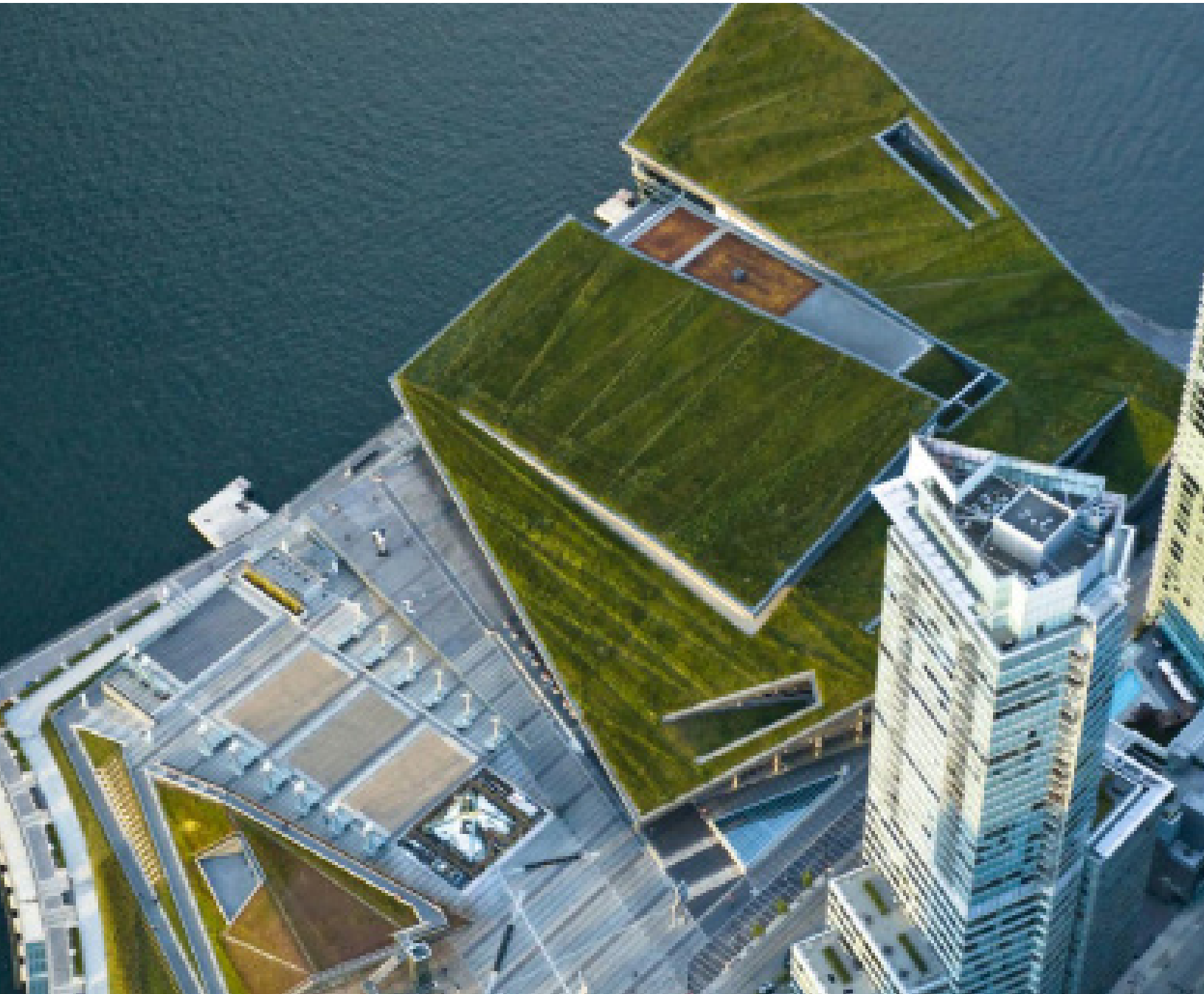
INTEGRATING PLAINS

Connecting Fargo Through A Green Roof System

A design thesis by Katlyn Rydberg



Thesis Archival Note

The following thesis project, entitled INTEGRATING PLAINS: Connecting Fargo Through A Green Roof System, was composed over the course of the 2022-2023 academic school year. The Thesis Program, as contained here, was initiated and completed in the fall semester as a part of the LA 763: Landscape Architecture Thesis Research and Programming course. Supplemental material, including the Thesis Boards and the Thesis Presentation documents, were generated in the spring semester as a part of the LA 772: Landscape Architecture Graduate Thesis Design Studio course. Any inconsistencies between the different documents, in terms of research and design, should be excused per the evolution of the project across the two semesters.

INTEGRATING PLAINS

Connecting Fargo Through A Green Roof System

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

By

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

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Thesis Abstract

The city of Fargo, ND, and the surrounding area has continually grown each year and is expected to grow in the future. With the growth is an influx in the building of homes, businesses, and roads. This growth has caused the area to become more of a concrete jungle opposed to the historical vegetative lake bed, it used to be. These hard surfaces and building production have negatively affected the energy consumption, runoff coefficient, and temperatures within the city, all of which have the potential to rise further yet. To prevent future and combat existing pollution and runoff, roof infrastructure will be researched through quantitative research and case studies to see differences in city buildings with and without roof infrastructure implemented.

Thesis Narrative

Roof intervention has been a concept discussed for years, but in small to moderate sized cities it is not nearly as implemented. Cities that have a steady annual growth should be putting a form of roof infrastructure into effect. Cities and towns are so commonly expanding outward and spreading across more land. It is less common that people like to live in multi-family or high rises over single family homes. When people move, businesses move to accommodate wants and needs of the residents. Since the likelihood of a mass of people changing their way of life is unlikely, new tools need to be implemented to prepare, prevent, and combat the effects that are inevitable. This thesis will involve research into the factual evidence that the growth in building quantities is causing a higher energy consumption, runoff coefficient, higher quantities of hard surfaces is causing a rise in runoff, temperature, and pollution within cities which in turn can lead to more extreme problems like flooding and health concerns. Research on the types of roof interventions will be beneficial for understanding the functions and uses of different interventions for the future use in creating a plan for building requirements for implementation on a large scale throughout the city. The region and city chosen was based on the familiarity with it currently and the plan to live in or around in it the future to see what is possible for the city of Fargo and surrounding area. The "site" is a plan for implementation in both residential and commercial buildings. The project focus is planned to be beneficial to the economy for a reduction in infrastructure problems, and socially for the health of the residents throughout the city area.

Typology

Green infrastructure

Green Roof

Masterplanning

Amenity Deck

Ecological Design

Case Studies

Vancouver Convention Center

Vancouver, British Columbia, Canada

The Vancouver Convention Center was designed by PWL Partnership Landscape Architects Inc. in 2003-2010. It is a 2.4 hectare green roof, designed towards native plantings, animal attractions and stormwater detention, while reduce energy and the buildings footprint.

Chicago Plant Conservation Science Center

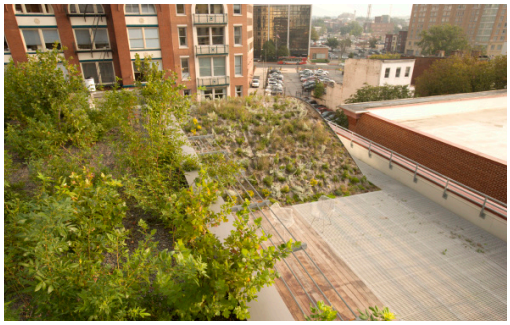
Chicago, Illinois, USA

The Chicago Plant Conservation Science Center was designed by Edward Larabee Barnes, Daniel Urban Kiley, and Booth Hansen Architects. It has a 16,000 sq. ft. green roof that is designed for research of different types of green roofs, they are monitored for plant climate effectiveness.

American Society of Landscape Architects Headquarters

Washington, DC, USA

The ASLA headquarters was designed by Michael Van Valkenburgh Associates. It was completed in 2006 and consists of 6 different forms of green roof throughout the 3,300 sq. ft. rooftop. The goal was to show that landscape architects can play a key role in green roof design.



Justification

Roof interventions are important to me because the roofs of buildings are underutilized space that could be useful outside of just utilities and HVAC for the building. If I was given the choice between seeing a view from the ground floor or the roof, I believe majority of people would say the roof. It allows for a whole different perspective from peoples average day. Amenity decks can be a beneficial addition to any building from a social connection idea. The area of a roof is usually the same as finished square footage of a single floor inside the building and potentially even more. All the wasted space could allow for water detention to slow the impact on a cities stormwater collection in mass rain events or if the equivalent of new tree for a cities ecosystem could be created without needing a specific location and spacing for it would be beneficial to all cities, communities, and overall the environment.

Emphasis

This project will have an emphasis on stormwater management, sustainable technologies, and native plantings to allow for optimal effectiveness of the roof interventions chosen for the concept of the site. The focus on stormwater management is a key component of the use of roof interventions whether it be for water collection and storage for a short time or the slow of impact to streets from filtering through plant material before entering into the cities stormwater drainage system. Sustainable technologies and materials will be a focus in the concept of construction and maintenance of the buildings that will have an effect on the overall outcome of cost and upkeep the building needs in terms of efficiency and environmental impacts. Native plantings will allow for the life of the roof intervention chosen to continue to grow with a high chance of plant survival due to plants being used to the climate of the region.

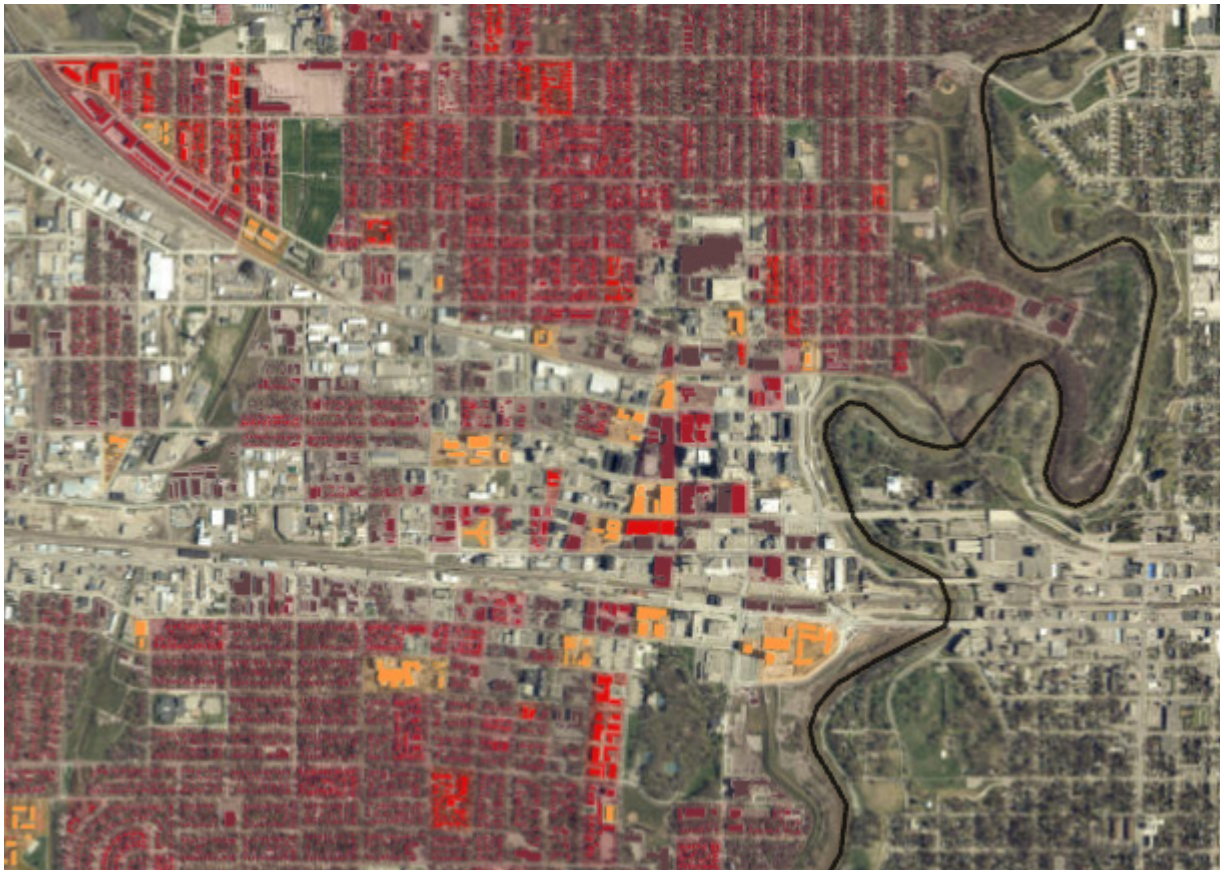
Project Elements

The project elements that need to be included in any roof intervention are protection from wind uplift, fire retardation, maintenance connection, water barrier application, and load bearing buildings. There are elements that are more specific to the type of intervention. For amenity decks, access for non maintenance persons, building edge safety, multiple seating areas, and walkable paths on the rooftop are the key elements for the specific intervention. Green roofs need extra elements for structural protection from roots as well as having heavier material layers on top of a building. Blue roofs have an element for water collection/detention as well as the mass elements needed for all interventions.

Audience Description

The audience for this project would be city planning and engineers for the implementation of the plan across a city wide basis, and commercial and residential building owners for the inclusion of the interventions on their rooftops.

Site Context



The site selection was based on how many different types of roofs were in a given area as well as the population density of different areas around the Fargo, West Fargo, ND and Moorhead, Dilworth, MN area since they are a close connecting set of cities. The data was taken through personal analysis of visiting different locations as well as using ArcGIS to view population density throughout the Fargo-Moorhead Metropolitan Area. The site chosen is in Fargo, North Dakota which is in the upper midwest region of the United States. The site will be in the Downtown district of Fargo. It was chosen from the broad building and roof types, as well as the high population density and the different residents and businesses that could implement a roof intervention.

Goals

- Manage Stormwater
- City Codes & Ordinances Abided
- Sustainable Technologies & Materials
- Commercial & Residential Future City Implementation Plan
- Energy Efficiency Growth

Plan for Proceeding

Research Direction

Using quantitative and case study research strategies, research will be conducted to contemplate the site analysis, context, and elements throughout the project. An in-depth ArcGIS analysis will be completed to decide which buildings are capable of housing a roof intervention, as well as be a key research component for native plantings in the perspective climate. Case studies and design journals will be used towards the prospective concept plans.

Design Methodology

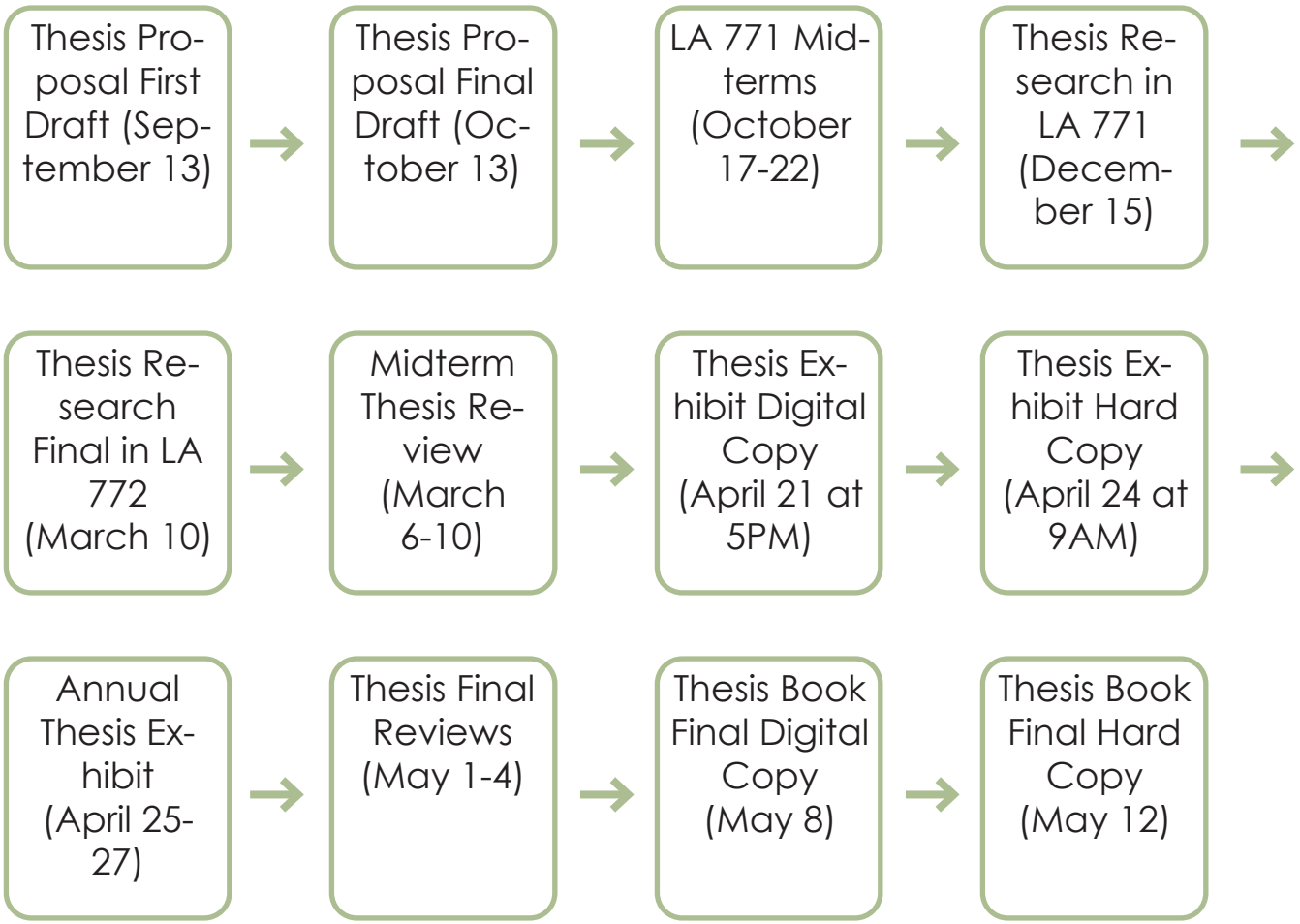
A mixed-method of research will be used in the form of quantitative research and case studies.

Process Documentation

Keep a bi-weekly schedule of scanning and documenting research, concepts, and graphics throughout the project. Keep backup external hard drive files up to date as well as OneDrive syncing capabilities for low possibility of lost work. The thesis book and boards will be documented once completed and stored in the NDSU library archives for future review. The presentation will be an in-person presentation at the end of the Spring 2023 term.

Plan for Proceeding

Timeline



Performance

Case Study Matrix

Case Study	Stormwater Management	Short Plant Root Depth	Wildlife Attractive	Accessibility: Physical/Visual	Awarded	Water Storage	System Type	Maintenance Level
Vancouver Convention Center	X	X		X	X		Semi-Intensive	Medium
Chicago Plant Conservation Science Center	X	X		X	X	X	Extensive	Low
ASLA Headquarters		X	X	X	X	X	Semi-Intensive	Medium
Minneapolis Central Library	X	X		X	X	X	Extensive	Low

Performance

Building Energy Consumption

Using data collected from energy modeling of a study house from a past Architecture project completed by fellow classmates. An early view on the effects of green roofs was established for relative plans in future research through the evaluation of current energy consumption of buildings in downtown Fargo with a connection to the city skywalk system that have the capability of a direct physical connection or a visual connection. Current energy data from the buildings will be able to give a before and after of how the designed green roof affected buildings in the study.

Baseline House

Energy Use Intensity(EUI): 184

Annual Cost (USD/SF/YR): $3.60

SIPS

Energy Use Intensity(EUI): 180

Annual Cost (USD/SF/YR): $3.53

ICF

Energy Use Intensity(EUI): 188

Annual Cost (USD/SF/YR): $3.66

Block/Mass

Energy Use Intensity(EUI): 166

Annual Cost (USD/SF/YR): $3.36

SIPS w/ Green Roof

Energy Use Intensity(EUI): 129

Annual Cost (USD/SF/YR): $2.68

ICF w/ Green Roof

Energy Use Intensity(EUI): 134

Annual Cost (USD/SF/YR): $2.77

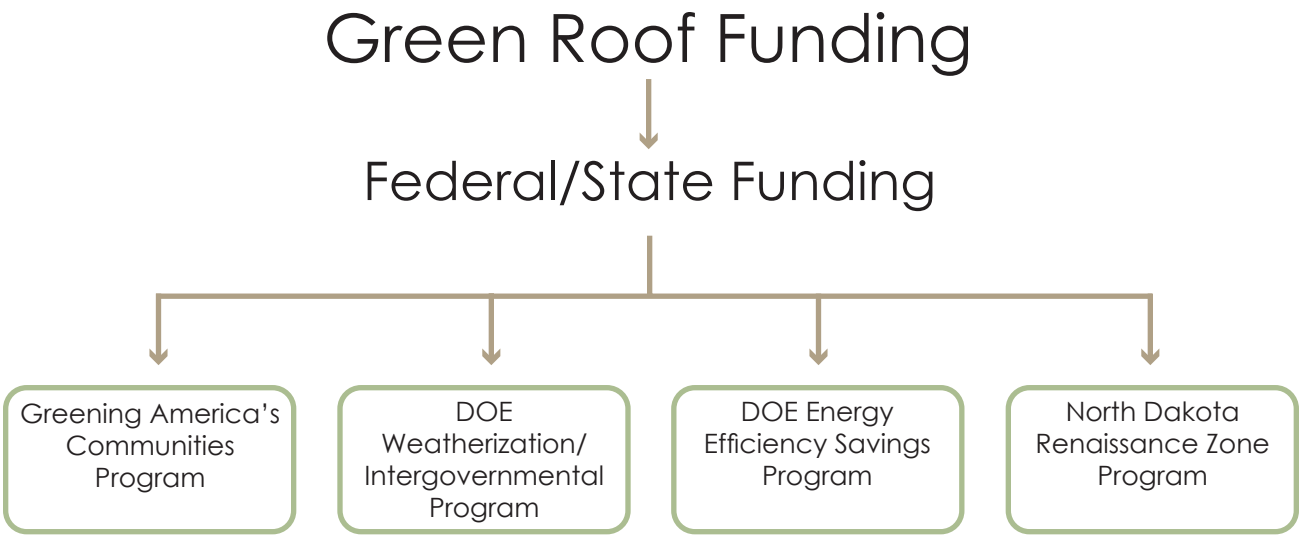
Block/Mass w/ Green Roof

Energy Use Intensity(EUI): 166

Annual Cost (USD/SF/YR): $3.34

Dissemination

There is continually more funding for green roof implementation each year. The U.S. EPA has opportunities for Federal Funding for green infrastructure projects and plans. For green roofs in a city environment, the "EPA Office of Sustainable Communities Greening America's Communities Program" is a great opportunity for funding for the downtown Fargo site location and context. The Greening America's Communities Program is aimed to help implementation of environmentally friendly neighborhoods with the incorporation of green infrastructure and sustainable design through a team of designers to guide the ideas. The DOE Weatherization and Intergovernmental Program is a funding opportunity that aims to provide grants and assistance to places and people that are encouraging of the implementation of green infrastructure, especially green roofs for a form of weatherization. The DOE Energy Efficiency Savings program can be implemented into projects design for private company and building owners to claim tax incentives and rebates for having a green roof, or any form of green infrastructure. The North Dakota Renaissance Zone Program is a tax incentive program to encourage revitalization of communities in ND.



Results

The intended results to come from my research is first to identify key factors that current built green roofs have that worked well and find what didn't, so that those features could be implemented or improved through my design. The energy consumption is used to view the factual evidence of the green roof design being implemented in a roof plan. That data will show how much energy use intensity is used during the year and how much the buildings energy use will cost per square foot per year.

Thesis Reflection

During this project there has been a significant amount of growth and progression from start to finish. Just like any project there are aspects that we like and aspects that we continually want to change. At the beginning of this project I knew I wanted to create a green roof but I had no idea that I would end up coming up with a plan for a system of green roofs.

For me the hardest thing I encountered was how I was going to make them all relate to each other and flow nicely between all the rooftops. The research was interesting to me in what types of drainage and what thicknesses are needed for all different typologies of green roofs. If I had to repeat this project or continue it further I would like to determine the types of planting material that would be beneficial for a cold climate, shallow growing medium green roof. I also would have liked to create some signage options for better access to the skywalk system and green roofs for pedestrians to know that the parks are there for them to use.

Overall this project was very beneficial to me because I learned that I am interested in green infrastructure design for the benefit of cities and people in the community. This design topic is something that I strive to reach in my future at some point.