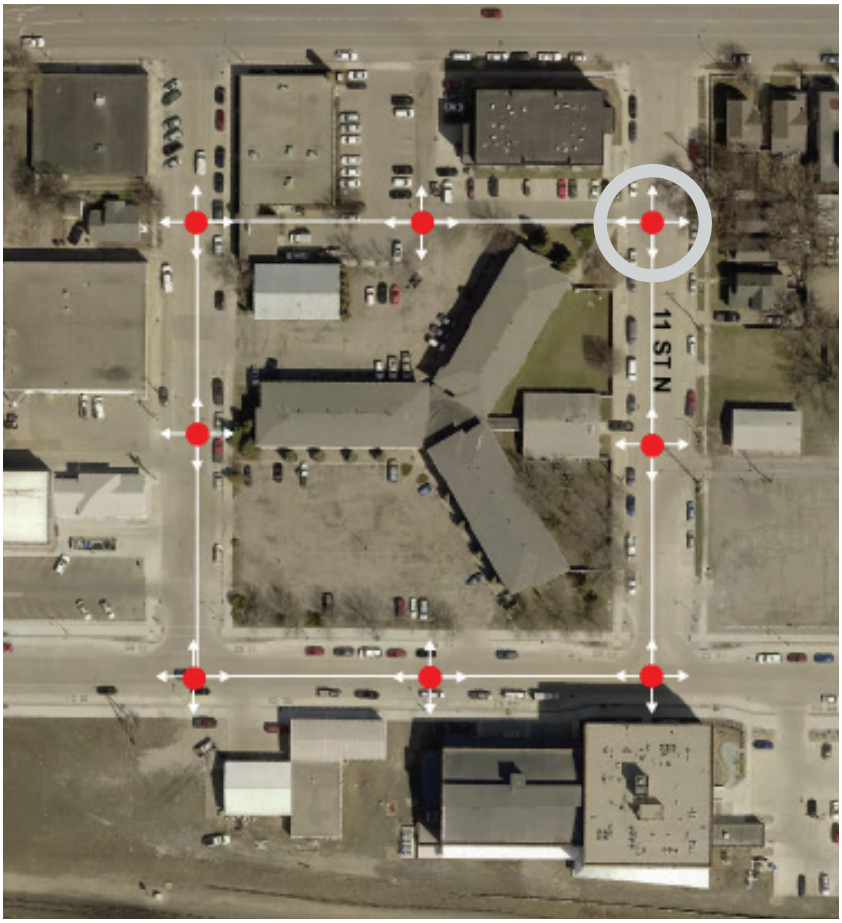
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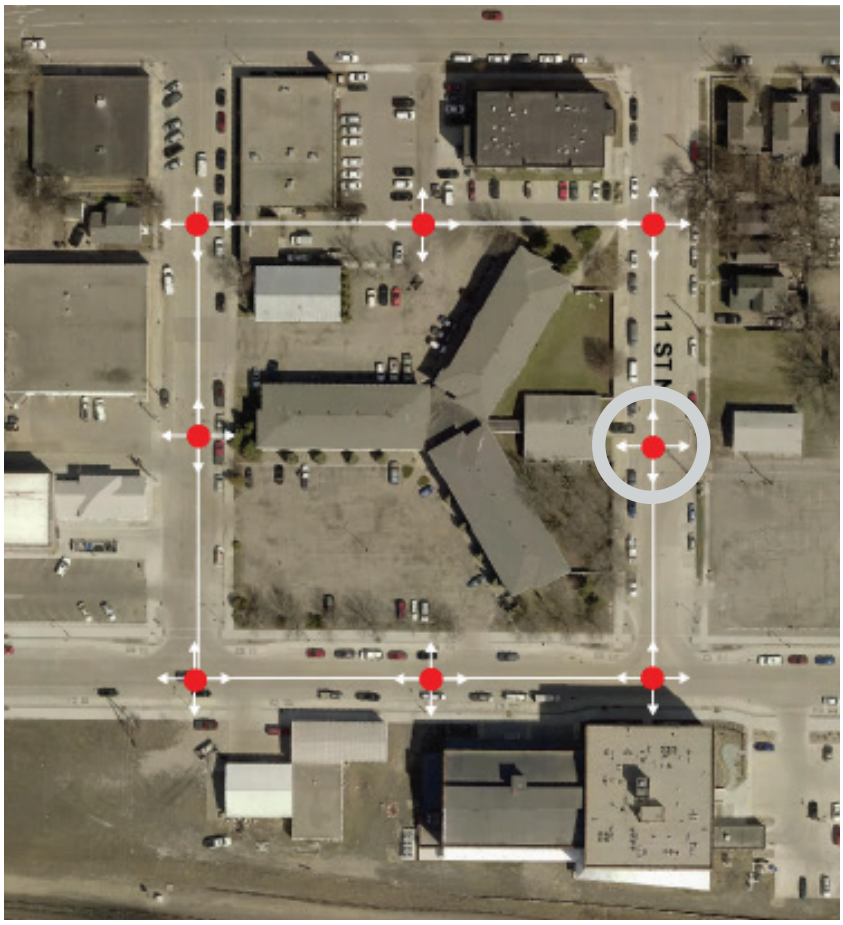
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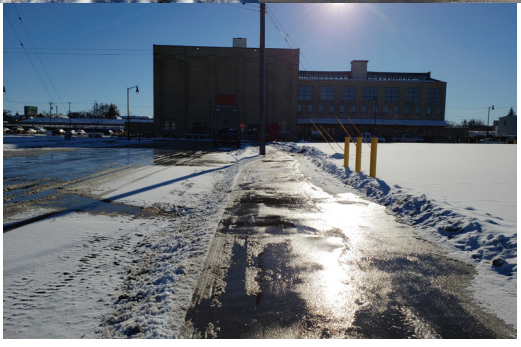

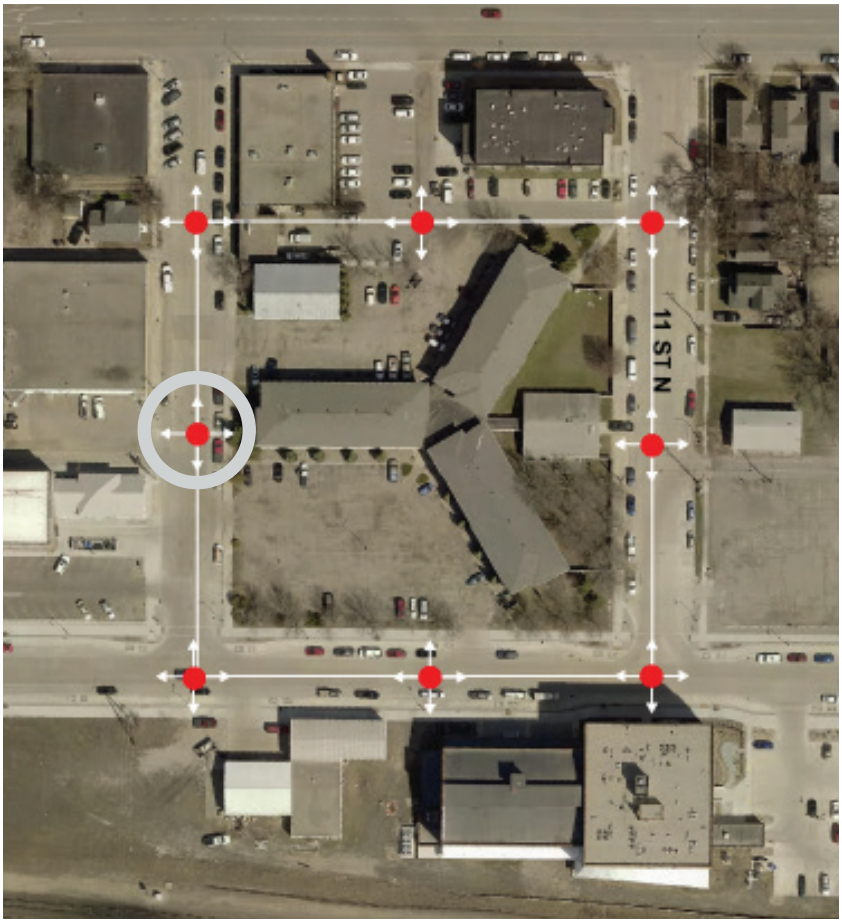
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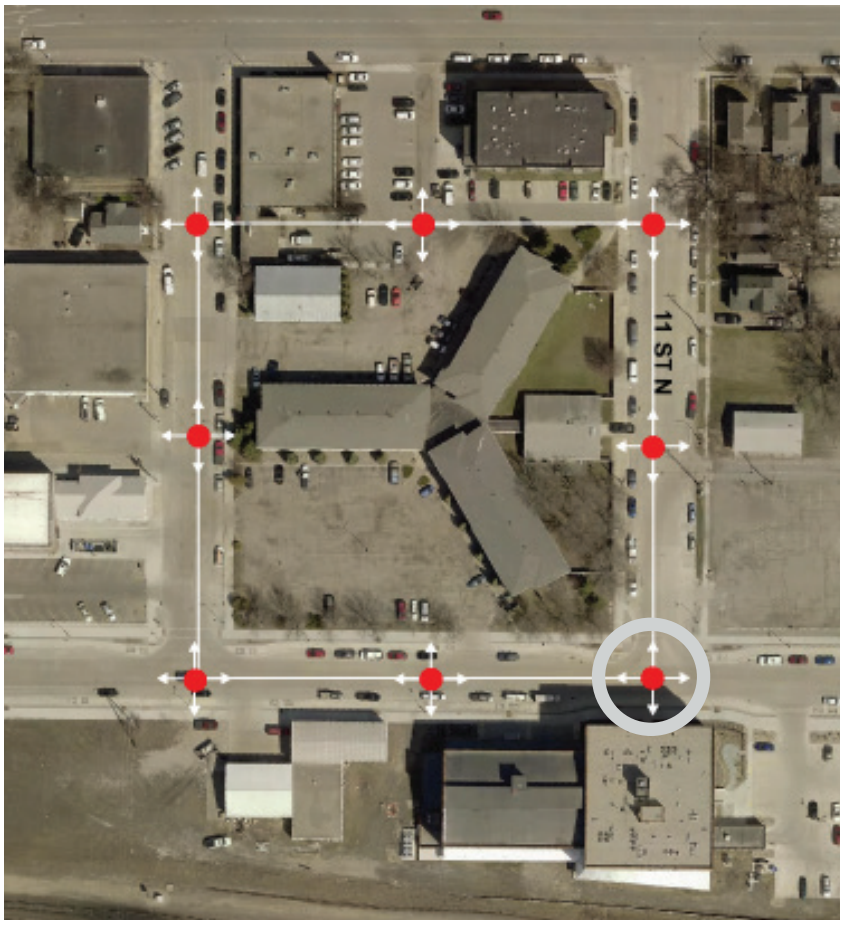
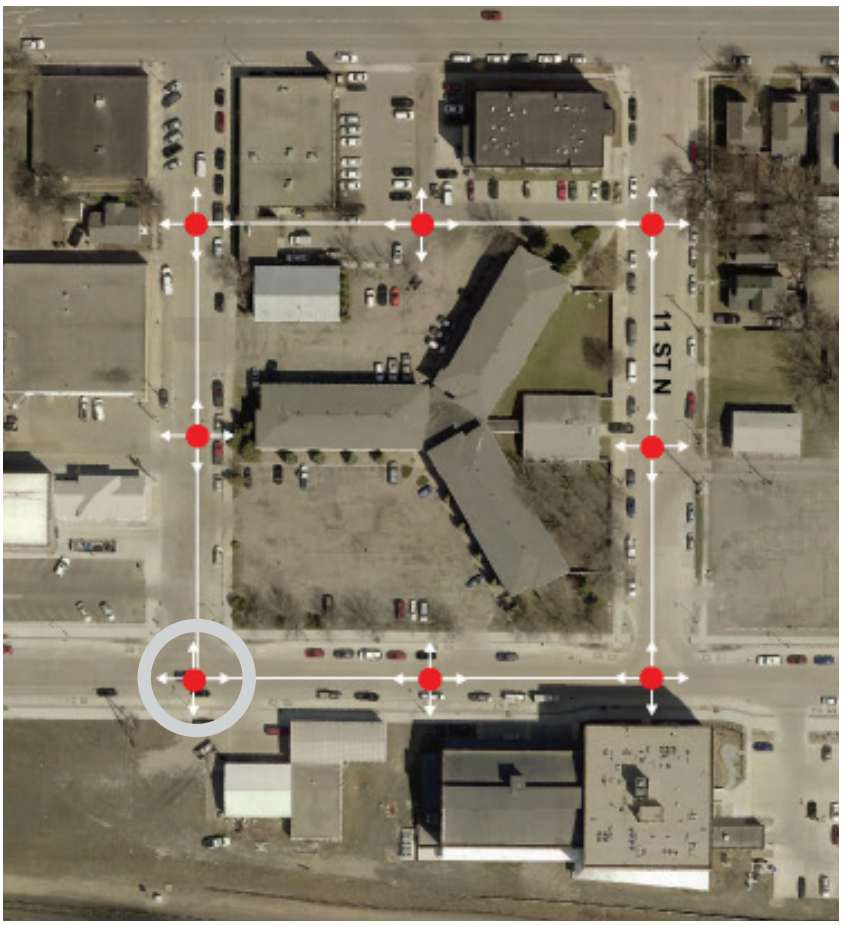

11 ST N


11 ST N
NP Ave N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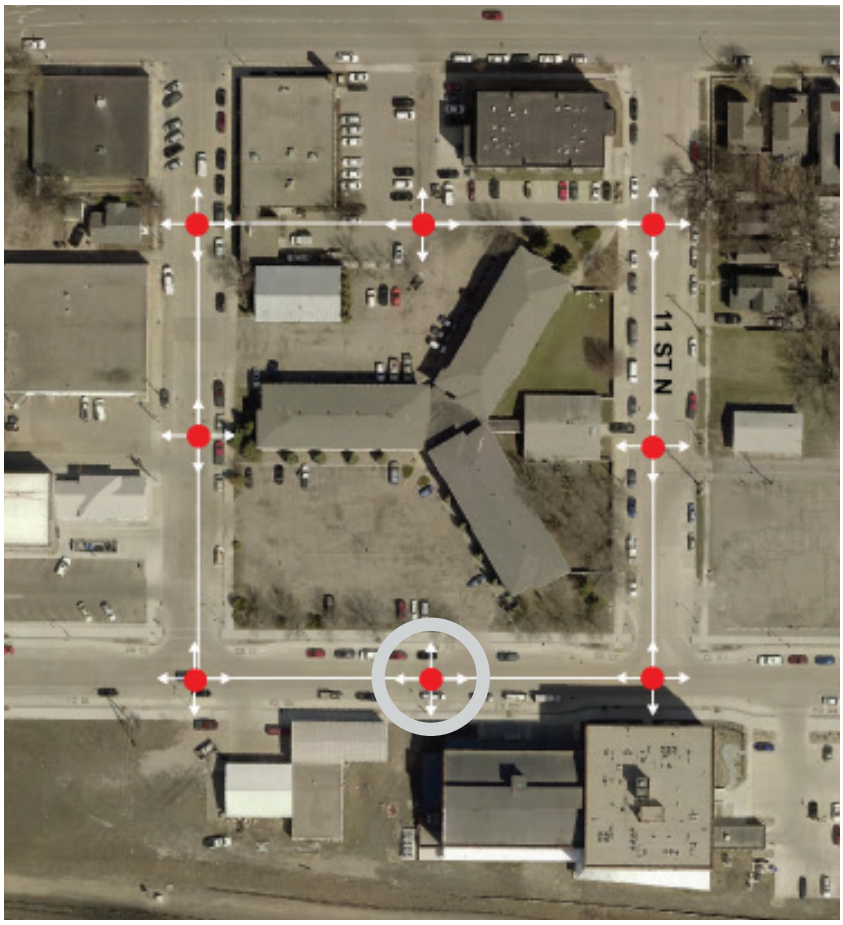
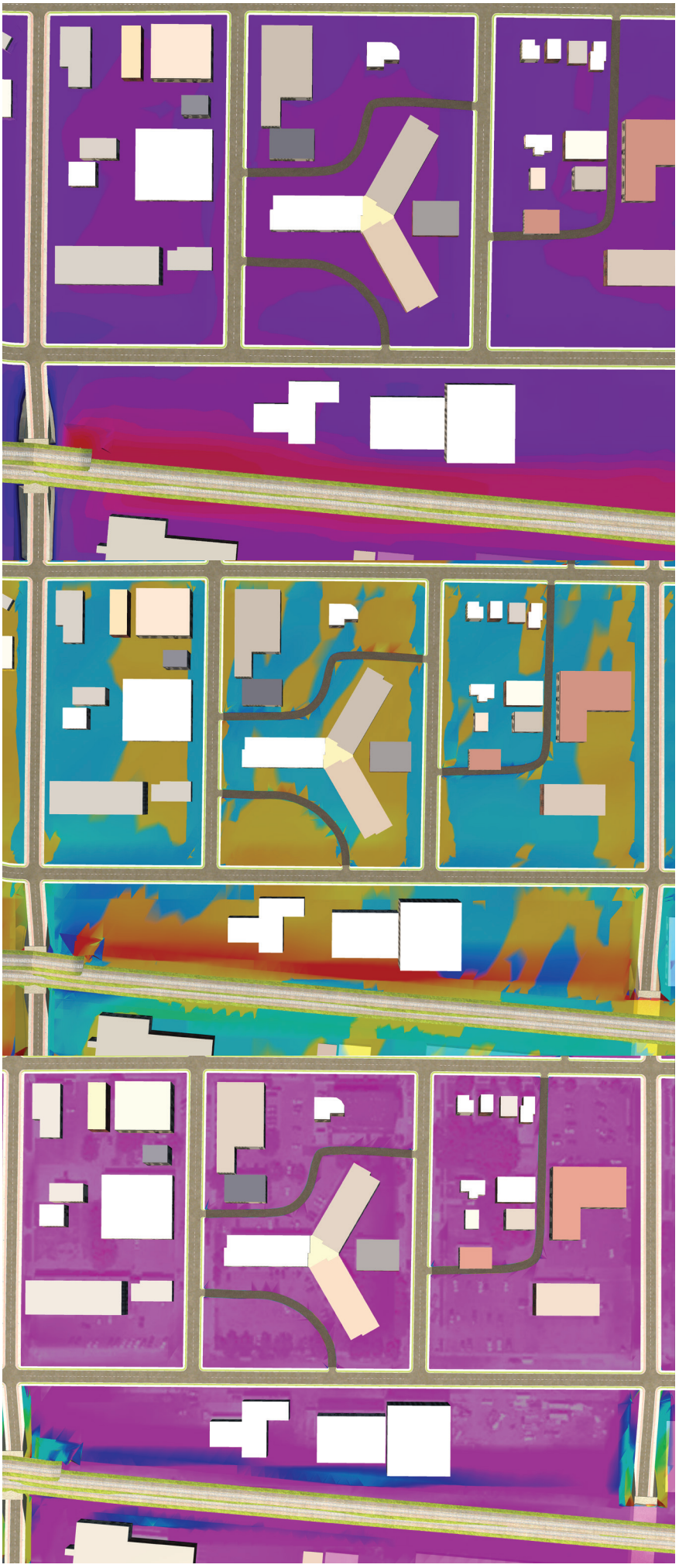
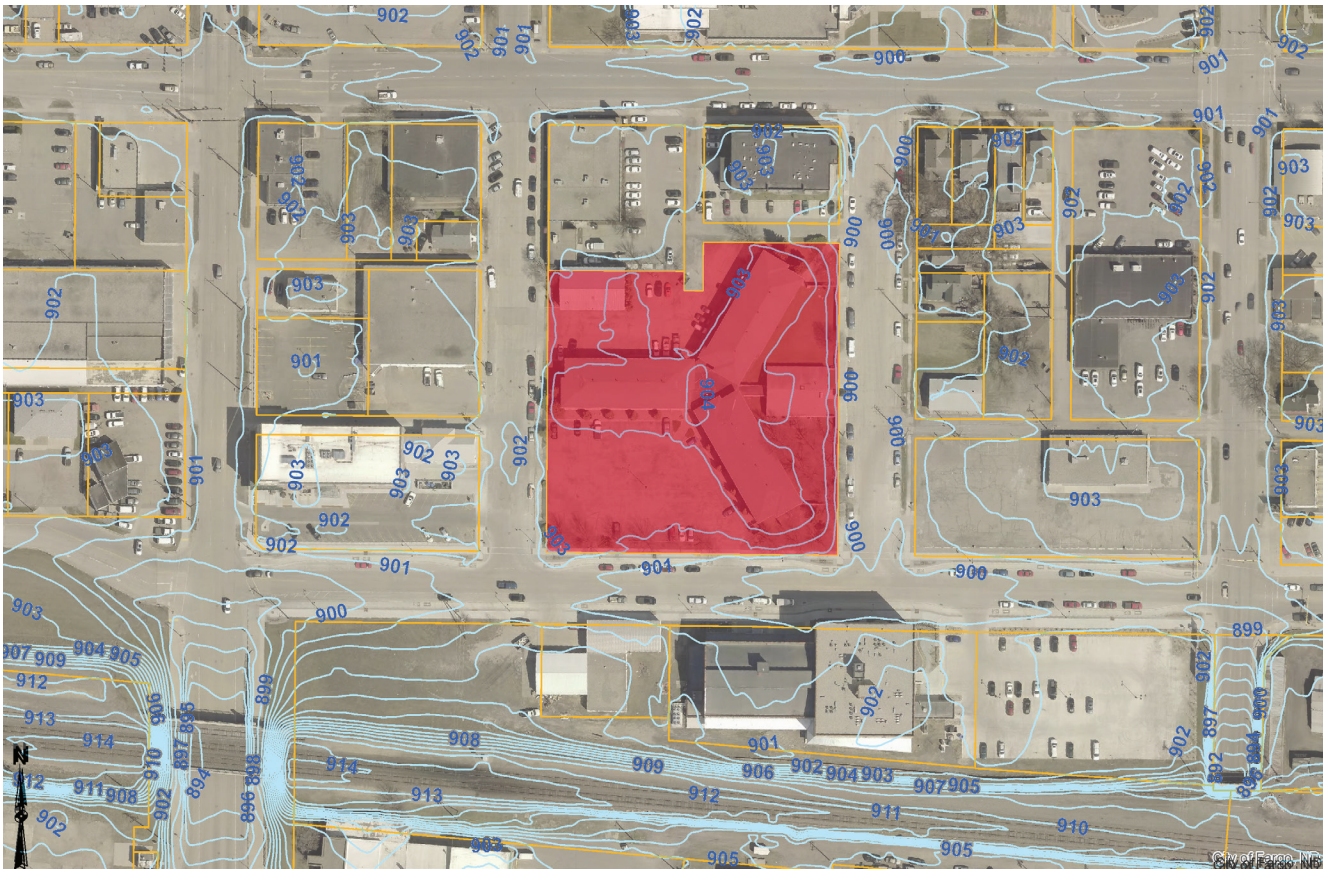

11 ST N


11 ST
NP Ave N

Top: Elevations
Middle: Aspect
Bottom: Slope

Analysis: Site is flat.

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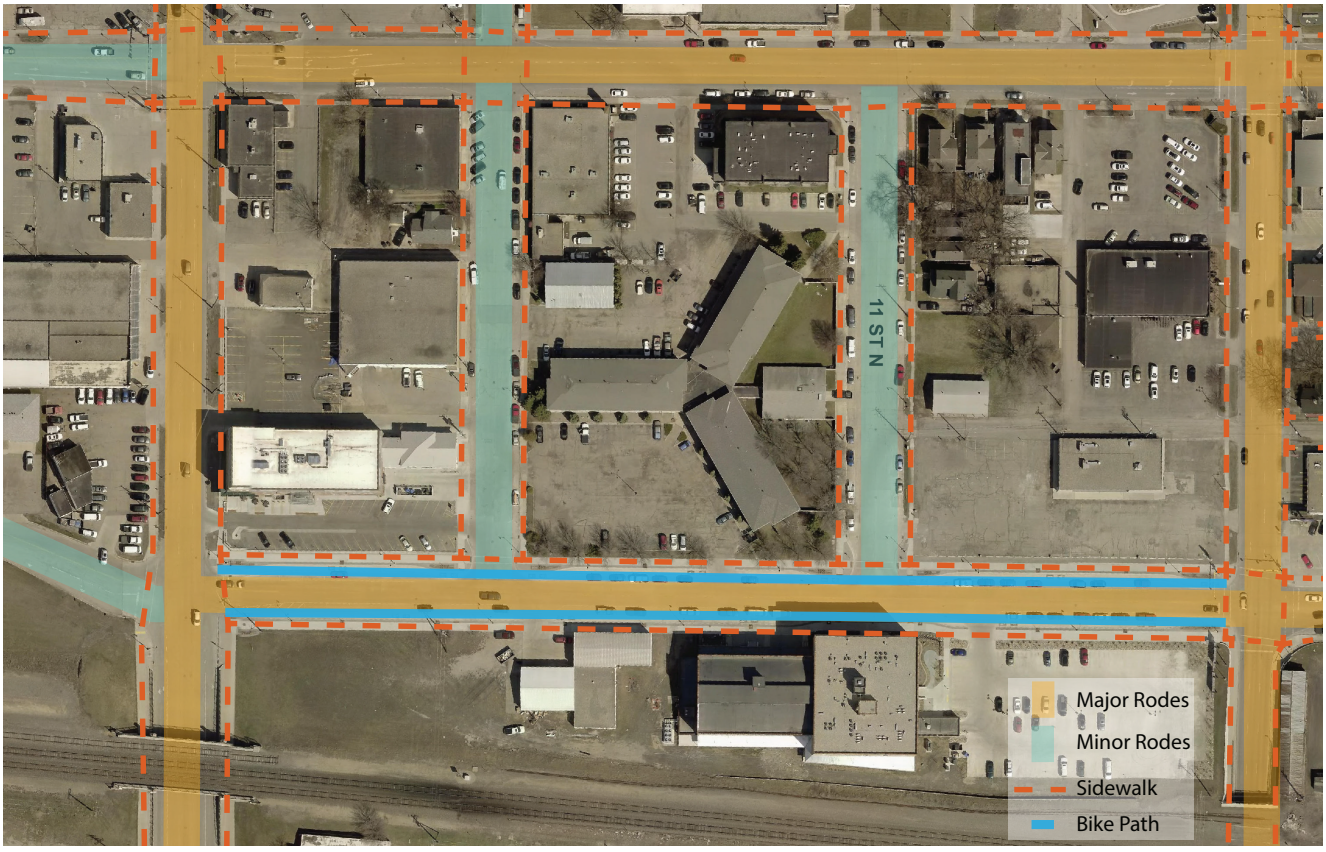
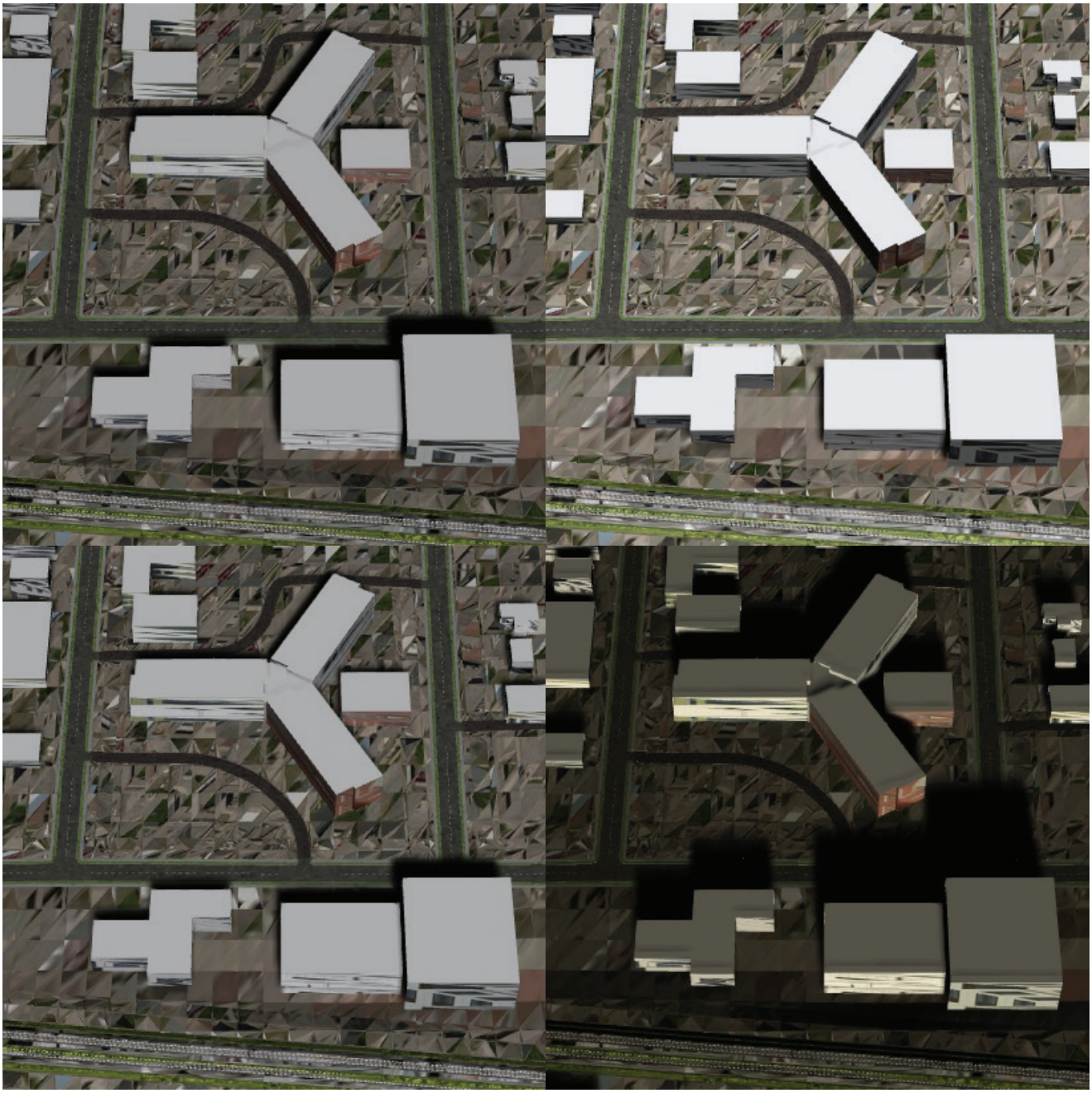
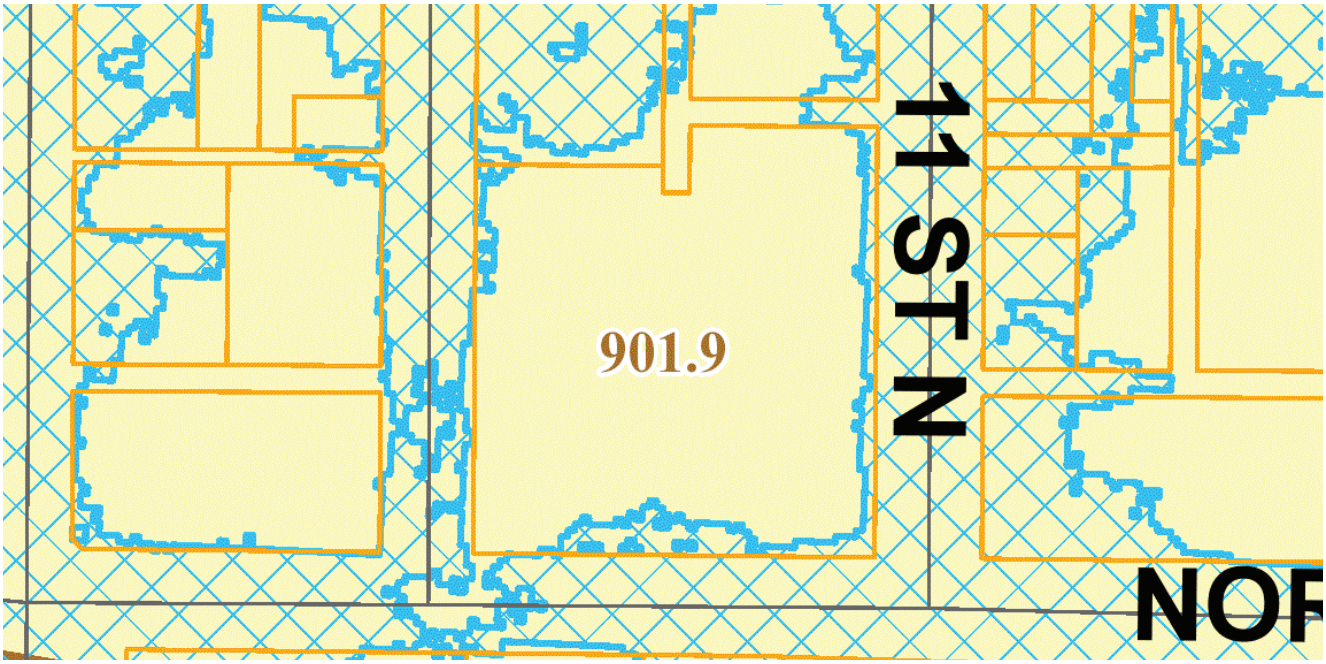

11 ST N
Major Rodes
Minor Rodes
Sidewalk
Bike Path



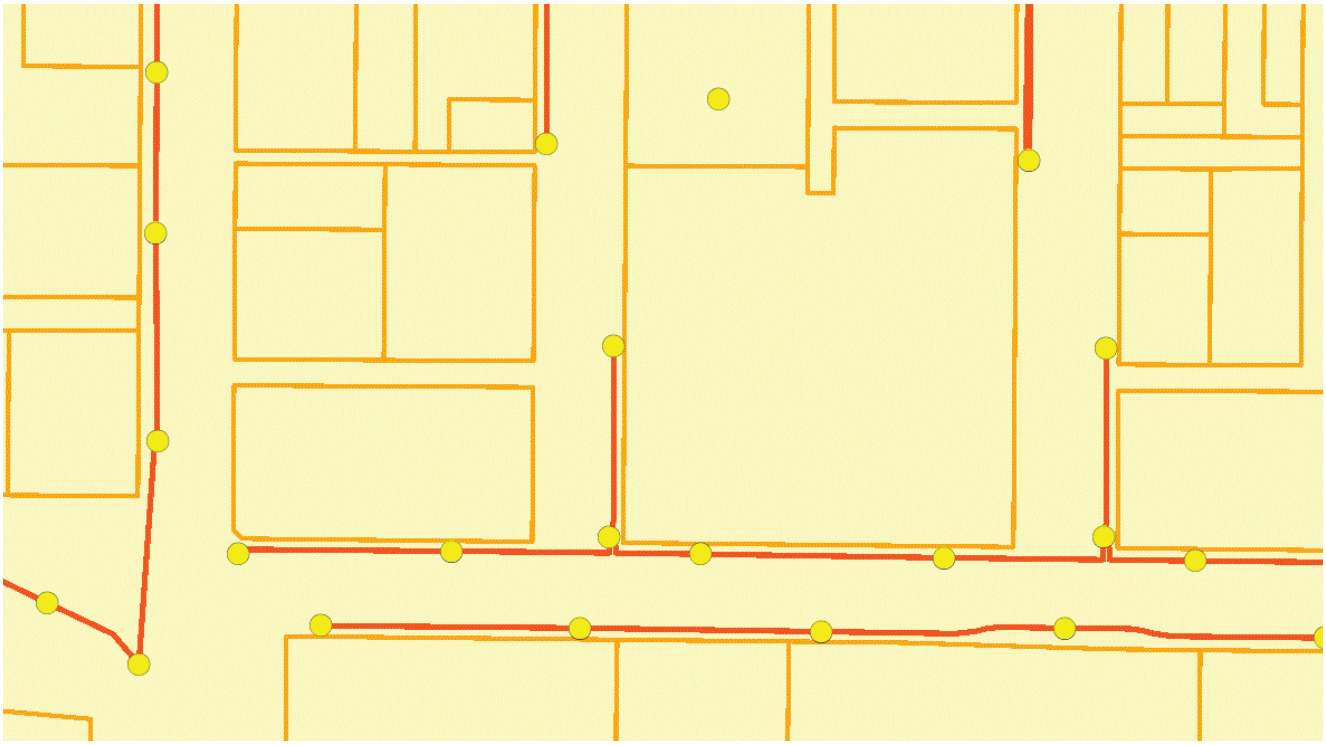
Top Left: March 20th, noon
Top Right: June 21st, noon
Lower Left: September 22nd, noon
Lower Right: December 21st, noon

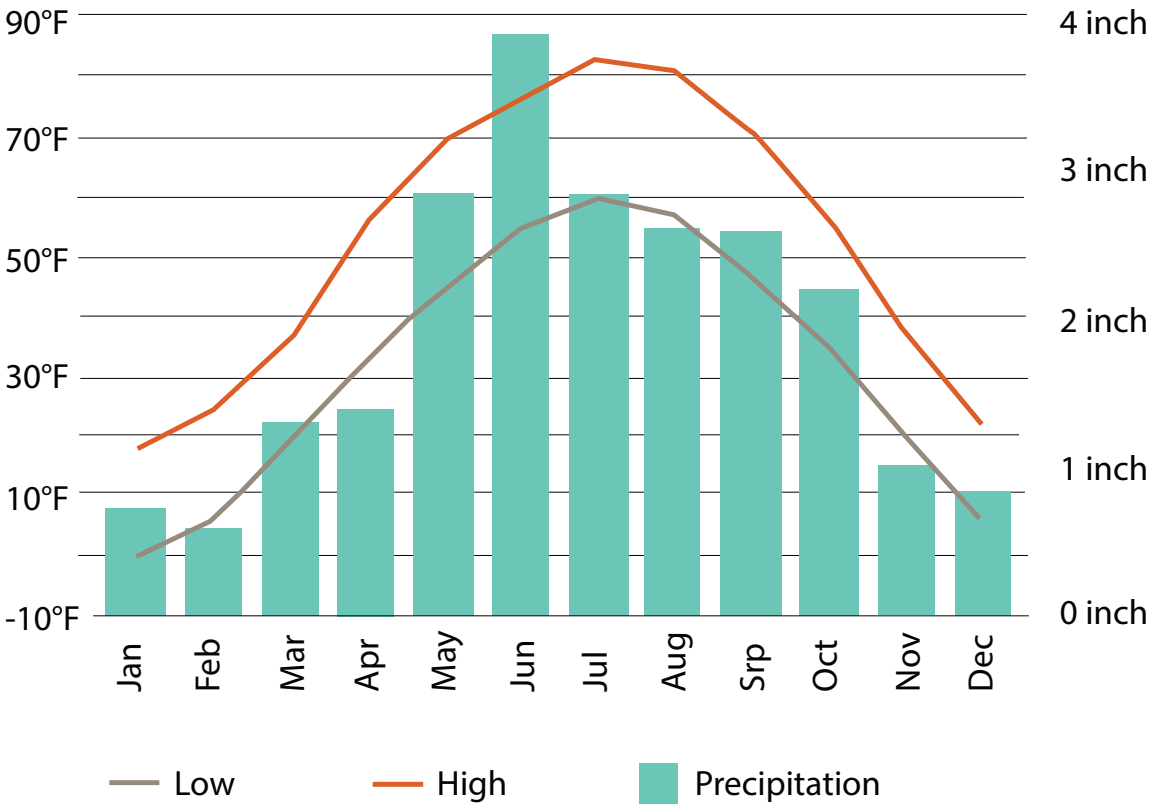


41 Foot Water Surface Elevation Inundation Area (WSEIA)

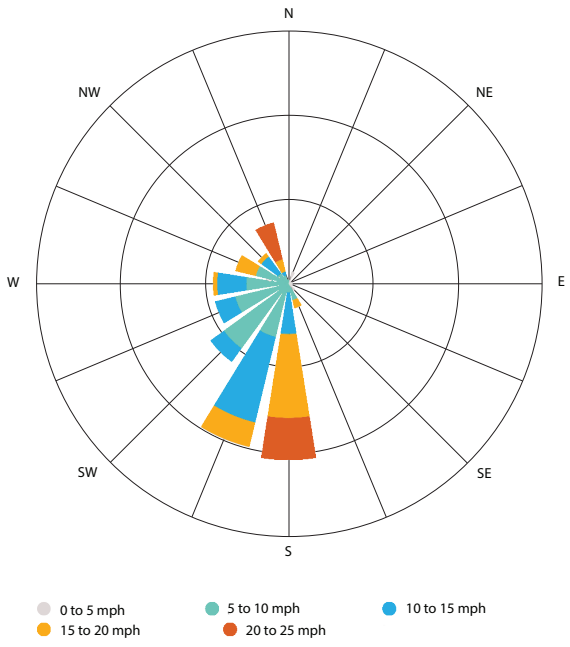
Soils

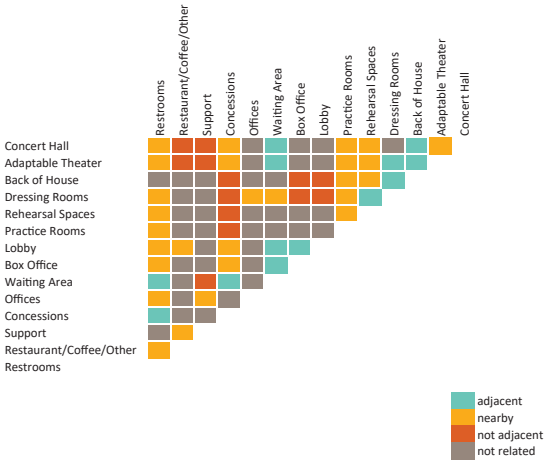
Of the 10 broad classes of soil for engineering classification, Fargo has 3: plastic silt, non-plastic clay, and plastic/organic clay. The soil on the site chosen for this thesis can be classified as clayey. The Vertisols soils on this site can be grouped as Aquerts. There is a high clay content, which means if it rains faster than the water can undergo evapotranspiration, ponding may occur.


Street Lights



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg. High (°F)	18	24	36	56	69	77	83	81	71	56	37	22
Avg. Low (°F)	0	6	19	33	45	55	60	57	47	35	20	6
Avg. Precip (in.)	0.71	0.59	1.30	1.38	2.80	3.90	2.80	2.56	2.56	2.17	0.98	0.83
Avg. Snowfall (in.)	11	7	9	3	0	0	0	0	0	1	8	11

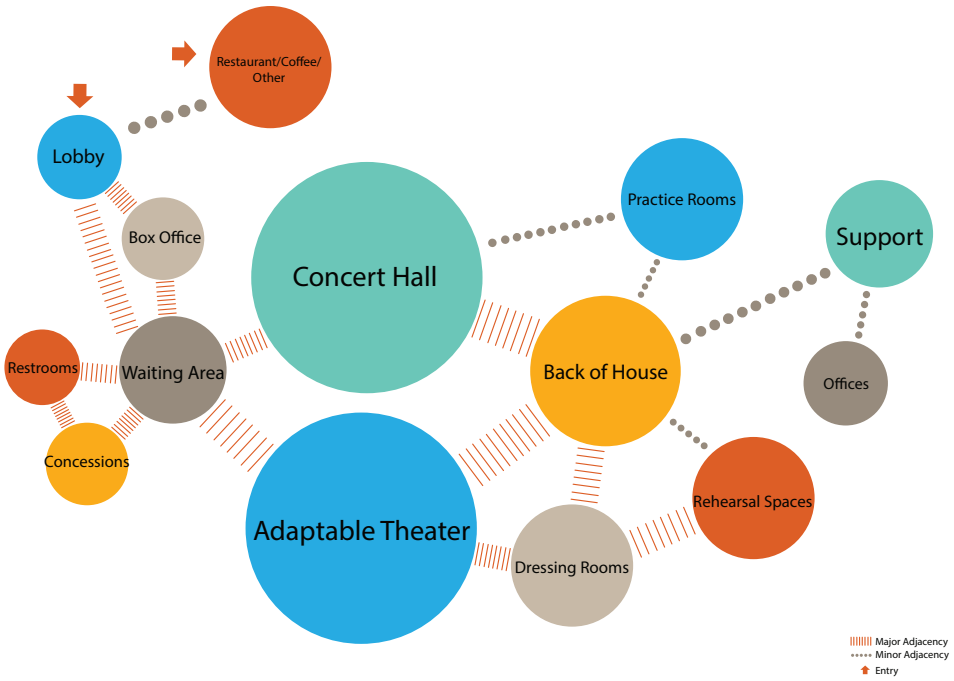




*subject to change

	Size in sq. ft	%
Concert Hall	10,000	23%
Adaptable Theater	10,000	23%
Back of House	7,000	16%
Dressing Rooms	1,000	2%
Rehearsal Spaces	2,000	5%
Practice Rooms	100	0%
Lobby	500	1%
Box Office	150	0%
Waiting Area	1,000	2%
Offices	300	1%
Concessions	500	1%
Support	10,000	23%
Restaurant/Coffee/Other	1,000	2%
Restrooms	500	1%
TOTAL	44050	100%

*dimensions subject to change



The main focus of this thesis will be to measure electricity consumption and the acoustical performance of the final project. In general, these will be measured using modeling/simulations and calculations. The results will be compared to case studies and codes and standards. Other performance to be measured are space allocation, other environmental aspects, like lighting, usage patterns, environmental impact, etc.

Space Allocation

Space allocation of this project will be measured by space per occupant/musician as well as space for mechanical, egress, circulation, solar panels, and more. Space will be measured in square feet within the design programs used via measurement tools provided. Scale drawings and models will be used to generate the measurement of spaces. Space allocation will be measured against codes, standards and other user defined requirements.

PERFORMANCE CRITERIA

Energy Consumption

Electricity used/consumed, produced, and potentially wasted will be measured in kWh. These measurements will be obtained by energy modeling/simulations and calculations. Results will be compared with case studies and measured against the normal codes and standards.

Environmental Performance (luminous, thermal, acoustical environments, ecosystem balance)

Multiple environmental performance criteria must be met in order for this project to be successful. Performance acoustics, such as reverberation time, diffusion, etc., will be measured in dB, SPL, and HZ through modeling/simulations. These criteria will be determined based on case studies and standards. Lighting will be measured in fc and lumens via modeling and drawings; criteria will be based on standards. Thermal comfort will be measured via ACH, temperature, relative humidity, etc. and will be based on codes and standards (ASHRAE).

Behavioral Performance (usage patterns)

Usage patterns can be measured via hours. Proposed uses for this project include: lessons (day-evening hours), rehearsals (evening hours), and performances (evening hours). These will be specified by the clients. Visual aids may be used to show relationships between occupation usage vs. time of day, circulation patterns, and heavy vs. light usage, etc. Performance criteria will need to meet occupant loads and needs.

Psychological Impact (aesthetics, sensory experiences)

Going to performances, whether theatrical or musical, can impact everyone involved emotionally. Audience members can take a mental and physical break from reality and potentially relieve stress. Performers have a chance to stretch out their creativity. In theatrical productions, more specifically, theater-goers can experience emotion through not only the actors performing, but also through their fellow observers. There are many potential psychological impacts; these can potentially be measured with audience and performer surveys.

Environmental Impact

Environmental impact is a large portion of this project. The main measurements to be collected in this instance will be electricity usage and production as well as pollution. Electricity will be measured in kWh and carbon emissions are measured in tons. These measurements will be taken from modeling/simulations, calculations, and case studies and other research. Success will be measured via meeting or exceeding LEED or net zero standards as well as comparing case studies with this project's projected pollution impacts.

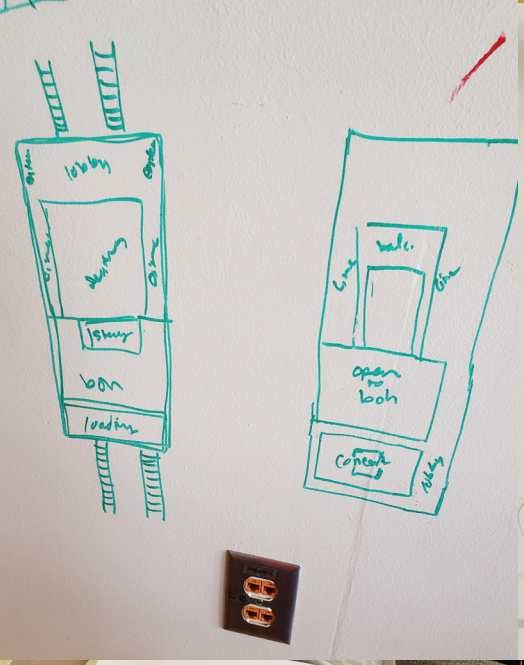
Code Compliance

Local and national codes and standards must be met in order for this project to be successful. ADA codes and ASHRAE standards will be met or exceeded. These criteria will be determined from readings, charts, tables, etc. from all levels of codes and standards.

Cost

Cost such as construction, materials, labor, demolition, electricity, maintenance, etc., will be measured in USD. These will be estimated via case studies, modeling, etc. Comparisons to case studies will be used to determine if the costs of this project are appropriate.

DESIGN


loading
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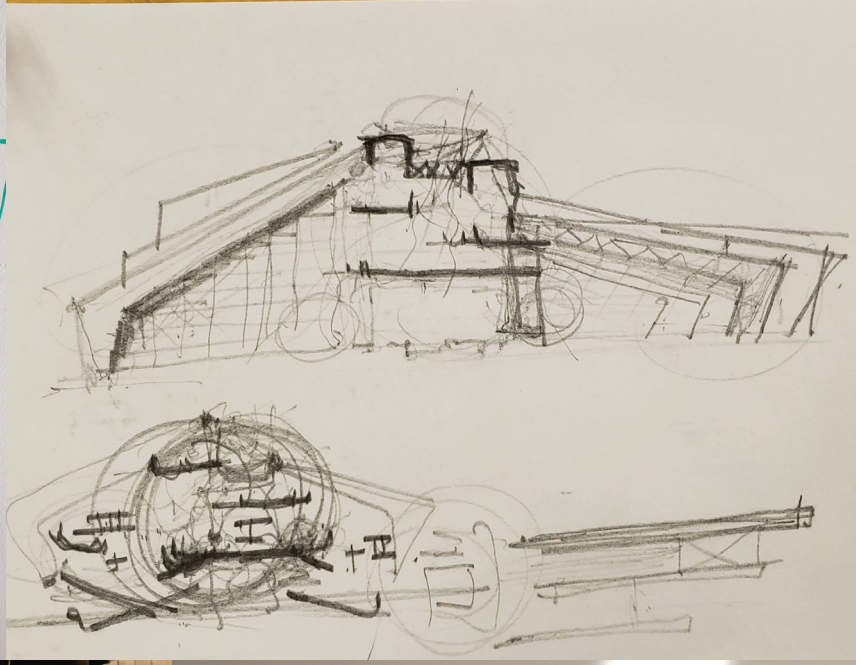
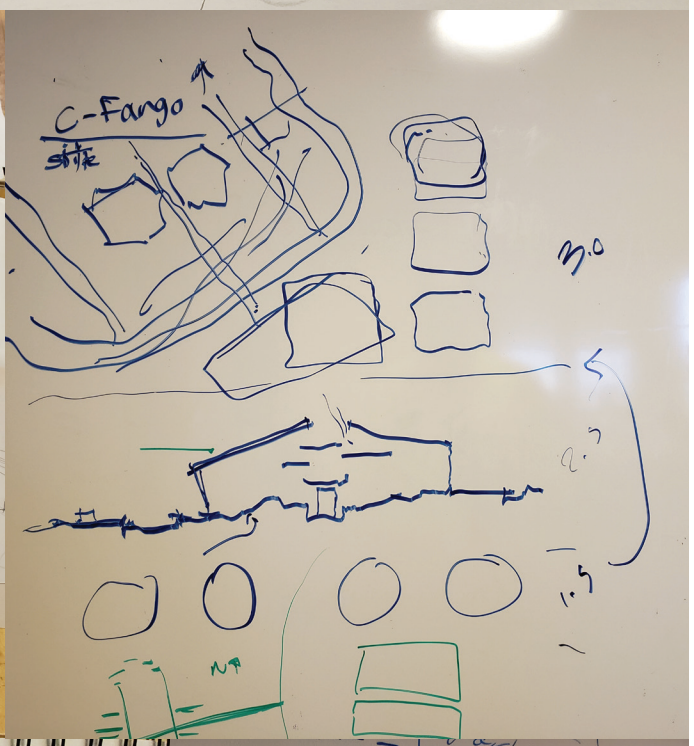
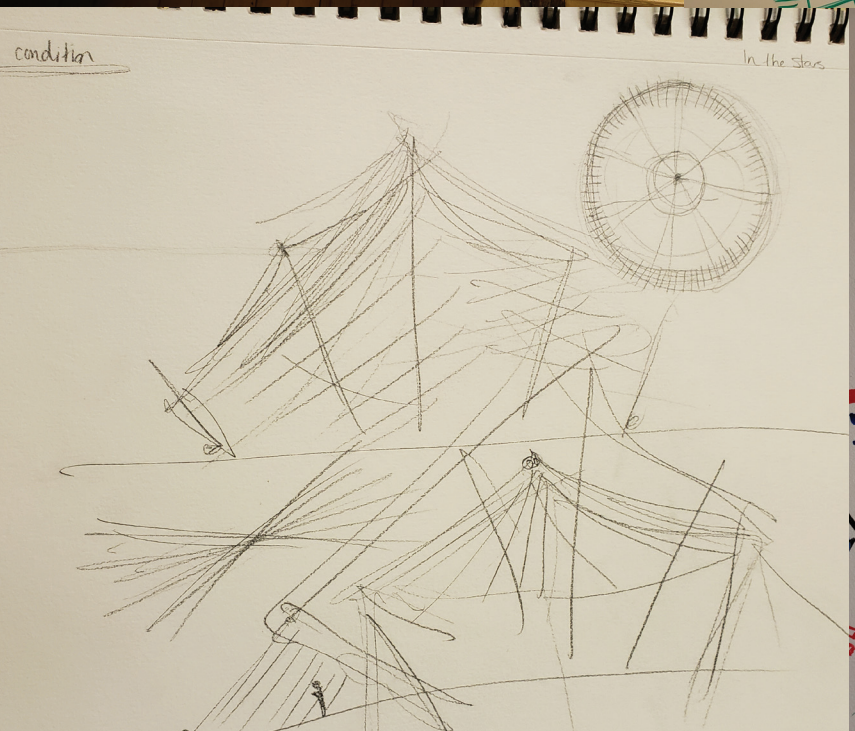
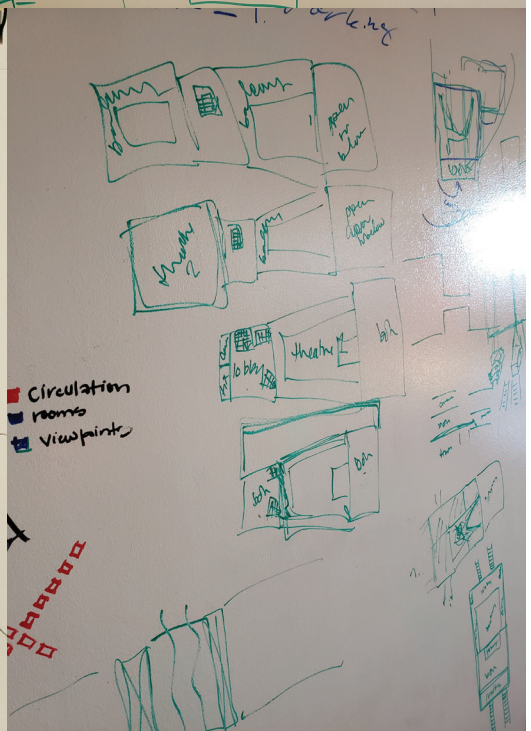


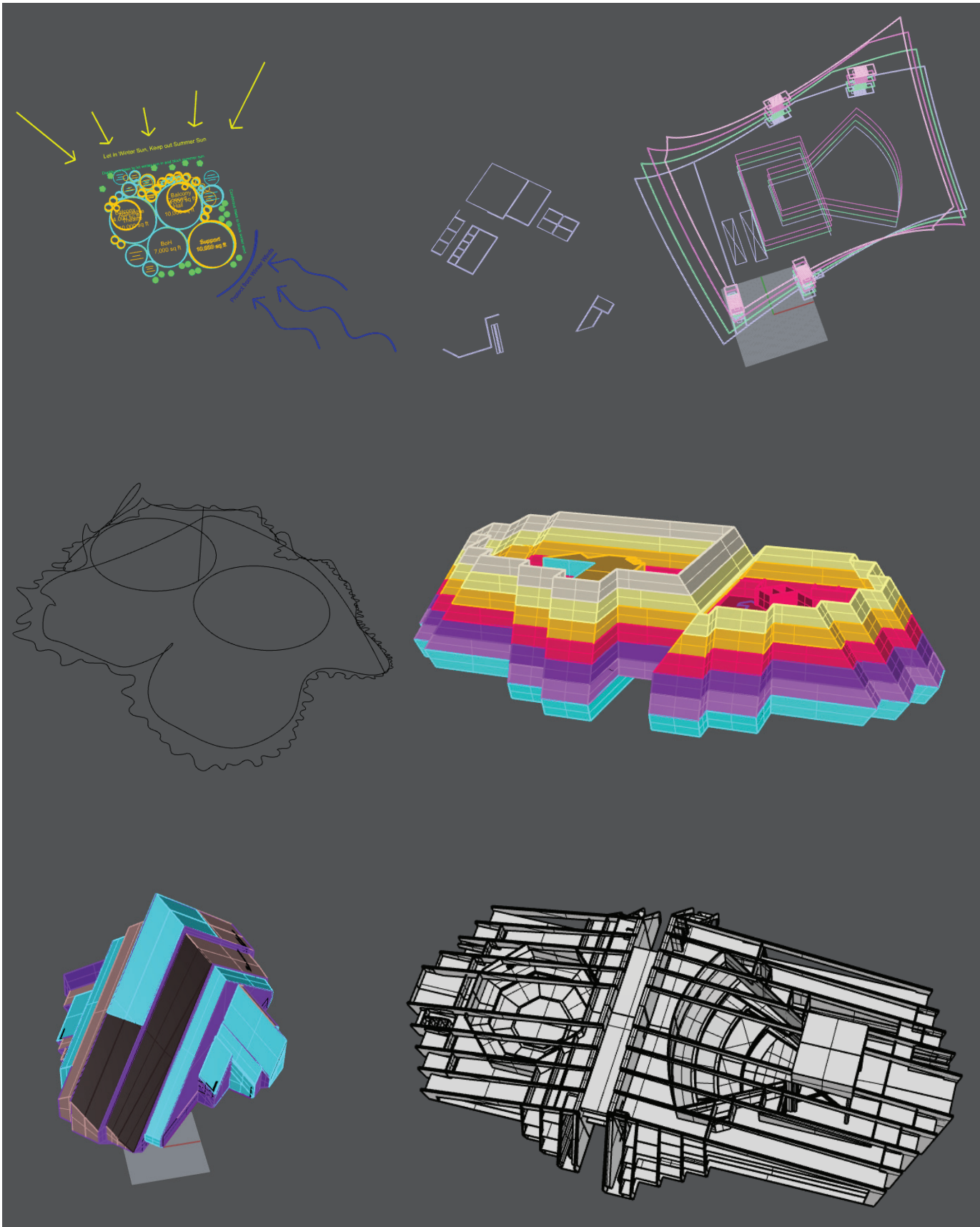

C-Fargo
3.0

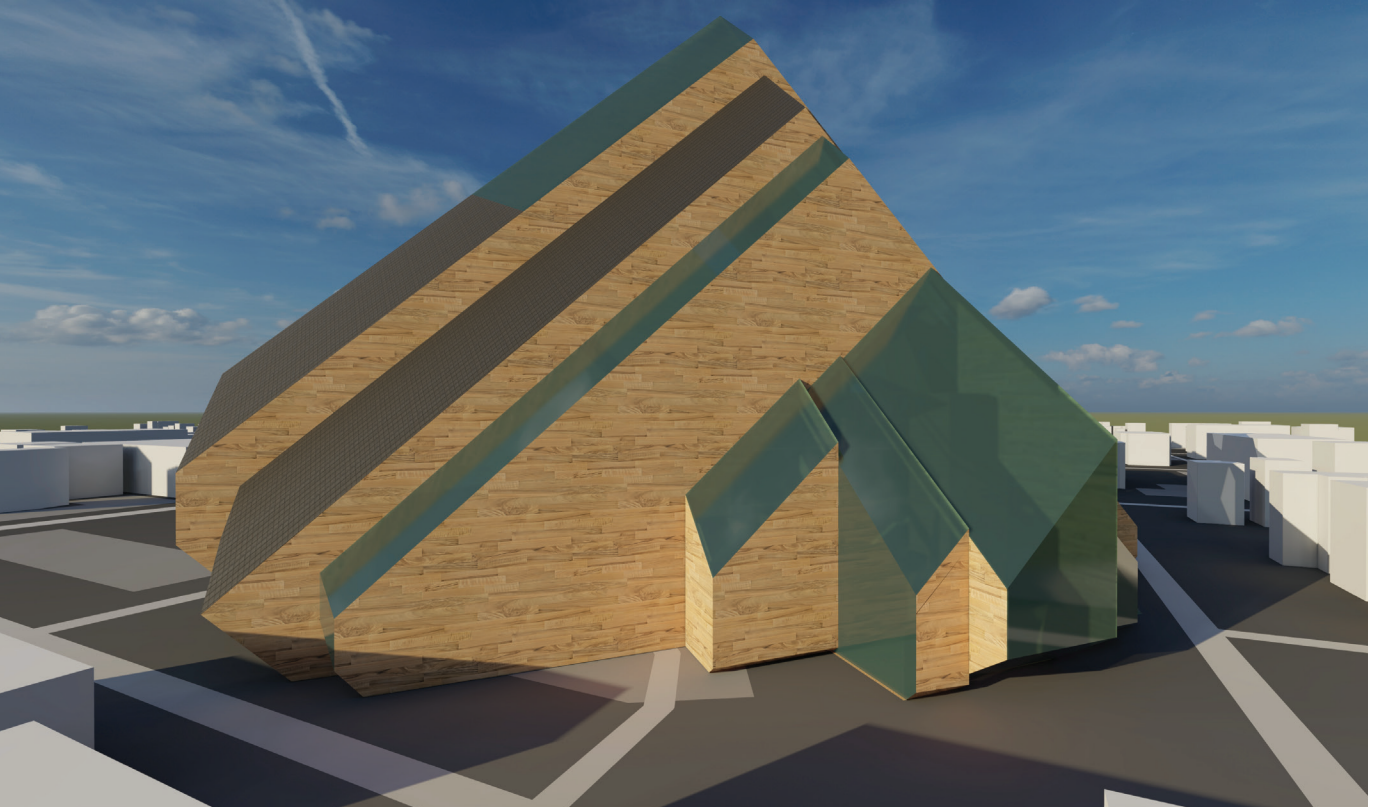

condition
In the Stars

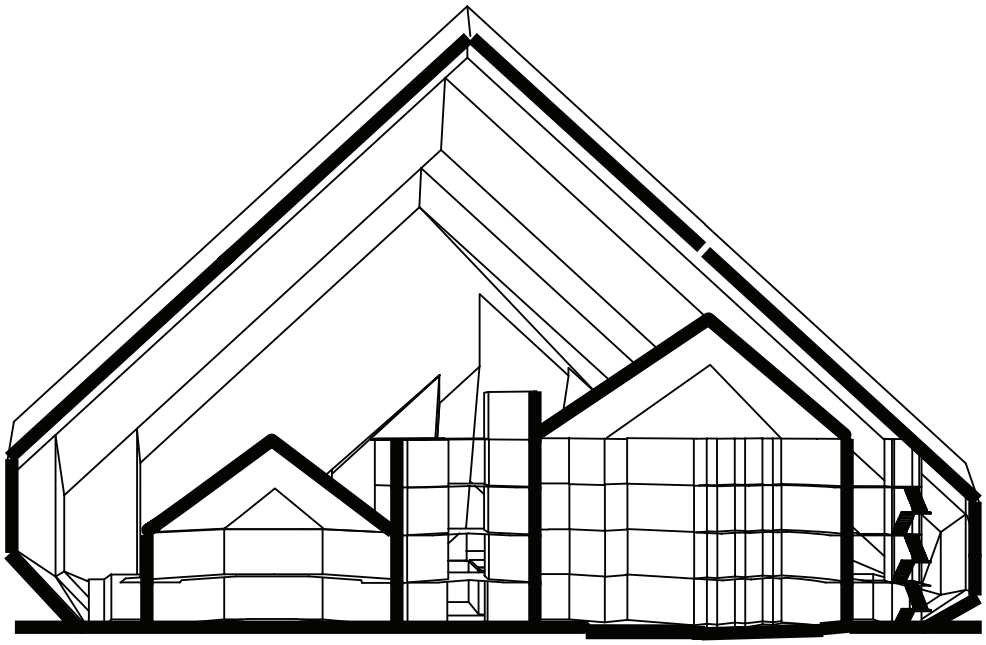

Circulation
rooms
viewpoints
theatre

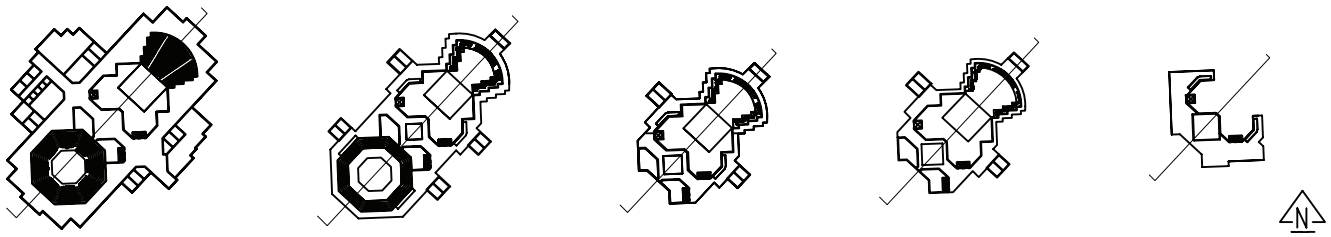
PROCESS DOCUMENTATION

Much of the design process for this thesis involved sketching and discussion. From the shape of the crescendo and decrescendo informing the section, to working out circulation and spatial relations, sketching played a large role in working out the design decisions and getting them on paper. Sketches on paper and white boards eventually turned into digital modeling via rhino, which were then finalized after some more sketching and discussion and turned into floor plans and renderings.





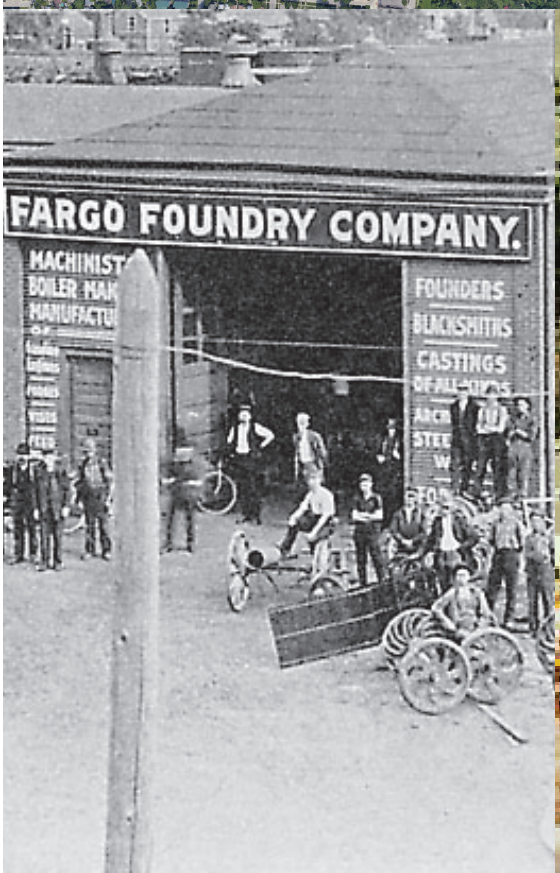


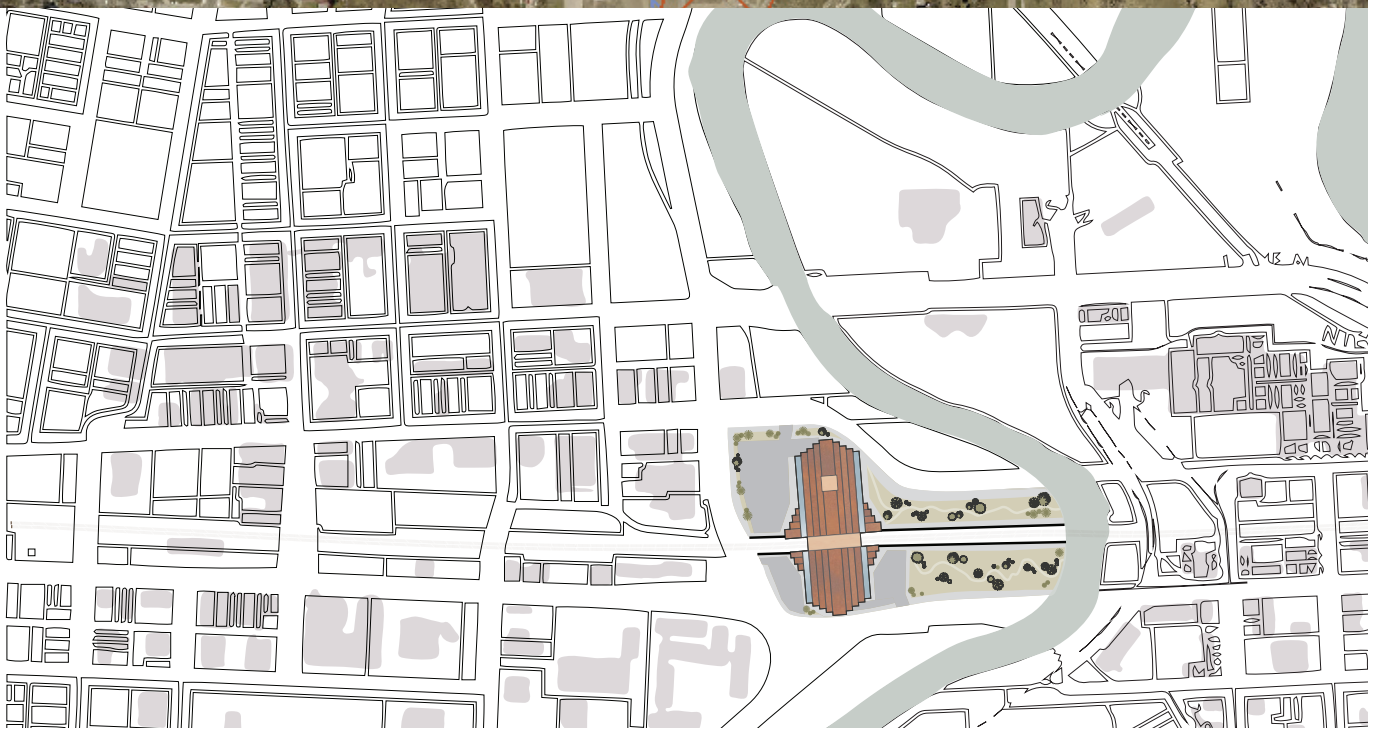


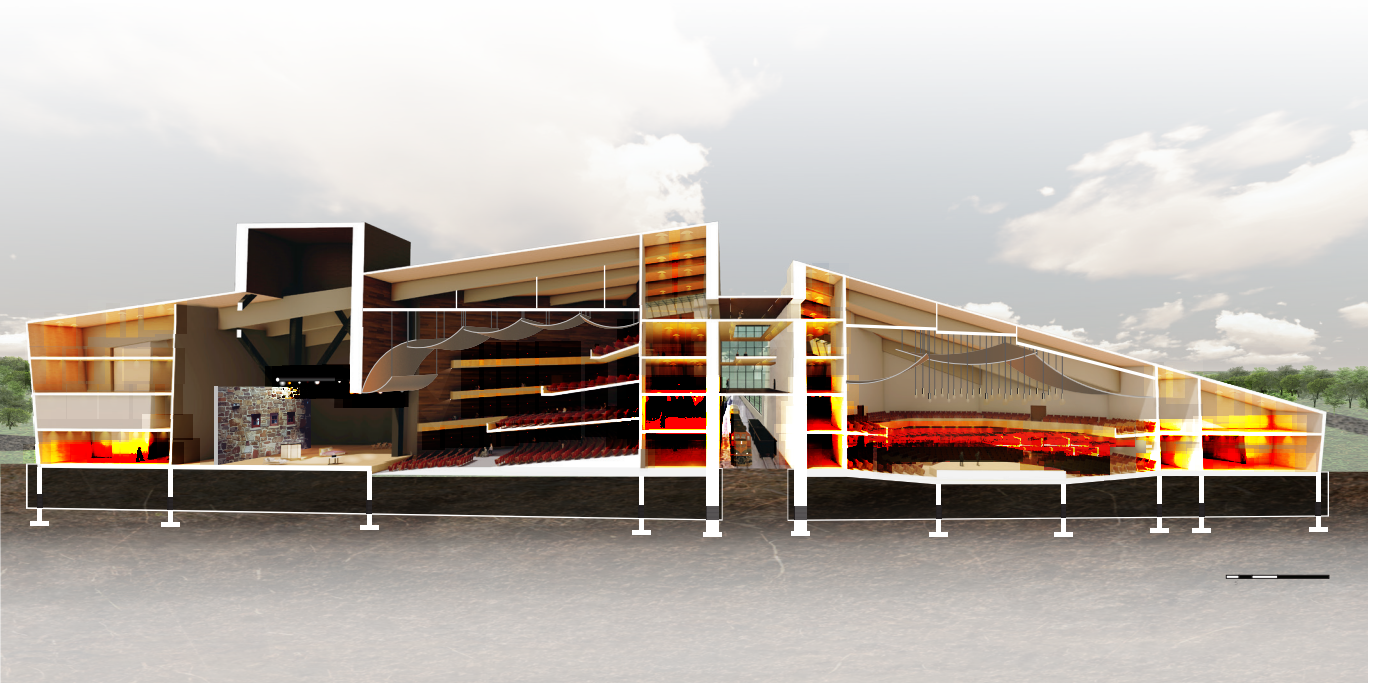
MID-CRITS

PERFORMANCE ANALYSIS:
RESPONSE TO THE SITE OR CONTEXT

With a new site in Fargo, the site context changed a little bit. The design had to avoid the flood plain and he change in site meant the resulting design would straddle the railroad track separating the NP Ave and Main Ave sides of the site. The design also addressed the site in relation to implementing sustainable design ideas like natural ventilation and maximum solar energy production by using the optimum solar tilt for a fixed solar panel. Regarding context, the resulting multi-purpose theatre would provide the Fargo-Moorhead area with a larger venue for traveling shows. The concert hall would also provide a more professional, more permanent space for the local orchestra to perform in.

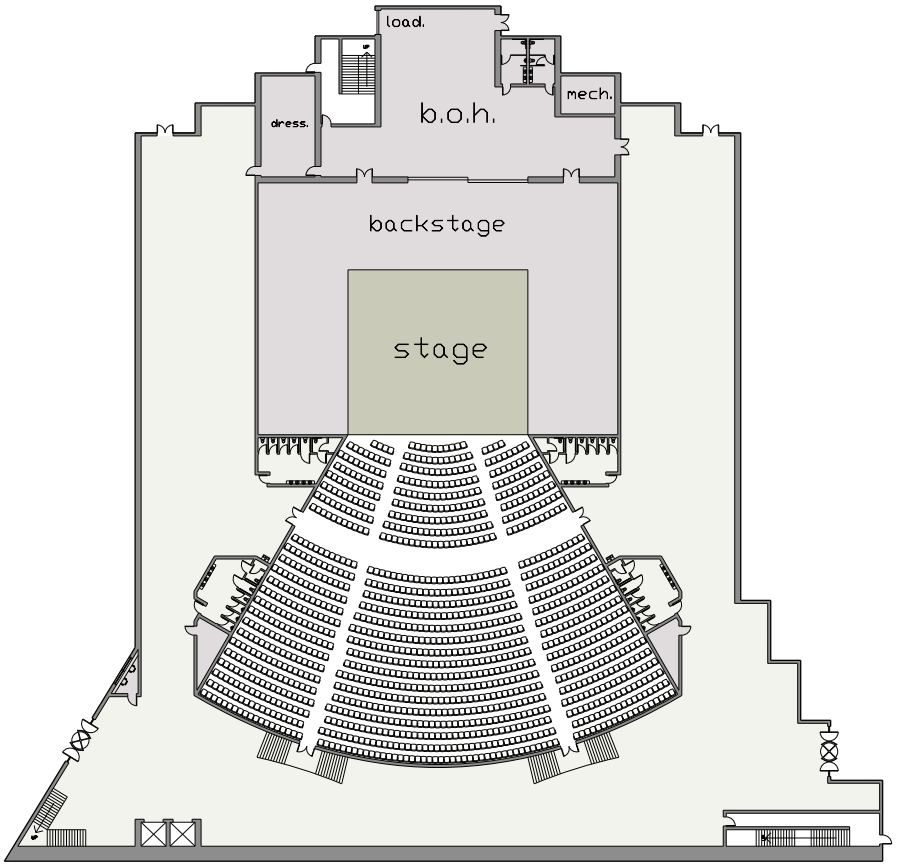


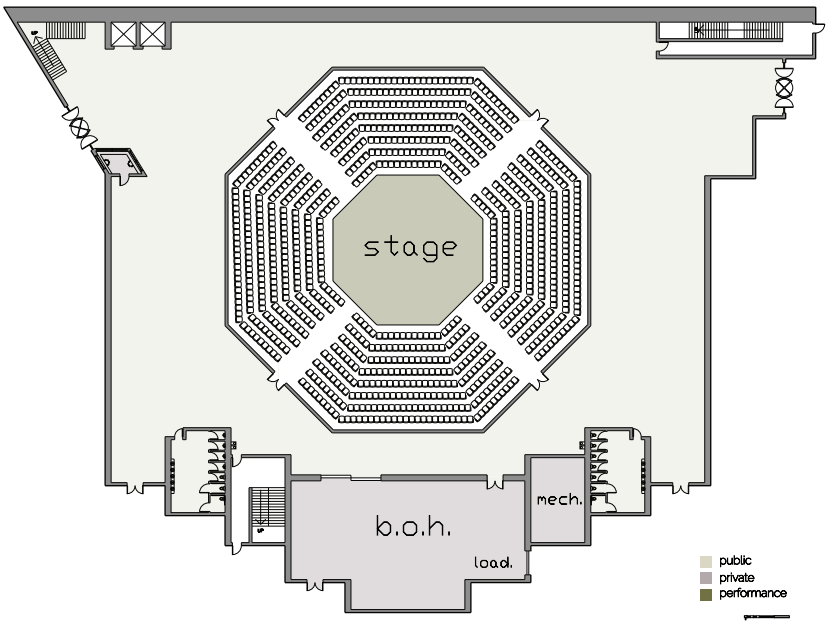




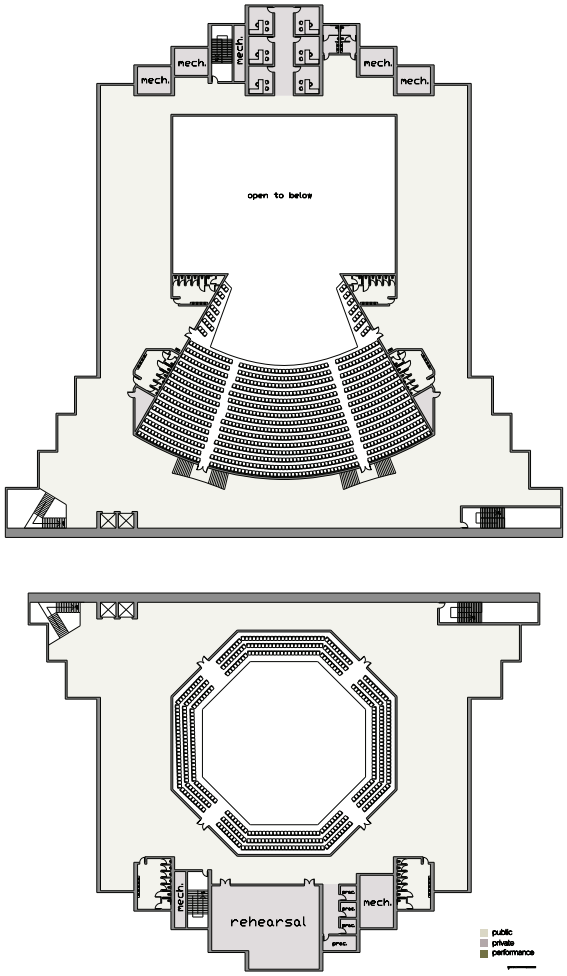
PERFORMANCE ANALYSIS:
RESPONSE TO THE TYPOLOGICAL OR PRECEDENT RESEARCH

The seating options, such as the number and arrangements, were chosen in response to the precedents and research. The relationship between the privacy of back of house spaces from the public and theatrical spaces were also informed by the case studies. Specifics, such as the structural details in response to the proximity to a train were also determined by looking at similar real-life examples.

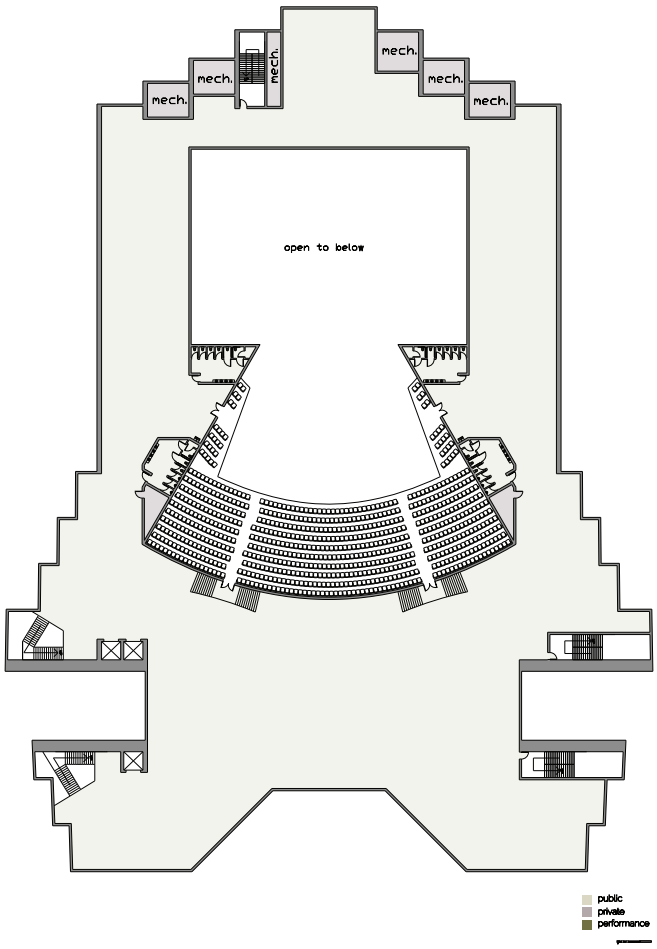




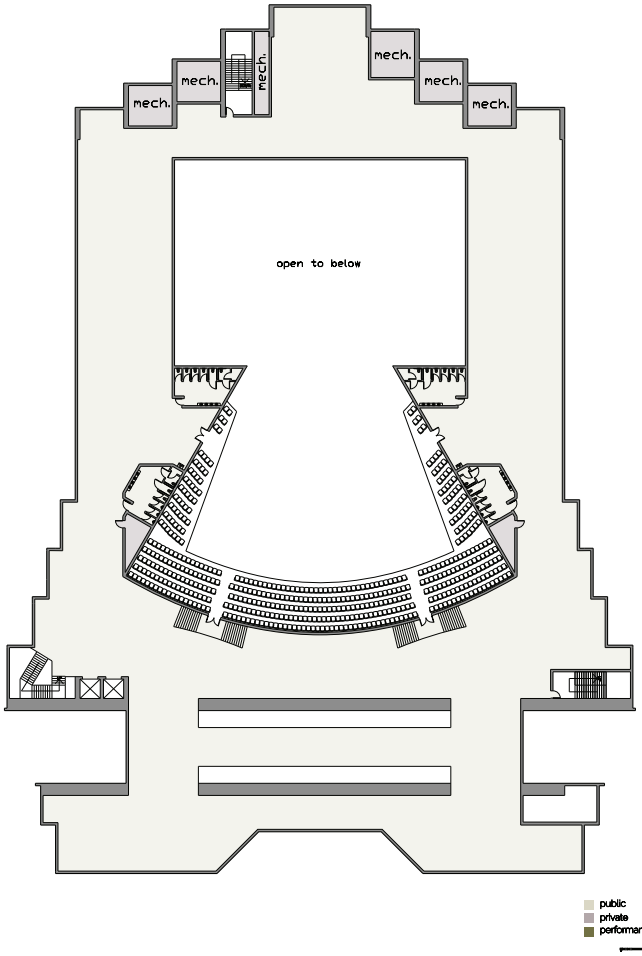
First Floor



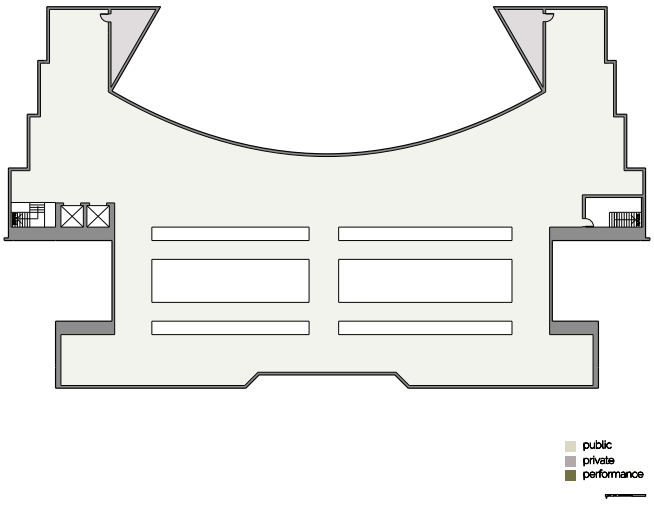
Second Floor



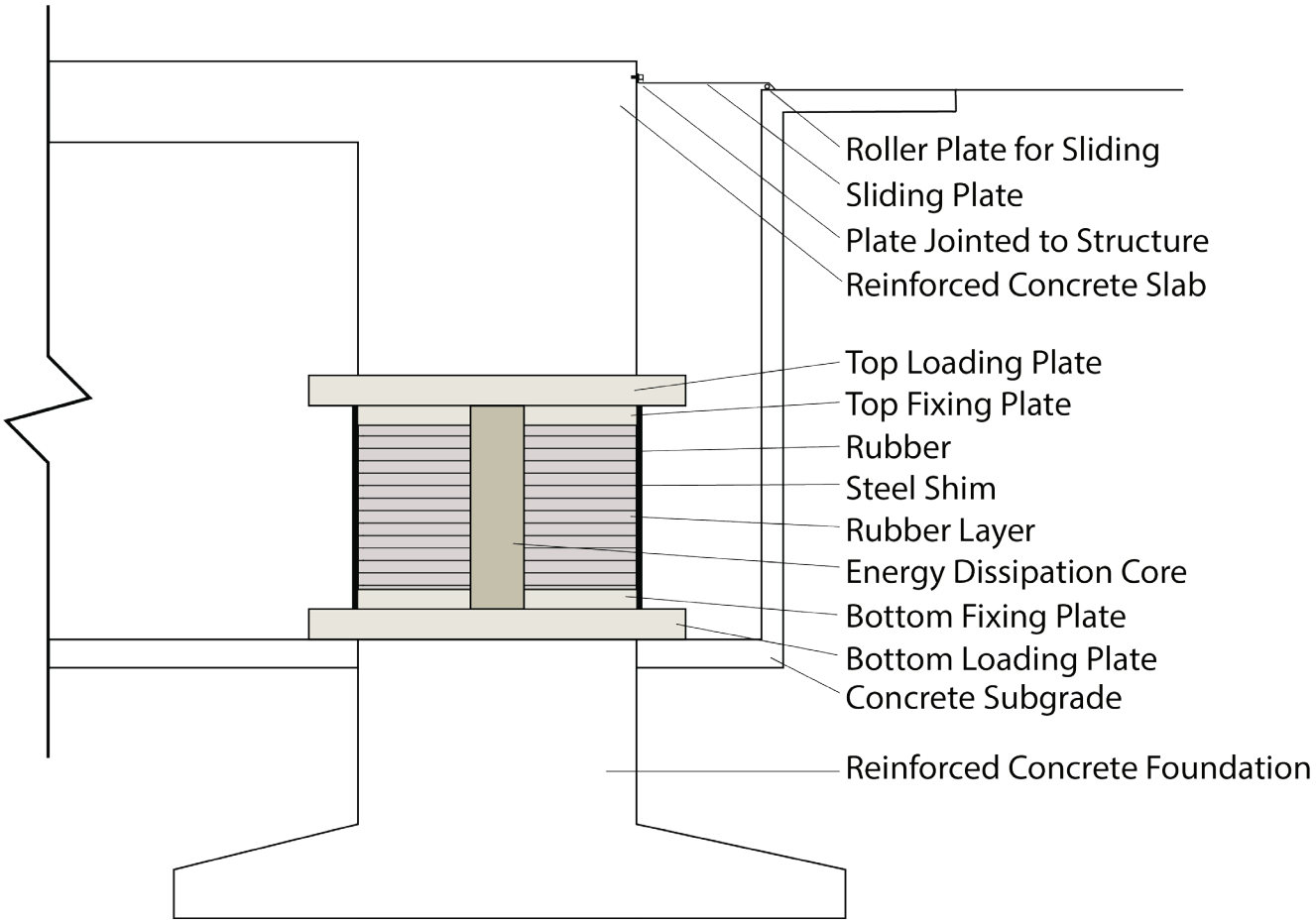
Third Floor



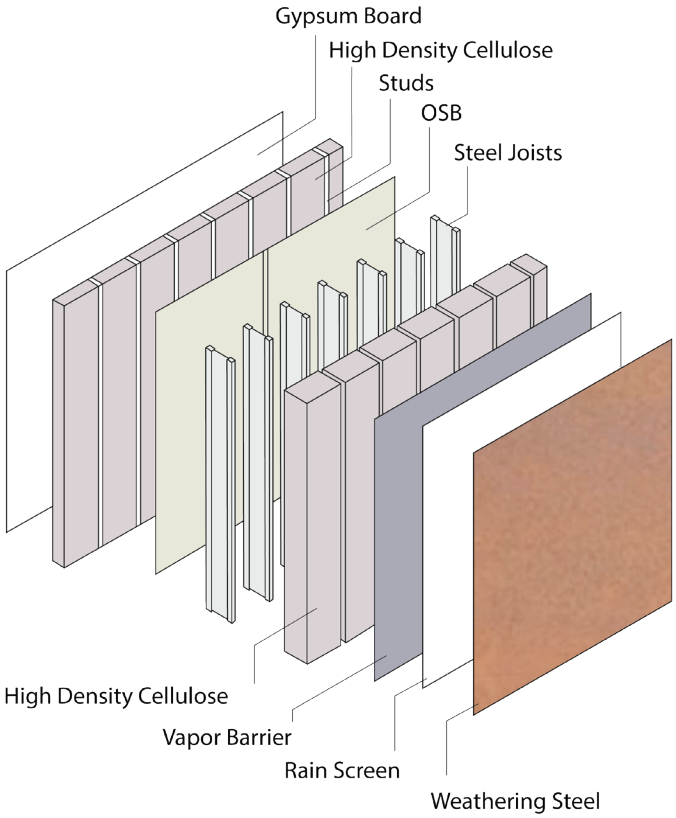
Fourth Floor



Fifth Floor



Base Isolation

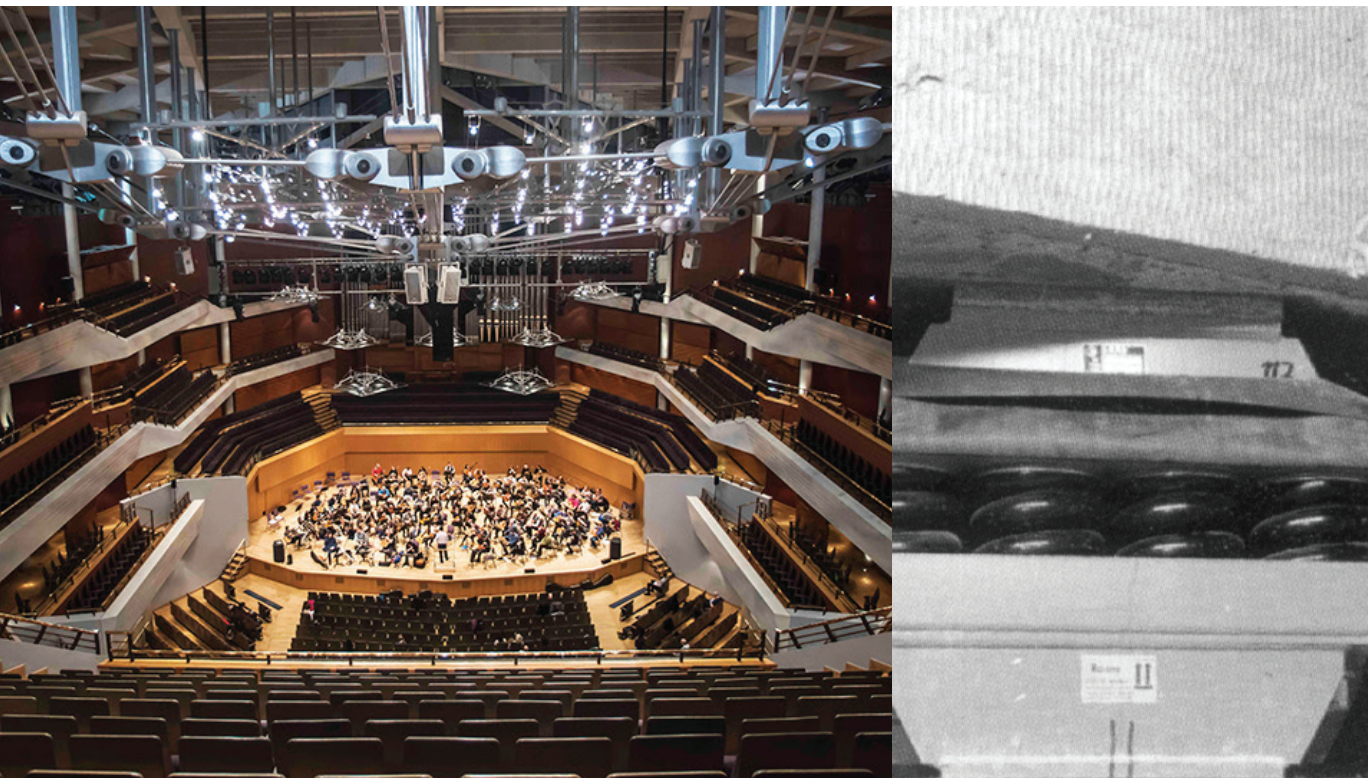


Wall Assembly

1.26 | Benaroya Hall Exterior and Isolation Close-Up

Benaroya Hall in Seattle holds 2,500 in it's largest auditorium. It's proximity to an underground train track, bus tunnel, light rail, and busy roads as well as the potential earthquakes made this hall a prime case study when looking specifically at the structural and acoustical relationship of the hall to a nearby train. Bridgewater Hall in Manchester holds 2,341 and uses similar technology to dampen external vibrations.

1.27 | Bridgewater Hall Interior and Isolation Close-Up

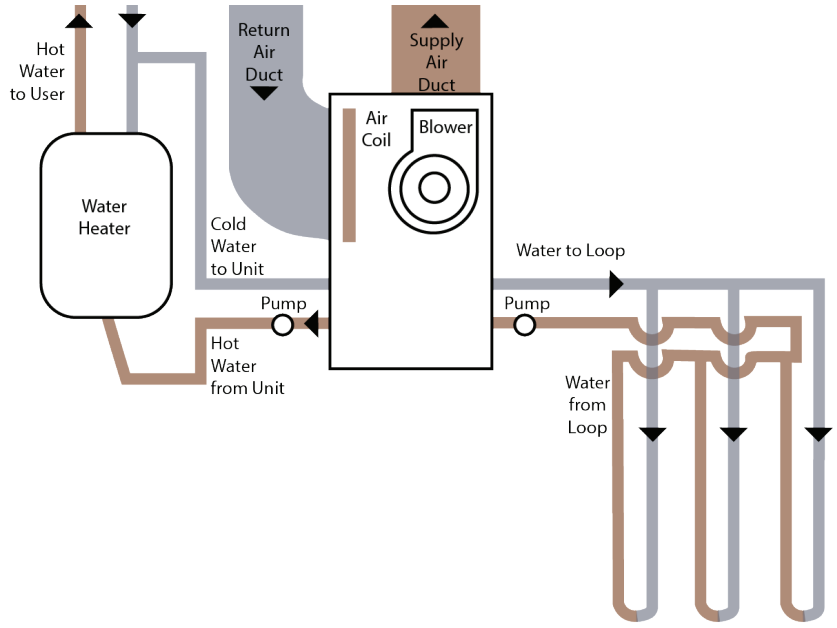


PERFORMANCE ANALYSIS:
RESPONSE TO GOALS AND PROJECT EMPHASIS

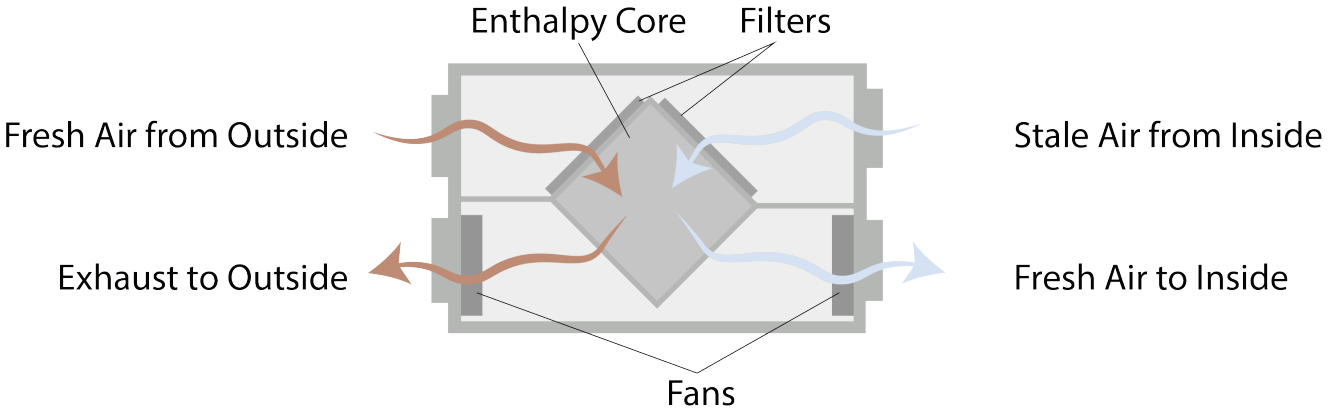
The original emphasis was intended to be placed on this project's energy performance. While it still points to the application of sustainable design to such large projects with the specific ideas of incorporating solar energy and natural ventilation as well as reduction of energy use with highly rated wall assemblies and energy efficient lighting and HVAC equipment, the emphasis turned towards connecting the public to culture via the performance arts community.

Approach to Orchestra Hall

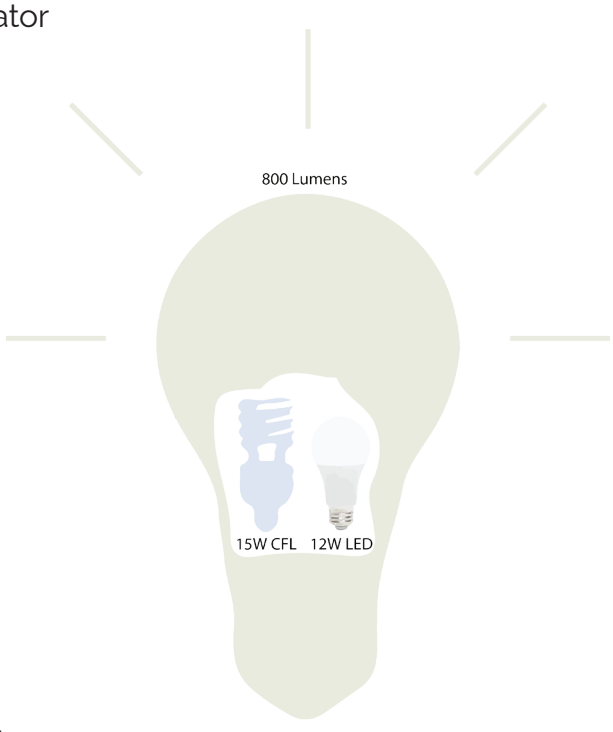
Orchestra Hall Interior



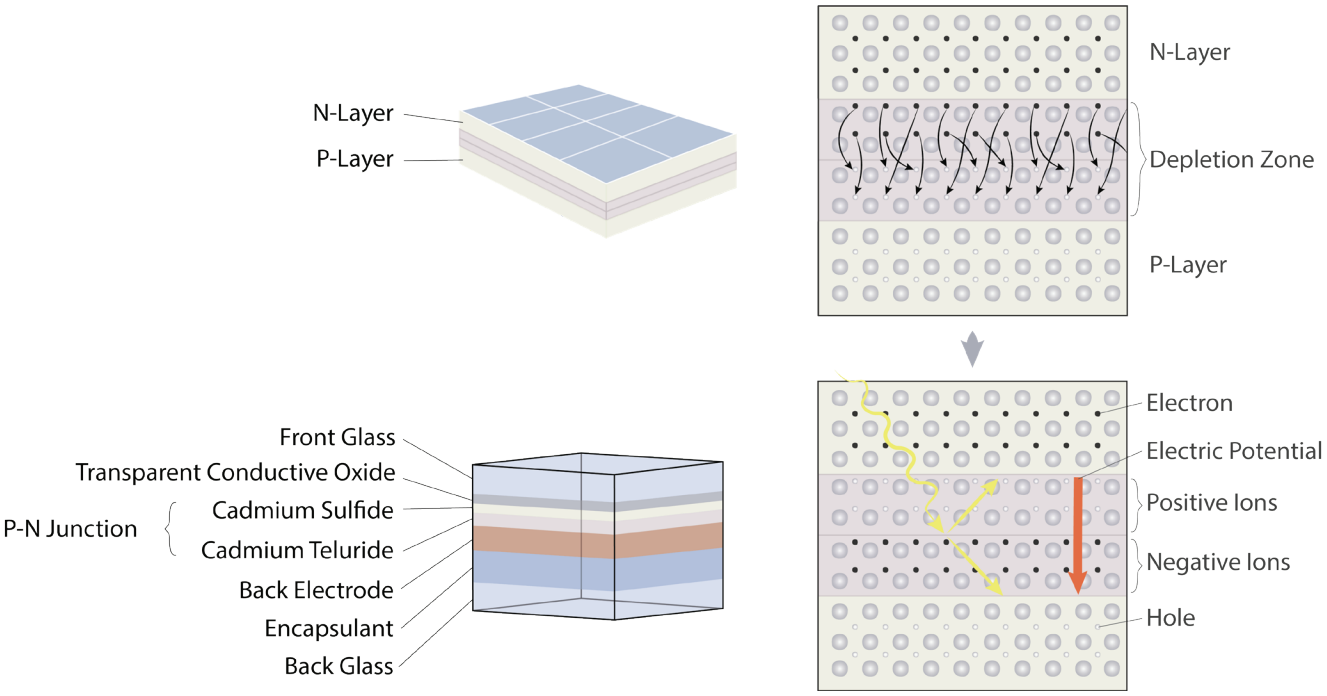
Ground Source Heat Pump



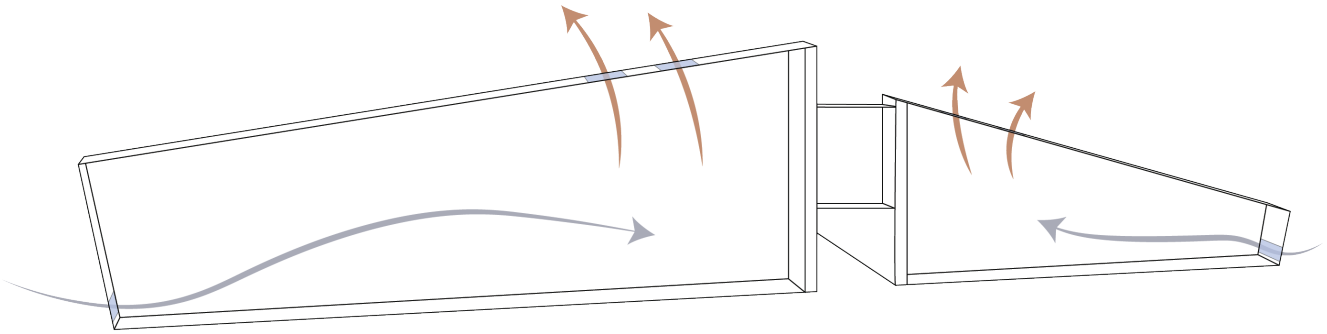
Energy Recovery Ventilator

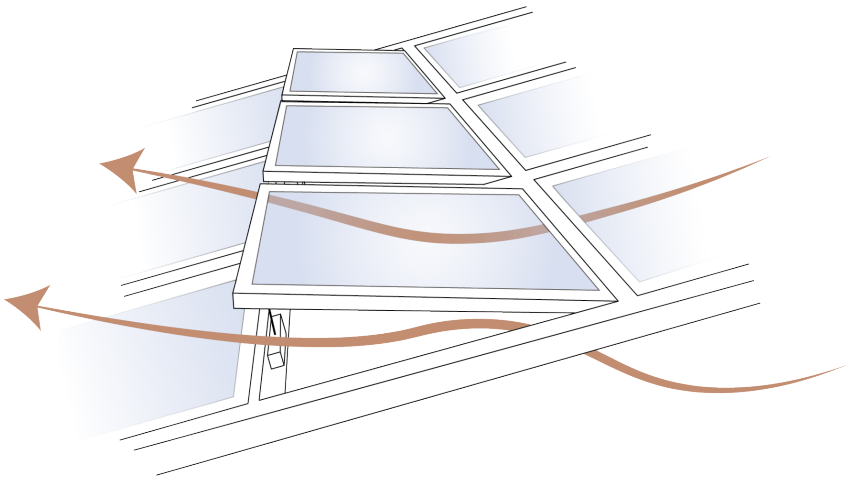


Energy Efficient Lighting

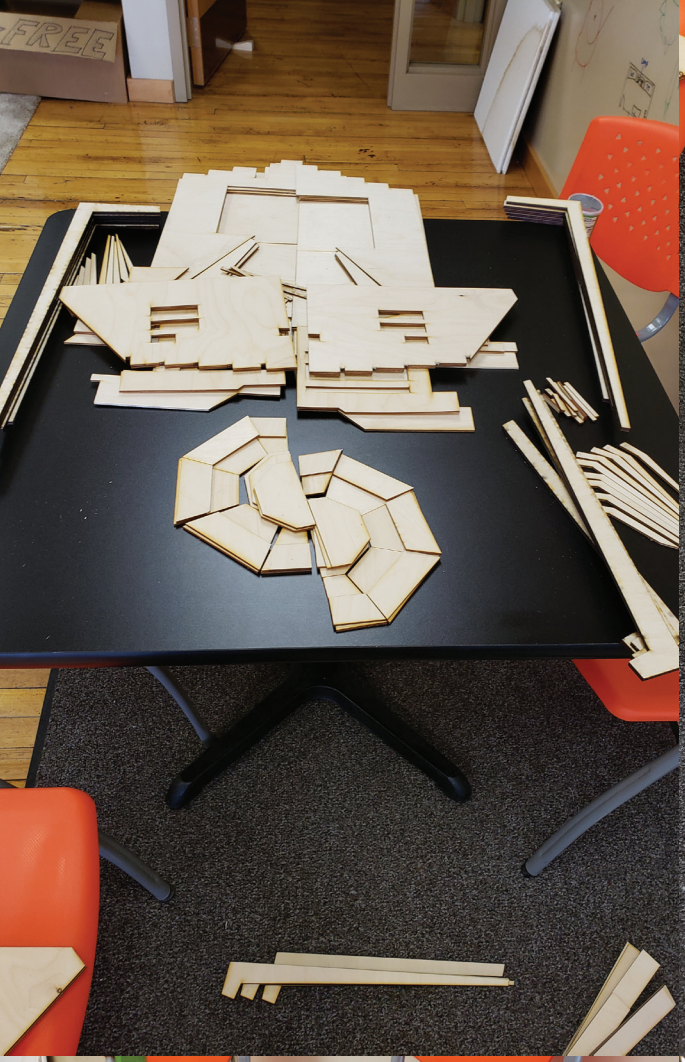


Solar Roofing and Glazing

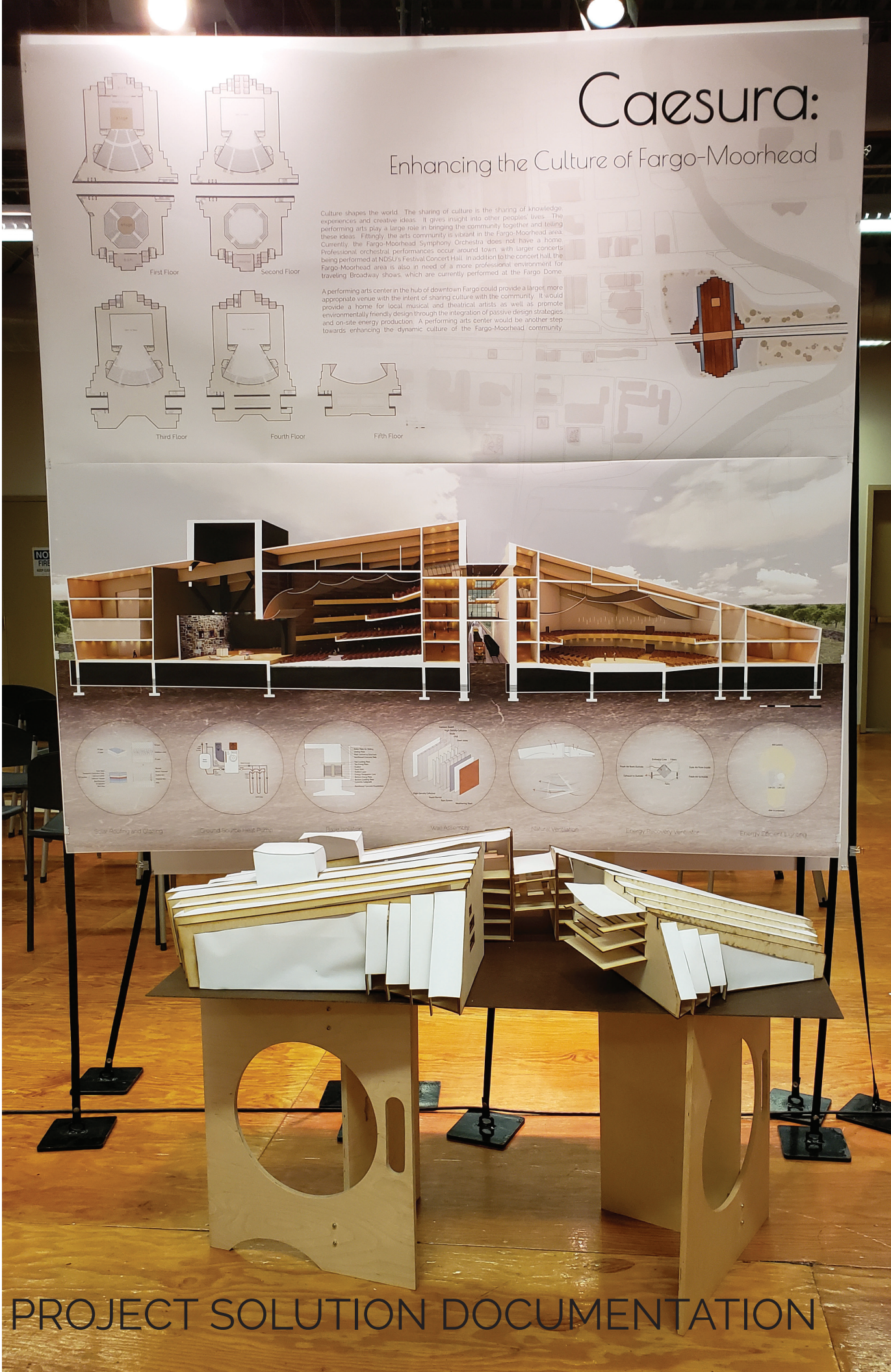




Natural Ventilation



MODEL PROCESS



PROJECT SOLUTION DOCUMENTATION

THESIS APPENDIX

REFERENCES

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PREVIOUS STUDIO EXPERIENCE

2ND YEAR | FALL 2015 | PROF. CINDY URNESS
Teahouse | Moorhead, MN

2ND YEAR | SPRING 2016 | PROF. DARRYL BOOKER
Small Dwelling | Marfa, TX
Pritzker Architect Birdhouse
Montessori School | Fargo, ND

3RD YEAR | FALL 2016 | PROF. PAUL GLEYE
Wellness and Empowerment Center | Fargo, ND
Culinary Institute | Fargo, ND

3RD YEAR | SPRING 2017 | PROF. REGIN SCHWAEN
Steel Museum | Fargo, ND
House of the 21st Century | Fargo, ND

4TH YEAR | FALL 2017 | PROF. BAKR ALY AHMED
Integrated Design Studio | High Rise | San Francisco, CA

4TH YEAR | SPRING 2018 | PROF. PAUL GLEYE
Urban Design Studio | Mixed Use | Brussels, Belgium

5TH YEAR | FALL 2018 | PROF. DOUGLAS HANSON
Guggenheim Museum Addition | Bilbao, Spain

5TH YEAR | SPRING 2019 | PROF. BAKR ALY AHMED
Thesis | Performing Arts Center | Fargo, ND

ABOUT

"...in the search for the answer, lies the answer"

-Frank Lloyd Wright

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