



Bringing Nature Indoors: Tetris Landscaping

A Thesis Design By: Rachel Borgert

Bringing Nature Indoors: Tetris Landscaping

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

By
Rachel Borgert

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

Primary Thesis Advisor
Anna Maria Visilia

North Dakota State University Libraries Addendum

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Secondary Thesis Advisor
Matthew Kirkwood

North Dakota State University Libraries Addendum

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LIST OF CONTENTS:

	Signature Page.....	x
	Table of Contents.....	xx
	List of Tables and Figures.....	xxx
Proposal	<hr/>	
	Thesis Abstract.....	01
	The Narrative of the Theoretical Aspect of the Thesis	02-03
	The Project Typology	04
	The Typological Research	#
	Ford Foundation for Social Justice HQ.....	06-09
	Hotel Jakarta.....	10-13
	Jaguar Land Rover Living Wall.....	14-17
	Major Project Elements.....	18
	User/Client Description	19
	The Site	20-23
	The Project Emphasis	24
	Goals of the Thesis Project	25
	A Plan for Proceeding	26-27
Program	<hr/>	
	Research Results.....	28
	Literature Review.....	30-39
	Project Justification.....	40-42
	Historical, Social & Physical Context.....	43
	Site Analysis.....	44-47
	Performance Criteria.....	48-49
Process Documentation	<hr/>	
	Design Concept	50
	Application of Results.....	51
	Statements	52
	Design Development.....	54-55
	Project Solution Documentation	53
	Digital Presentation.....	#
	Educational Design.....	56-57
	Therapeutic Design.....	58-59
	Work/Social Design.....	60-61
	Performance Analysis.....	62-65
Appendix	<hr/>	
	Reference List	66-68
	Previous Design Studio Experience	69
	Personal Identification.....	70

LIST OF TABLES AND FIGURES:

Page(s)	Description Credit
(cover)	Photograph Rachel Borgert
ii	xx xx

Proposal

05	Web Image Unknown
06	Project Location New York Yimby
07	Overhead View of Atrium Raymond Jungle
08	Overlay and Spacial Analysis New York Yimby
09	Image of Ford Foundation for Social Justice HQ Atrium Raymond Jungle
10	Image of Hotel Jakarta Courtyard ArchDaily
11	Overhead View of Courtyard ArchDaily
12	Sections Through Hotel Jakarta ArchDaily
13	Image of Courtyard ArchDaily
14	Image of Jaguar Land Rover Living Wall Scotscape Smartscape
15	Image of Green Wall Display at Geneva Auto Show & Module system ANS Group
16	Graphic Design of Living Wall Scotscape Smartscape
17	Image of Jaguar Land Rover Living Wall Scotscape Smartscape
20	Graphic of Site
22	Google Earth Images
29	???

Program

44	Site Plan SDK Architects
44	Sun Path Image Unknown
44	Site Image Google Earth
44	Land Development Graphic Rachel Borgert, Illustrator
45	Site Images Kaia Erickson
45	Proposed Sunroom Additon Location Rachel Borgert, Illustrator
46	Site Images Kaia Erickson
47	Floor Plans SDK Architects
48-49	NASA Study Graphics Inspiration Bored Panda

Process Documentation

50	Tetris Blocks
51	Modular System Graphics
54-55	Design Themes Graphics
56-61	Digital Work
62-63	Master Plans/Planting Plan
65	Alternative Variations of Design

THESIS ABSTRACT:

According to the Environmental Protection Agency (EPA), the average American spends 93% of their life indoors. Almost 70% of which is at home. By being indoors there is a greater chance of being exposed to higher concentrations of airborne pollutants, commonly found in indoor atmospheres. With an increase in people working from home, homeschooling their kids and spending limited time outdoors throughout the year it has caused a negative impact on their mental and physical well-being.

NASA conducted a study on indoor plants and how they eliminate indoor air pollutants called Volatile Organic Compounds (VOCs) in the atmosphere. Based off this study calculations were made on the number of plants necessary to filter out and eliminate air pollutants. Utilizing the plants in the study to design an interior landscape modular system that can be a dynamic addition to a residential house. With tetris like modules that can be arranged to create an educational interior landscape for homeschoolers, a work interior landscape for those working from home or a therapeutic interior landscape all year round. Whatever the resident desires.

This thesis is a proposal to design a residential interior landscape that will promote physical and mental well-being to those who experience it.

THE NARRATIVE OF THE THEORETICAL ASPECT OF THE THESIS:

It's no secret that people find nature to be serene and visually pleasing, so it only makes sense to bring that tranquility inside. Using artistic designs and arrangements of living plants, the interior landscape can create a natural, feel-good environment that appeals to the senses while adding aesthetic value to your space. The interior landscape will bring the experiences of nature into the built environment; through living walls, water features, raised planters, inground plantings, using natural and man-made materials.

A healthy home environment is vital to a person's well-being and house plants contribute to it more than you think. The research for this thesis is based on the NASA Clear Air Study on indoor plants and their ability to purify the air. NASA conducted a Clean Air Study in association with Associated Landscape Contractors of America, in an effort to find the most effective common indoor plants for filtering harmful toxins and pollutants from the air like: benzene, formaldehyde, trichloroethylene, xylene and ammonia from our surroundings-chemicals that have been linked to adverse health effects like headaches, dizziness, eye irritation and others. It is important to ensure that air quality is of high standard, something that regular house plants can help achieve. (BoredPanda, 2019)

According to the research results the florist's chrysanthemum and the peace lily are the best plants for purifying the air. NASA also recommended to have at least one plant per 100 square feet. (Wolverton, 1989)

The motivation for this research project comes from the desire to create a space in a residential house that promotes cleaner air and seeks to improve mental well being of the residents and those utilizing the space.

The goal of this research is to identify which plants are best to incorporate into the interior landscape design that promotes the highest benefit of cleaner air. Using the recommendations from the NASA study of one plant per 100 square footage of space. To create a space that promotes physical well-being through the breathing of cleaner of air.

The anticipated findings from this research are that well designed interior landscape themes that are based on the needs of the residents. That also can allow for a dynamic design that can change and develop over time.

The research will ultimately show the need for interior landscapes in residential houses and utilizing the modular components and design elements that make it easier for residents to incorporate and interior landscape into their own houses, so they too can gain the physical and mental benefits of the space.

PROJECT TYPOLOGY:

PROJECT ELEMENTS

The proposed design will be an interior landscape that improves physical and mental wellbeing, through five design elements; water feature, living wall, patio, inground planting and raised planter. These design elements will be combined to form the interior landscape that promotes physical and mental wellbeing.

Physical: Including plants into the interior landscape design enhances the indoor air quality by removing toxins and filtering air. Utilizing the research results found in the NASA clean air study and the best interior plants in that study to purify the air.

Mental: Being surrounded by nature reduces stress, increases productivity, and generates happiness in people. Through creating three themes that will utilize the five design elements into the interior landscapes. The three themes are: Therapeutic interior landscape used for relaxing and restoration, an Educational interior landscape design used for learning and playing, and the last theme is a mix use interior landscape utilized for work and social needs.



CASE STUDY:

FORD FOUNTAIN CENTER FOR SOCIAL JUSTICE HQ

New York City, NY

The Ford Fountain Center for Social Justice's headquarters is a historic landmark in New York City designed by Kevin Roche John Dinkeloo and Associates in 1967. The building contains an interior landscape in the form of an atrium. The Atrium is the building's signature feature. It is a twelve-story, 5,290-square foot, 160-foot high, glass walled atrium open to the public. The Atrium's garden initially designed by Dan Kiley, was the first atrium of its kind in the United States. The atrium's environment consists of over 40 trees, 1,000 shrubs, and 22,000 vines and ground cover. Dan Kiley used the plant's bloom sequence to mimic nature and seasonality. The understory provided color, fragrance, and texture. The main tree species were magnolia, Eucalyptus and Cryptomeria, chosen for their presence and form. Jacaranda and Pyrus were used to enhance the space through color and texture. The ferns and grasses were used to create patterns and dappled light on the forest floor. The plants were planted directly into the soil. (Jungles, 2020)

In 2015, The atrium went through a renovation due to the inherent challenges in the atrium, light requirements, extreme slopes, temperature, and humidity constraints, hindered the full success of the landscape over time. The renovation work was done by Raymond Jungles, Inc. (RJI). The team performed extensive analysis of the original plan and sought to combine Kiley's vision for the atrium with scientific innovation. As a result of the team's innovation, adaptability, and close collaboration during both the design and construction phases, the project was successful. The atrium today is again as Dan Kiley envisioned it.

PROJECT LOCATION



GROUND FLOOR PLAN

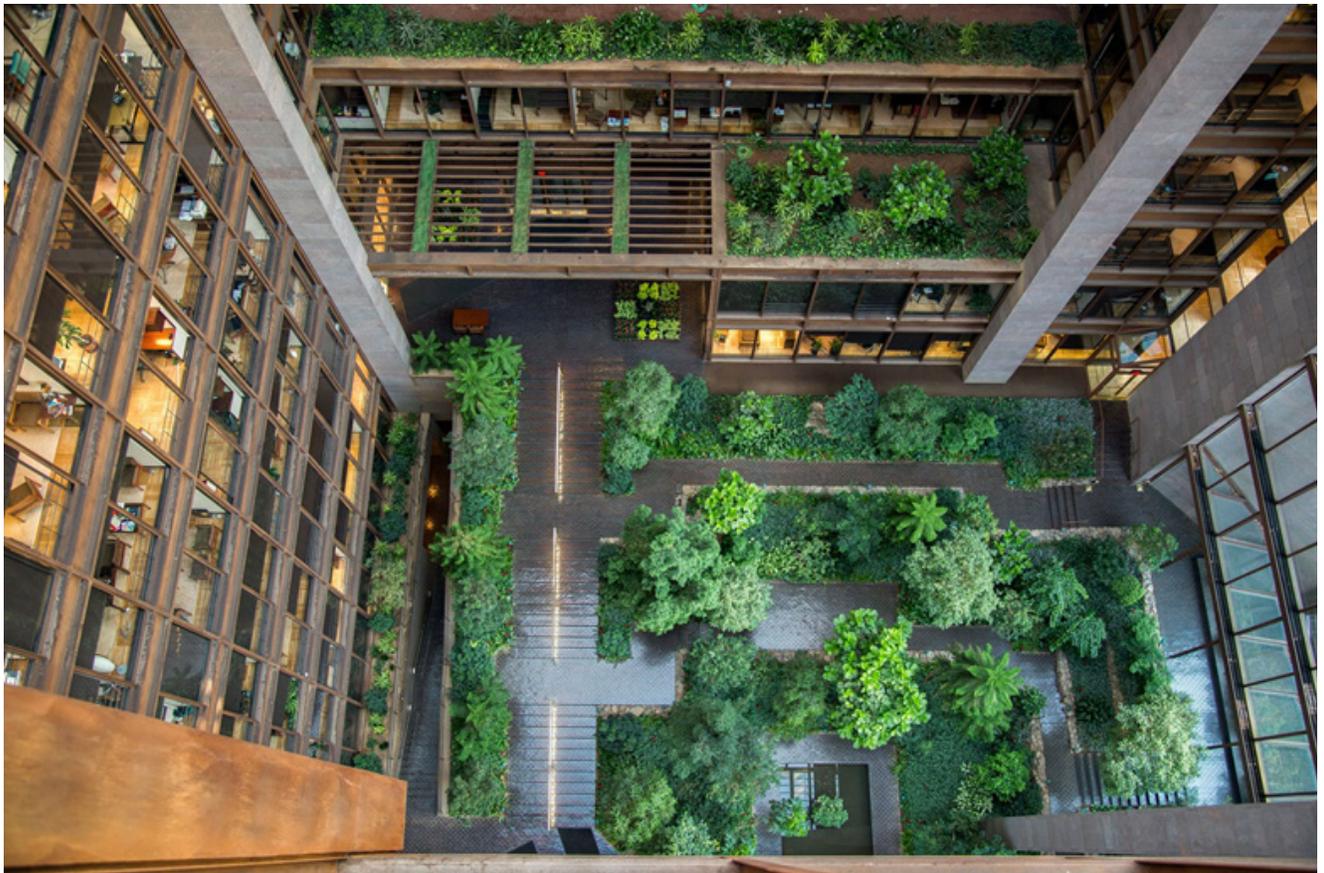


INTERIOR LANDMARK DESIGNATED AREA

Research Findings:

What the Atrium has in common with other interior landscapes is that it includes an array of plants, a water feature and walking paths within the design. In addition to its being a glass walled atrium, common in the construction of atriums. In architecture, an atrium (plural: atria or atriums) is a large open-air or skylight covered space surrounded by a building. So, this atrium is no different than other atriums in how it is constructed. But what make it uncommon is that it was designed and then renovated with adaptations and innovativeness to ensure the survival and prosperity of the landscape within. The thirteen-foot grade change from 42nd to 43rd street. To best accommodate this dramatic change, Kiley's design provided pathways at three levels and stairways which served as a throughway. With all the plants being planted inground. In addition to being the first atrium of its kind in the United States.

The landscaped atrium of the Ford Foundation Building is one of the most successful and admired interior spaces in a modern building created in New York City after WWII. (Docomomo US, 2020). The Ford Foundation and its architects offered New York an alternative model for modern office buildings with a lush landscaped full-height atrium that occupies most of the building, a botanical garden in the heart of Midtown. With the atrium's purpose being more than a headquarters, the center is a vibrant, accessible hub for champions of a just society. In other words, a place for both the public and office workers to go to interact and come together. Both as a social space and an office like workspace.



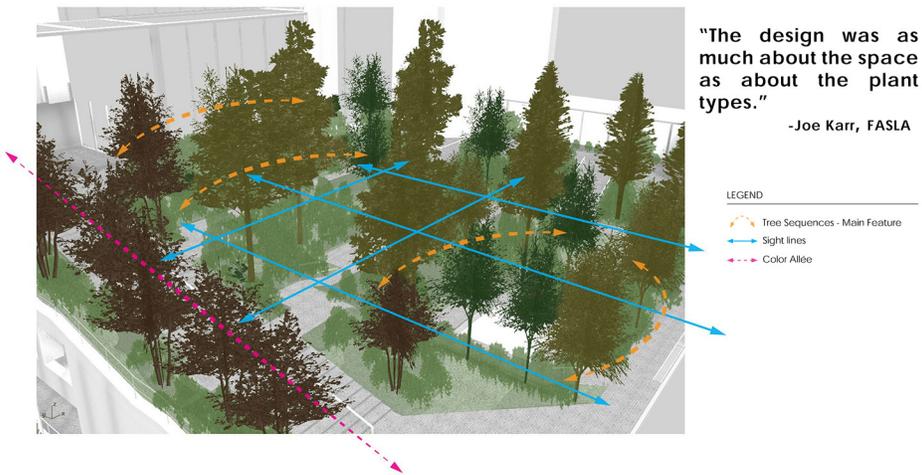
Analysis:

The failure of the original design was due to the harsh environmental conditions within the building. The new renovations remediated those issues. The materials used in the design is an equal balance of both natural and man-made. Utilizing technology and innovation. The landmarked garden atrium was restored to its original Dan Kiley aesthetic while incorporating a new brick pathway to improve wheelchair access and allow for more inclusive circulation, and a touch-and-smell loggia garden with Braille totem signage for the visually impaired. (Docomomo US, 2020)

OVERLAY ANALYSIS SECTION

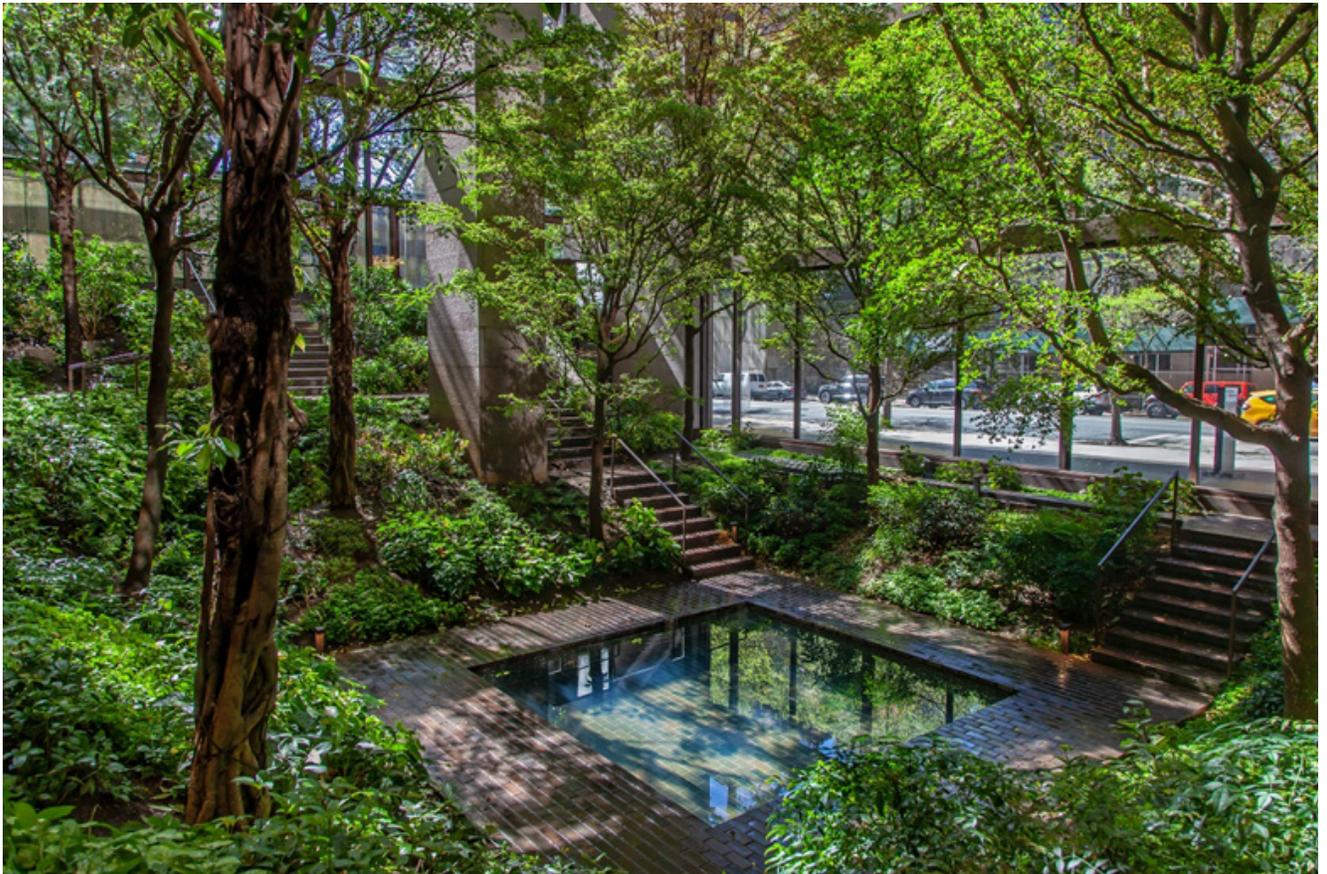


SPATIAL ANALYSIS



Conclusion:

The Atrium at the Ford Fountain Center for Social Justice's headquarters in New York City, NYC, is an excellent example of an interior design that is one of the most successful and admired interior spaces. Starting from a failing design that was renovated to become a success. With multiple adaptations and innovations that had a twofold effect to promote the benefit of the nature environment within the atrium and the benefit of those who experience it. A space to go to interact with others on a social level and to use for those working in the building.



CASE STUDY:

HOTEL JAKARTA

Amsterdam, The Neverlands

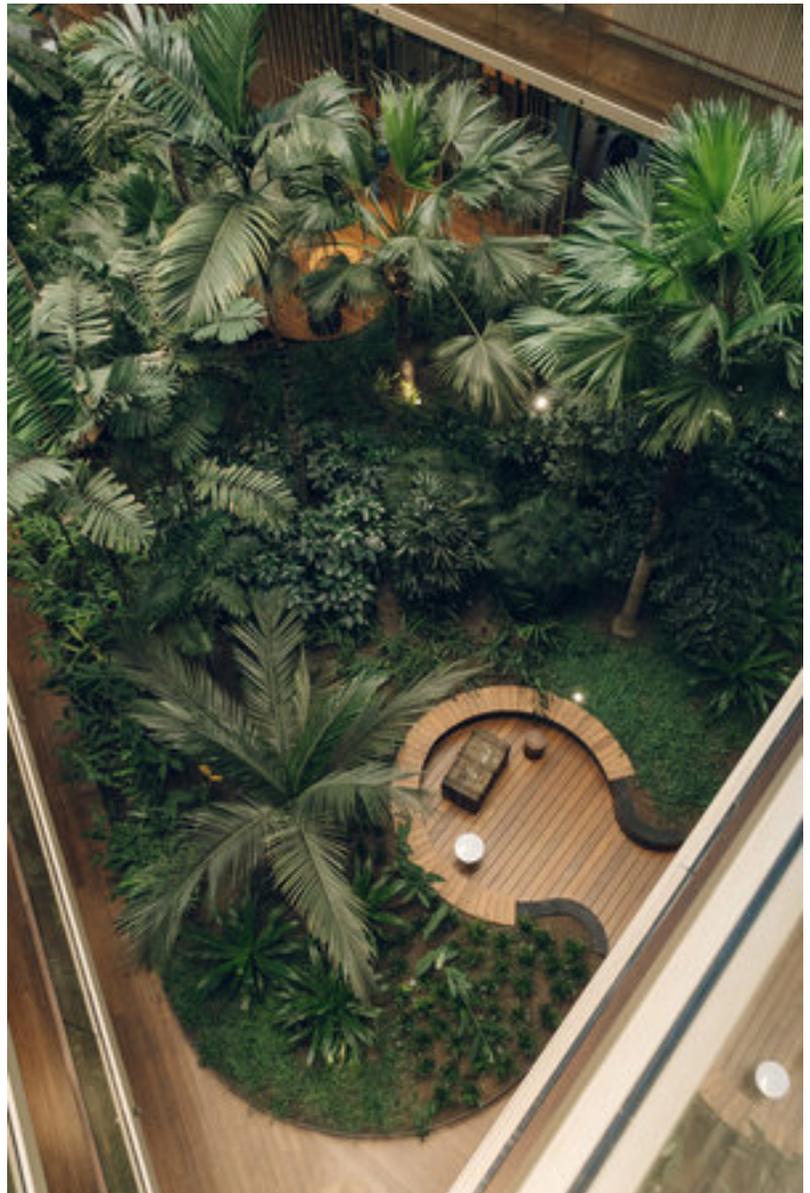
The Hotel Jakarta is an Indonesian-inspired hotel located at the very tip of Java Island in Amsterdam with an indoor subtropical jungle at the heart of the hotel, designed by SeARCH architects and urban planning from Amsterdam. The subtropical garden is a courtyard that is incorporated into the hotel which symbolize the historic maritime connection between Amsterdam and Asia. With the courtyard consisting of a selection of Asian trees, palms, and plants; like meters-high palms, banana trees, climbing plants, flowers and all kinds of other flora. With all the plantings within raised planting beds, in addition to patio/deck like space and walkways. (Caballero, 2020) The design and maintenance of the subtropical garden is a result of a collaboration with the Hortus Botanicus. The 4-star hotel houses a dynamic public space with various bars, restaurants, coffee corners, a wellness center and cultural activities, all built around the central subtropical garden.



Research Findings:

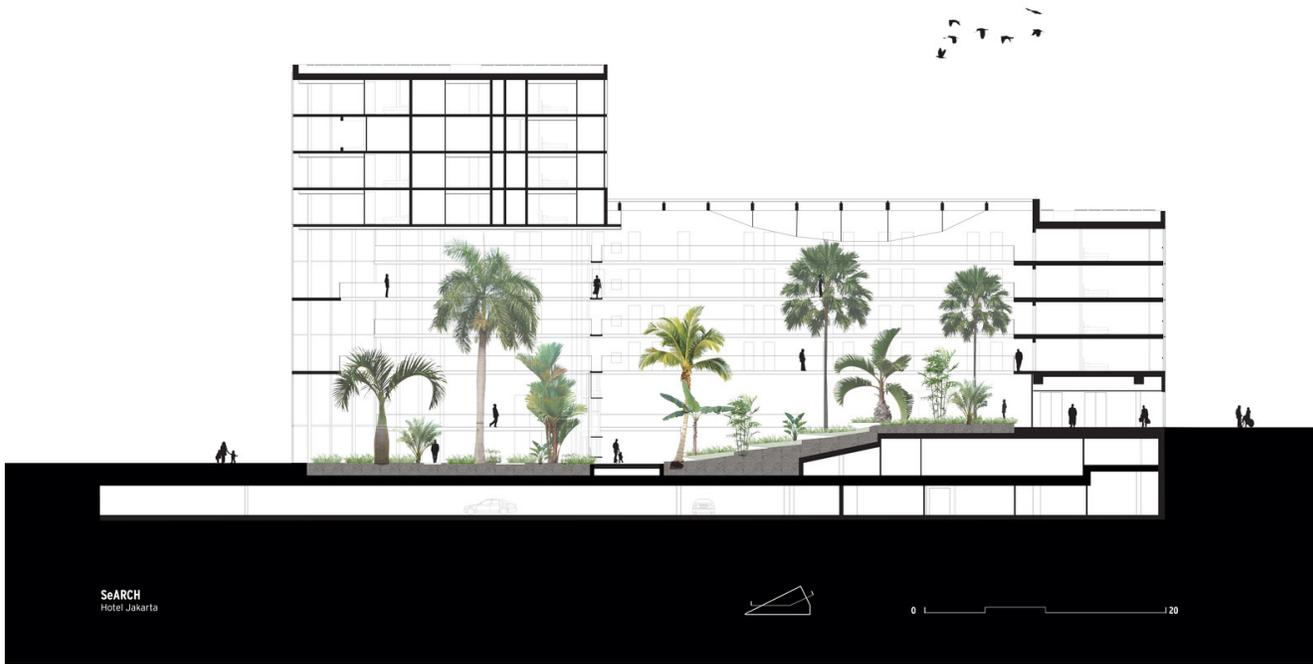
What the Hotel Jakarta has in common with other interior landscapes is that it includes a variety of vegetation, walking paths, raised plantings, and deck/patio space. But what make it uncommon is that the whole design of the landscaping is focused on sustainability. Rainwater collected from the roof is used to water the plants. The courtyard is in the center of the hotel to act as a temperature regulator in both summer and winter. Most of the materials used in the design of the courtyard and hotel are pure: wood, steel, and glass. Manly natural material locally sourced.

In addition to the sustainability, the tropical covered indoor garden is literally be the heart of the hotel. Usually, courtyard gardens are the final element of a design, more like the green feature of a building. That's not the case here, the designers started with the garden and constructed the building around it. Making the courtyard uncommon and unique. (Cosentino, 2021)



Analysis:

Hotel Jakarta Amsterdam is the most sustainable hotel in the Netherlands, with its transparent and glass facades and unique thirty-meter high wooden main structure. Light floods in from the central skylight into the courtyard. The wooden construction, bamboo, subtropical plants and glass provide a spectacular warm atmosphere. The basic structures and natural elements also appear in the restaurant, bar and in the rooms. (WestCord, 2019) The whole design is natural with the materials in the design being all natural and pure.



Conclusion:

The courtyard Hotel Jakarta in Amsterdam, is an example of an interior design that is both sustainable and multi-purpose that has dual benefits both for those who interact with the courtyard when they are staying at the hotel as a form of relaxation and socializing but also as a sustainable design that began the idea of the hotel in the first place. The courtyard is a great example of an interior landscape that is designed as a raised garden. A place for relaxation and restoration within the hotel. The building and courtyard radiate tranquility and wellness, a therapeutic garden.



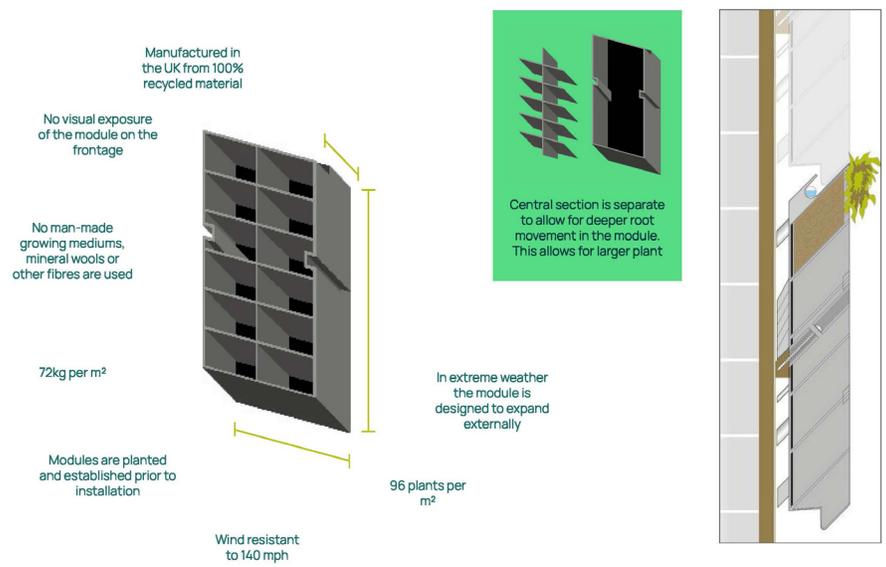
CASE STUDY: JAGUAR LAND ROVER LIVING WALL DESIGN Sainsbury on Thames

The Jaguar Land Rover Green Wall is a 645.84 square foot living wall installed in 2020 by the Scotscape Smartscape team for the Sytner Group in the new showroom for Jaguar Land Rover in Sunbury on Thames in Munich. The wall holds 2,940 plants - bringing the power of nature straight into the heart of this building. The 'wave' design includes species known to reduced particulate matter in the air and reduce harmful VOC's, including peace lilies, Bird's nest fern, and Chinese evergreens. There were 11 different varieties of plants selected in the living wall design. (Scotscape, 2020)



Jaguar Land Rover took their green credentials a step further by using a beautiful living wall designed by ANS Global, as part of their state-of-the-art auto show stand at this year's Geneva Auto Show. Every year the major car manufacturers unveil their latest creations at a series of extravagant car shows around the world. The green wall display for the Geneva Auto Show convention measures around 16 feet wide by 8-foot-high, was on display in Geneva for a few months then dismantled and all the plants replanted in the local area. The modules and irrigation are then reassembled in Paris and then restocked with a selection of plant-life chosen for their ability to withstand the interior exhibition environment, with its bright lights, masses of people and air-conditioning. Once the show is over, the plants are donated to local charities and then the show moves on to its next international destination.

System - Module



Research Findings:

What the Jaguar Land Rover Green Wall has in common with other interior landscapes and living walls is that it includes a diversity of vegetation, and adds greenery indoors, but what make it uncommon is that the living wall is a modular system that is uses Fytotextile® modules that can be made to be disassembled and reassembled and transferred from place to place.

Also the living wall was designed for a twofold purpose to incorporate plants into the building through creating a healthy space and help to reduce acoustics in the large space to bring a sense of calm, since living walls absorb noise, and give staff and customers a sense of tranquility. It is also used as a marketing means to reinforce the positive impact the Jaguar Land Rover has on the environment.



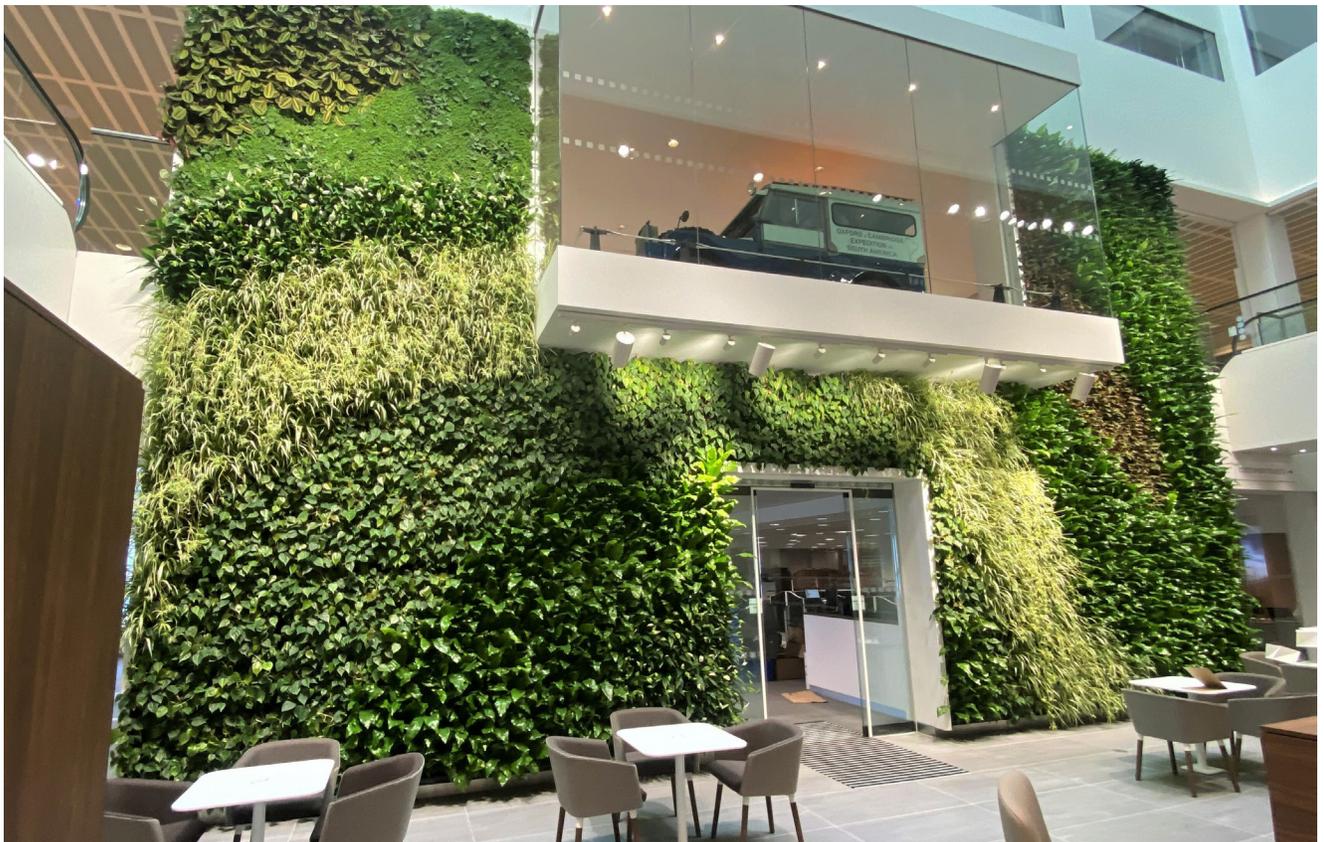
Analysis:

In the design for the Land Rover Display the plant selection is specifically chosen for their air filtering ability and promote a healthier indoor space. With the modular system allowing the living wall to be incorporated into any indoor space. ANS Group's green walls illustrate that intent that there are many ecological and environmental advantages of green walls and since independent research tells us that rich interior planting such as living walls gives visitors the impression of success, comfort and class.

Research also suggests that extensive planting, such as the interior green wall, can reduce tension and anxiety levels by as much as 37%, fatigue by a similar level, anger and hostility by 44% and depression by 58%. Those are dramatic improvements in employee wellbeing which can lead to better communication, better team working, better performance and productivity and - through increased feelings of satisfaction - lower staff turnover. (ANS Group, 2021)

Conclusion:

Including a living wall indoors has countless benefits including, but not limited to; creating a healthy space, aesthetics, help to reduce acoustics in the large space, bring a sense of calm and tranquility to those who experience it and be able to be dismantled and reassembled at will. The living wall display for the Jaguar Land Rover in Sunbury on Thames in Munich, is an example of an interior design that has utilized all those benefits and more, a living wall design with unlimited potential, environmentally, socially, and economically. For staff, costumers, and marketing means.



MAJOR PROJECT ELEMENTS:

The general project elements that will be incorporated into the interior landscape will include:

- 1. Living Walls/Vertical Gardens:** These green installations are planted upright for aesthetic, environmental, and space saving purposes. Incorporate hydroponics, drip irrigation, climbing plants. They will be functional, highly customizable and tailored to the building's needs and personal preference to the design.
- 2. Water Feature:** Water features will be incorporated into the interior landscape elements, as an attractive addition to the building. Plants also absorb sound; therefore, background noise in the building can be reduced. Being replaced with a soothing relaxing sound of water. Experiencing the indoors like it was outdoors.
- 3. Patio:** An open space that can be multi-purpose and allow for movable furniture to be used for work, relaxing, socializing and many other resident needs. It is a space that can be made using pavers, laminate wood, stone, and other materials, depending on the design and needs
- 4. Inground Planting:** Allows plants to be planted directly into the ground but indoors instead of outdoors. Creating a space that is more immersive into nature. To allow those experience the space, benefit from the natural state of the vegetation and encourage plants to prosper.
- 5. Raised Planters:** Allows plants to be elevated and easily accessible to those who are limited physically. Allowing them to interact with nature and maintain the plants with ease. Also, it creates a more formal look and define separation between the path and the bed space. Easily maintainable and the raised beds can be built out of a variety of materials depending on the design and the needs of the residents.

USER /CLIENT DESCRIPTION:

The interior landscape will be for the private use of the residence of the house where the interior landscape addition will be incorporated onto. The space will be utilized by people of all ages and abilities. There will be three themes that the space of the interior design can follow. The use of the space will be represented by the theme.

The first theme is a therapeutic interior landscape which will function as a place to encourage relaxation and restoration. Those utilizing the space will be surrounded in a natural, plant-dominated environment purposefully designed to facilitate interaction with the healing elements of nature. Interactions can be passive or active depending on the garden design and users' needs. Sensory gardens, healing gardens, meditative garden and restorative gardens are different types of variations to the therapeutic design.

The second design theme is an educational interior garden that is utilized by children as a place to learn, interact with nature, encourage exploring and indoor gardening. The users can use the space as a place for learning through homeschooling. The space can be an excellent tool to teach children about biology, life cycles, and sustainable farming in addition to many other options since the space will be a mix use space that is flexible and can adapt to the needs of the users. Through formal and informal learning activities.

The third design theme is a multi-use space that can be utilized as a space to work during the day and in the evening, it can be used as a social gathering space. For those working at home, indoor plants have also been proven to have a calming influence, yielding a higher concentration while performing tasks. To take a break and allow their creativity to come to the forefront. The homeowners can use the space to bring guests into and socialize, having furniture to promote and encourage conversations and interactions.

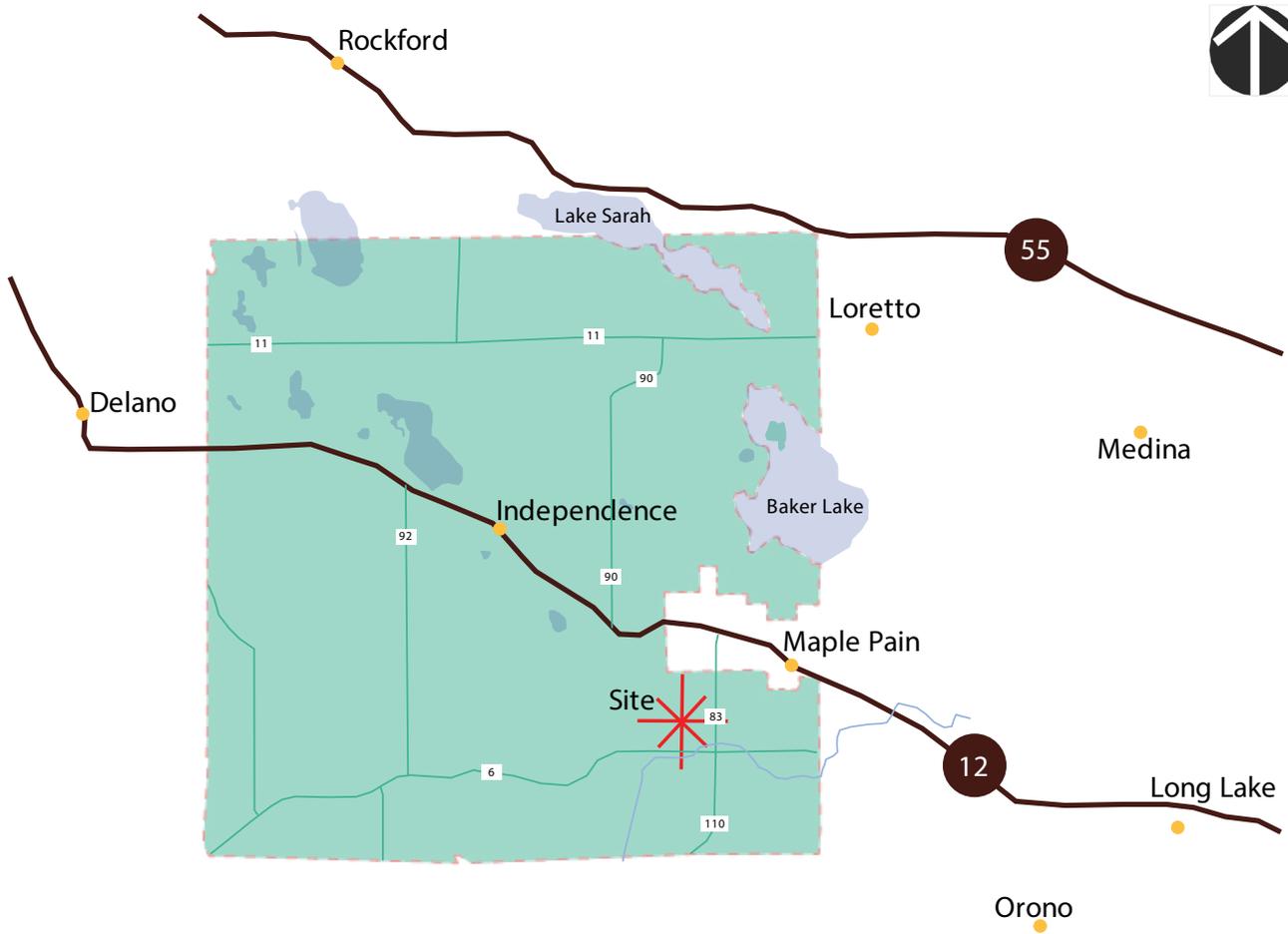
SITE INFORMATION:

Region & City

REGION:



CITY:



Why is this specific site appropriate for the proposed project?

REGION: Midwestern United States.

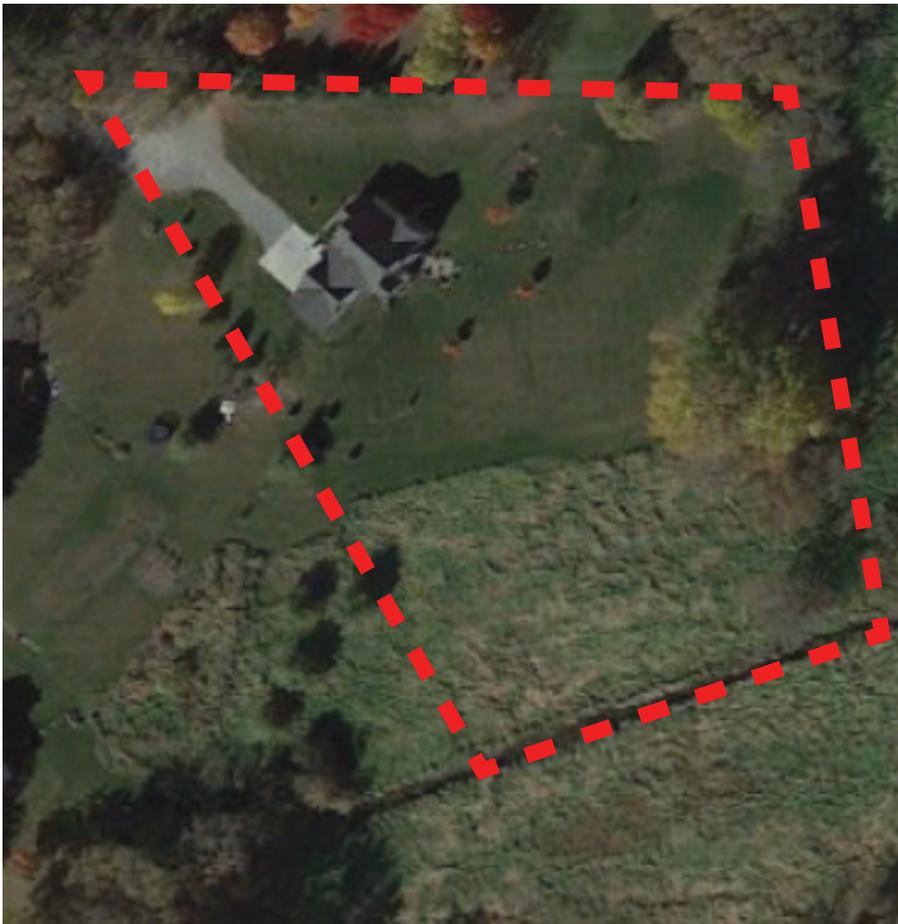
Minnesota, located in the Mid-West, is the appropriate for the proposed project because of the cold climate. Due to the low winter temperatures, outdoor social activity ends once the temperature dips, encouraging people to be indoors more and be separated by nature. With everyone being in doors there is a higher potential to getting sick and ex-posed to VOC that negatively effect a person's health. Coupled with the fact that flu sea-son occurs in the fall and winter during the time people tend to be indoors due to the colder weather.

CITY: Independence, Minnesota

Independence, Minnesota is a humble city located in Hennepin county and offers the advantages of rural lifestyles to its residents even though it is within the Twin Cities Metropolitan District. As of the census of 2000, there were 3,236 people, 1,088 households, and 908 families residing in the city. The average household size was 2.97 and the average family size was 3.25. The median income for a household in the city was \$79,126, and the median income for a family was \$82,143. So, the city is an average city that serves as a general basis for the interior landscape addition proposed in this thesis.

SITE INFORMATION:

Site Location



Why is this specific site appropriate for the proposed project?

SITE: Is a 3.3 acre property located in the rural country side of Independence, Minnesota. U.S. Highway 12 serves as a main route in the community. Independence is located 24 miles west of Minneapolis, Minnesota. Independence is a “gem” of a rural city in the heart of an exploding metropolis. It’s dotted with pretty, little farms, lovely and unique homes, attractive churches, lakes, ponds, rolling hills, wetlands and large wooded areas. Two major Three River Parks- Rebecca and Baker - can be accessed directly from Independence.

The site is an average site that serves as a basis for the interior landscape addition proposed in this thesis. The house is a residential house, that is on a minimum of one-acre plot of land and satisfies the building permits of the area for an addition of this kind to the existing house. Any site could be used for the interior landscape addition as long as it meets the requirements for the addition.

- The house is a residential house
- On a minimum of one-acre plot of land
- The addition is approved by building permits of the area
- The location of the addition is to be facing Southeast, or of the like that allows adequate amount of sunlight

The site was selected because it meets these requirements and I am familiar with the owners and the site itself.

PROJECT EMPHASIS:

To design a residential interior landscape that will promote the physical and mental well-being to those who experience it.

To promote the physical well-being through incorporating house plants, from the NASA study that purify the air, into the residential interior landscape design. To design a space that meets and exceeds the NASA clean air study recommendations to have at least 1 plant per 100 square feet.

To promote the mental well-being through the use of three themes for designing the residential space: a therapeutic interior landscape, an educational interior landscape, and a work/social interior landscape design. In identifying the activities/elements used within each design theme and the benefits they promote for each theme to those who experience them. For example, creating a space that is predominantly plants and the materials utilized in the design are all-natural materials like wood, stone, soil. The design would encourage a calming healing experience needed for a therapeutic garden. In contrary to a design that is partially plants and prefabricated materials like, metal, concrete, and synthetic. Leading to a more formal design that intent is to promote focus on work and gathering spaces to socialize. The five elements in the design the garden beds, vertical gardens, water features, etc. will be used to enhance upon project emphases to promote the physical and mental well-being to those who experience the residential interior landscape.

GOALS OF THE THESIS PROJECT:

Physical Goals:

1. To design an ideal Indoor landscaping that provides both physical and mental health benefits to those who experience it.
2. To design an environment indoors that can be dynamic in a modular system that residents can incorporate into their own homes and when proven successful it can be incorporated into businesses, offices, restaurants, churches, and any other form of building that meets the necessary qualifications for the addition.

Theoretical Goals:

1. To design a space that meets and exceeds the NASA clean air study recommendations to have at least 1 plant per 100 square feet.
2. To design themes that meet the needs of the residents that use them, to be a place they can go to be surrounded by nature indoors all year round.

Social Goals:

1. To design an interior landscape that brings people back to the outdoors and the importance of nature for their well-being physically and mentally.
2. To design a place that connects people together, individual or as a group, to celebrate nature and its numerous benefits.

PLAN FOR PROCEEDING:

DEFINATION OF RESEARCH DIRECTION

The Theoretical Premise/Unifying Idea:

To research the purpose and undefining ideas behind interior landscapes. The multiple advantages of interior plants within relation to human health and wellbeing.

Project Typology:

To research the interior landscapes, through various case studies and compare the project elements. Seeing what elements are common between them and what make them a successful interior landscape.

Historical Context:

To research the historical context and design principles behind interior landscapes. Which elements are necessary for interior landscapes? In addition to researching the patterns of designs and their purposes. In addressing the need for interior landscapes in relation to human health and wellbeing.

Site Analysis:

To conduct a Site Analysis to decern the ideal location for an interior residential landscape addition to an existing residential house. Allowing anyone to obtain their own interior landscape, a place where they can go that promotes their physical and mental well-being

Mixed Method Quantitative/Qualitative Analysis:

-Gathering and analyzing archived research pertaining to interior plants and the amount of particles removed from the air by plants, NASA research studies. In addition to research pertaining to studies conducted of the health benefits of interior landscapes, psychological and physical.

Graphic Analysis:

-Compiling the data into graphics (received from interviews and surveys) to analyze them and compare them. Looking into statistics of interior plants and the utility of them in the landscape.

Digital Analysis:

-Obtaining information from GIS and suitability analysis. In addition to a collection of measurements, analysis, visualization and interpretation of digital data from scholar journals.

Interviews:

-Conduct interviews to key members of the facility utilized for the interior landscape. In addition to gathering information through surveys and direct observation of facility.

RESEARCH RESULTS: RESEARCH METHODS

The results of my research and investigations into the theoretical premise of the thesis project is the design of an interior landscape that will be implemented into an existing residential house. This interior landscape intent is to promote the physical and psychological well-being of its residence. The implementation of the design will be in the form of module elements that will be designed in a way that can be connected to form a unified design interior landscape that will be able to be attached to an existing residential house.

This research is intended for architects and interior designers who are, or will be, designing spaces that be attached to the house, the architects discipline, and will include interior landscape elements, the interior designers discipline. Examples of these modular systems that will interconnect are: in-ground landscaping, raised planter, water feature, vertical wall and patio space. The research and critiques of literature pertaining to the thesis question: How to design an interior landscape that can encourage physical and psychological well-being to those who experience it?

LITERATURE REVIEW:

This literature review critiques and summarizes three texts which were integral to the research conducted. The question investigated was; How to design an interior landscape that can encourage physical and psychological well-being to those who experience it? The three texts were heavily relied upon for information, and, therefore, were analyzed beforehand to conclude that they were reliable, accurate texts.

Interior Green. By: Gina Phillips (1999)

The first text is Interior Green by Gina Phillips, a green industry veteran, with over 24 years in the business. She began her career in interior landscaping in downtown Chicago for Rentokil (now Ambius), then joined Environmental Care (now BrightView) in San Francisco. Her text was published in the Journal of Property Management in 1999 and it is about the role of plants inside office and residential buildings in improving indoor air quality. Incidence of indoor air pollution on sealed offices; Findings of the United States National Aeronautics and Space Administration on the effectiveness of indoor plants in cleaning indoor air; Effects of air quality on employees' ability and desire to work; How to care for indoor plants.

In this report the focus will be mainly on the role of plants inside offices and residential buildings in improving indoor air quality pertaining to the findings of the United States National Aeronautics and Space Administration on the effectiveness of indoor plants in cleaning indoor air and the effects of air quality on employees' ability and desire to work, moral.

As a whole; the text insightful into the science behind the study conducted with indoor plants and their effect on indoor air quality. In addition to the correlation between better air quality increase peoples' morale and productivity. In reviewing the text in reinforced and enhanced upon my understanding and knowledge of indoor plants and the positive effects they have physically and mentally. That said the text, since it was written as a simplified reference to the NASA study it lacked more of the in-depth science behind the plants involved in the study; the amount of air pollutants individual indoor plants filter out and which toxins they filter out

More of than others. I had to reference the original NASA study research report to fill in the gaps not mentioned in the text. The NASA research was used as a reasoning behind the correlation of moral of employees in relation to better air quality.

According to the text; the EPA, The United States Environmental Protection Agency, ranked indoor air pollution among the top five environmental risks to public health. Which isn't too surprising to read since Americans, on average, spend approximately 90 percent of their time indoors, where the concentrations of some pollutants are often 2 to 5 times higher than typical outdoor concentrations. Unless a house includes proper ventilation and adequate air exchange the concentration of pollutants will naturally increase. By implementing a natural solution to cleaning the polluted air inside residential houses and decreasing the toxicity buildup will in return encourage a healthier atmosphere for residence to live in which is exactly one of the goals in the thesis proposal. Using a nature-based solution and its role in increasing people's mental health and physical well-being.

Preliminary data on the ability of a group of common indoor plants to remove organic chemicals from indoor air was presented. The group of plants chosen in this study was determined by joint agreement between NASA and the Associated Landscape Contractors of America. The chemicals chosen in the study were benzene, trichloroethylene, and formaldehyde. These chemicals are commonly released from building materials, furniture, and carpeting, in addition to fumes from cleaning solvents; radon and second-hand smoke. All of which have adverse effects on the human health, especially ad high dosages.

In the initial NASA study, over a dozen varieties of common interior plants were placed in sealed, Plexiglas chambers. Formaldehyde, a toxic chemical with the greatest exposure to humans, was introduced. Within 24 hours, the plants-philodendron, spider plant, and golden pothos-removed 80 percent of the formaldehyde molecules from the chamber.

A quote from Dr. B. C. (Bill) Wolverton, a NASA scientist, believes that NASA's findings about indoor plants have some down-to-earth applications for cleaning dirty indoor air. He estimates that 15 to 20 golden pothos (*Epipremnum aureum*, *Scindapsus aureus*) and spider plants (*Chlorophytum comosum*) can clean and

LITERATURE REVIEW:

refresh the air when placed in an 1,800-square-foot home or office. Achieving similar results, two interior plants from the Dieffenbachia family used per 100 square feet of space, also help reduce air pollutants. I agree with him that indoor plants have some down-to-earth applications and that there are many things to consider in the plant choices selected to meet certain air quality requirements. But as I mentioned earlier, this text is a general overview of the NASA studies and further understanding of specifics would be immensely helpful in calculating the necessary quantities, qualities, specification of certain plants pertaining to what toxins they filter out, the amounts that each plant filters, and potentially is there adverse effects of having too many indoor plants in an area? Further details and analysis are needed in the text.

The calculation given in the text, through The Plants for Clean Air Council recommends two plants per 100 square feet. Room size: width x length = square feet / 50 square feet = # of plants. The calculation assumes that all indoor plants are created equally and have similar air cleaning qualities. After resourcing the original research study from NASA some plants can filter out some toxins but not all of them, so having a variety of plants can help to compensate the lack of the others or enhance upon them.

Cleaner Air = Better Morale

By improving the air quality of indoor space, it in response also improves the moral of those experiencing the indoor plants; that by using plants in the office or home to improve the quality of air make it a more pleasant place to work-where people feel better and perform better. In fact, research findings published in *The Role of Horticulture in Human Well-Being and Social Development* suggest that improving the physical environment had a direct impact on the employee's ability

and desire to work. That Plants contribute to psychological well-being as well as improve the aesthetics of an office. Tropical plants add warmth to accent the corporate environment. A plant-friendly office is a happy and cheerful office.

The text had a logistical and rational approach as they approached the belief that clean air equals better morale. Stating that an improvement of the quality of air make an office a more pleasant place to work where people feel better and in return perform better. The correlation between the two references is brief and is lacking a psychological study into the reasoning behind the change in morale. The reasoning behind the correlation to make it valid and relevant. Further re-search is needed to fill the void.

In conclusion, Interior Green text stresses the role of plants inside office and residential buildings in improving indoor air quality the text insightful into the science behind the study conducted with indoor plants and their effect on indoor air quality and in return the effect it has on people's mental well-being. In reviewing the text in reinforced and enhanced upon my understanding and knowledge of indoor plants and the positive effects they have physically and mentally. The text is a simplified reference to the NASA study it was lacked more of the in-depth science behind the plants involved in the study. I had to reference the original NASA research report to fill in the gaps not mentioned in the text. The NASA research was used as a reasoning behind the correlation of moral of employees in relation to better air quality. The correlation referenced had a logistical and rational approach but requires a psychological study into the reasoning behind the change in morale.

LITERATURE REVIEW:

Healthy, Productive Workplaces: Towards a Case for Interior Plantscaping by: A. Smith, M.Tucker, and M.Pitt (2011):

The second text is *Healthy, Productive Workplaces: Towards a Case for Interior Plantscaping* by: Andrew Smith, Matthew Tucker, and Michael Pitt. Their text was published as an academic journal called *Facilities*, published by the Emerald Publishing Limited in the United Kingdom of Great Britain & Northern Ireland on April 2011. The text is about the investigation of office users' perceptions of their working environment in relation to the addition of plants.

In this report the focus will be mainly be on the design methodology approach on the investigation of office users' perceptions of their working environment in relation to the addition of plants. In the investigation the office users' perceptions were examined using a survey, administered to two groups of people: an experimental group and a control group, before and after the installation of plants. The results were analyzed to determine any statistically significant differences between the two groups and between the pre- and post-test surveys for the experimental group.

In reviewing their investigation and study approach I seek to replicate their study in a smaller scale. Acknowledging their results and considering the significant differences between the experimental and control groups pertaining to the users' perceptions, tying with the thesis performance criteria and the psychological impact that the addition of plants to an indoor space can have. Utilizing the experiment as a guideline for the performance measurements and analysis for the Thesis

In the findings of the research there were significant differences found between the experimental and control groups for the work environment contributing to; pressure, health concerns, morale and preference for plants. There were also perceived improvements in productivity, pressure, privacy and comfort although these were non-significant. Sickness absence reduced substantially in the area with plants and increased slightly in the control area. After reviewing the findings

from the study there were interesting parallels from this text and the earlier text reviewed, the correlation with the addition of plants to a space had a positive effect on health of the users. That there were less people absent from work due to sickness, I can infer that it be since plants help to filter the air, removing toxins that can cause people to get sick.

The research limitations and implications to the text is that it would be useful to extend this research over a longer time frame and in a greater range of buildings to validate the results. Since the study was done with one group of people from a single business for a limited amount of time the research results are limited. If the experiment was able to be duplicated over a longer time frame and in a greater range of buildings, then it could help to reinforce the original results in addition to enlighten other users' perceptions that weren't accounted for in the original experiment. There could be variables that weren't considered and could help to refine the experiment to a goal or result that they seek to enhance upon. The current experiment is very broad and can be taken in multiple views, if they focused on a specific aspect in their research, they may be able to know what the bases is for the most productive and healthy workplace, in relation to the addition of plants.

There are certain practical implications of the experiment that can be noted; that by providing well-designed workplaces, including living plants, organizations can potentially improve employee perceptions, leading to performance gains and reduced absence. This paper suggests that significant savings can be achieved in comparison to the cost of plants. The investment of plants in the workplace can result in the business gaining interest in the form of performance gains and healthier employees.

The value of this text is that the role of indoor nature has received relatively little attention compared to the number of studies on outdoor nature. By incorporating and enhancing upon these kinds of experiments we can gain a greater insight and understanding on the affects indoor plants have on people beyond just the office. Taking the indoor plants form one environment and placing them into various others like: residential houses, commercial buildings, industries, schools, hotels, restaurants, hospitals, and see if they have similar affects to their occupants. There is so much potential in studies and experiments in the addition of indoor

LITERATURE REVIEW:

plants. Additionally, this paper applies the research to a real working environment as opposed to experimental designs, which have formed the majority of previous studies available.

In conclusion the investigation of office users' perceptions of their working environment in relation to the addition of plants, through their design methodology approach, findings of the research limitations and implications, practical implications of the experiment, and the overall value of the experiment conducted in the text. There is so much potential in studies and experiments in the additional use of indoor plants and the overall study had good results but those results are limited and could be enhanced upon through to extend this research over a longer time frame and in a greater range of buildings, over a variety of building environments. The article was very insightful and use it as a guideline for the performance measurements and analysis for the Thesis. Tying with the thesis performance criteria and the psychological impact that the addition of plants to an indoor space can have.

The Manual of Interior Plantscaping: A Guide to Design, Installation, and Maintenance, by Kathy Fediw (2015):

The third text is *The Manual of Interior Plantscaping: A Guide to Design, Installation, and Maintenance*, by: Kathy Fediw, an internationally known interior plantscape consultant, author and speaker with over 30 years' experience. She is a LEED Accredited Professional, a Certified Landscape Professional, and a Certified Landscape Technician. Her 248-page book, published in 2015, is a whole manual about: Interior Plantscaping; how to design all the major types of interior plantscapes--atriums, indoor gardens, green walls, potted office plants, and miniature displays like dish gardens. The basic design principles and the mechanics behind a successful interiorscape, as well as how to maintain and care for indoor plants, with tested information on watering practices, pruning, plant nutrition, and preventing pests and diseases. It includes an indoor plant palette of 60 best indoor plants for a design that make it both functional and aesthetic.

*"Plants are an integral part of today's commercial interiors. They set a mood, direct foot traffic, enhance architectural features, improve productivity, and make indoor spaces healthier and more livable."
~Google Books*

The review will focus on the chapters pertaining to indoor gardens, green walls and vertical gardens, and the basic design principles and the mechanics behind a successful interiorscape. These chapters were selected in reference to the project elements chosen for the thesis project. The focus is to gain insight and direction on how to create a functional and aesthetic interiorscape for a residential house.

In chapter 7, refer to interior gardens, it gives an interesting historical overview of indoor gardening and defines what an indoor garden is, a grouping of plants that

LITERATURE REVIEW:

are planted in a substrate with the appearance of being planted in the ground. Other decorative elements such as rocks, pathways, garden furniture, sculpture, and water features may be included. This is definition grasps the essence of an outdoor landscape, but it is deployed in a way that is meant for the indoors. It continues on stating the number of benefits gained from indoor gardens and the functions that they play multiple roles depending on the purpose of the space, one of the functions that stuck out to me was: A setting for creative thinking, indoor gardens provide a space for everyone from engineers to artists to take a break, relax, and allow their creativity to come to the forefront. I never thought of indoor gardens in this manner, my original view was that it is a place to sit, relax, destress, in a natural setting. A mental influencer as well as a physical influence on health and well-being. This is another element I can utilize in the thesis design inspiration. The chapter continues on describing the design principles; which are in essence are similar to outdoor gardening and landscaping. In addition, the chapter goes into detail about the construction process of building the gardens foundation. This will aid me immensely in the thesis, my only critique is that the chapter should have additional diagrams and visuals, in building the garden's foundation. The chapter is describing key points to know in the process but doesn't visually walk through "how to do it yourself" additional construction diagrams would be beneficial in a step by step procedure in how to install the foundations. Overall interesting and educating chapter.

In chapter 9, refer to green walls and vertical gardens, are also known as biowalls or living walls. Green walls can fit every space, size and budget. The chapter discusses the multiple options available for vertical walls: Planting pockets and wall sconces; involving planting plants into soil filled structures that are attached directly to the walls, biofiltration walls, or biowalls; are a highly specialized green wall system that is integrated with the building's HAVAC system and becomes a permanent feature for the building. Most biowalls are hydroponic systems, that use complete fertilization in water using a drip irrigation to maintain the plants. The issue I came across in the chapter is that talks about the green wall options but doesn't mention how to implement and build your own vertical wall.

In conclusion, the book is a general overview pertaining to interior plantscaping and the different components and aspects of it, but it lacks a deep insight in “how to” build and “do it yourself” parts of the book. For a manual that claims in the title that it is a “Guide to Design, Installation, and Maintenance” it guided in the educational premise of interior plantscapes but lacks the fundamental part about how to implement the gained knowledge. A person will never really know plantscaping unless they do it. It is the doing that solidifies the knowing, which unleashes the power of applying the interior plantscaping principles and skills correctly. Knowing and doing are two different things, but when combined, the synergy far exceeds the sum of the two combined. If the book were to be a complete manual it should include the implementation aspects to complement the educational guide of the book.

PROJECT JUSTIFICATION:

My Master's thesis project is the design of an interior landscape that will be implemented into an existing residential house. This interior landscape intent is to promote the physical and psychological well-being of its residence. The implementation of the design will be in the form of module elements like in-ground landscaping, raised planter, water feature, vertical wall and patio space. These modules will be designed in a way that they can be connected to form a unified design space that is attached to an existing residential house.

Why is the project that you have defined important to you as a person (your personal reasons)?

I originally wanted to do an interior landscape. Something where it can be replicable to multiple places (a modular system), in a residential house that can have an "outdoor space (landscape) indoors" so there can be green space for people all year round utilizing indoor plants. I was wondering if there is a way I can really tie in horticulture and plants into my thesis because that is really where my passion is. I love plants, trees, and all things outdoors. I would love to share that passion with others through allowing people to experience plants and nature all year round, even in the winter and when people are stuck indoors.

Why is it important for you to do this project at this stage of your academic development?

It allowed me to pursue a passion of mine and expand my knowledge and understanding of landscaping beyond just the outdoors. Also, when people hear that I am in landscape architecture some people ask about issues with their house plants, which isn't my realm with the degree but with this project it lets me dabble in indoor plants.

Why is it important to do this project at this stage of your professional development?

I can become more well-rounded in all parts of landscape indoors and outdoors, in addition to a little part of architecture itself. How that is possible to create landscaping indoors utilizing the architecture component. An addition to a house

PROJECT JUSTIFICATION:

that can be a green space. Like how they have landscaping some houses in India.

How is the project going to add to your knowledge base?

I have a minor in horticulture and a passion for plants this project will allow me to expand upon that knowledge and design.

How is the project going to add to your set of skills?

I know plants but this will also test me in creating a space that can function as a suitable place for the plants to thrive and clients can use. To design a modular system of various elements (water feature, raised planting, in-ground planting, and vertical gardens) each element will be a component of the modular system that each piece will fit together like Tetris pieces. I will have a range of the space/addition to the house that I will have to design different combinations of designs available to the public that they can choose from and those can be implemented into their existing house, as a sun room like space, or entryway, mudroom. I am researching Frank Lloyd Wrights Modular system and seeing what he did to make his system so successful and learn from it and some way implementing some of his techniques

Why is doing the project important for the profession at this time?

It is a niche that is mainly available to high end clients like businesses, hospitals, ...etc. I want to make it available to everyone. Many people have indoor plants, but it gets difficult to maintain them with all of them being in separate pots scattered around the house. It would be great to create a space where the plants can be and where watering can be done all in one, in a courtyard like space indoors.

How can you justify the project economically?

Creating a low-cost indoor landscape modular system will benefit clients physically and emotionally. There are numerous benefits to having greenery especially all year round. Economically it can be built into existing houses. There will be no need to build a whole new house to implement into. The design of the addition will be very sustainable through the seasons.

How can you justify expending the funds to implement the project?

The price to construct the modular system will be low cost with high rewards;

PROJECT JUSTIFICATION:

Plants can help to regulate temperature in a house, remove toxins and particles in the air, increase mood, motivation, decrease stress, and multiple other benefits in implementing this system.

Where might the funds come from for your project and are the sources justified? It will start with an Entrepreneur like approach by exposing the idea/design and see if there is a need and from there network to people interested in investing in the project. Once the modular system is implemented, word will spread, and requests will come in. then the funds could come from middle class residents who hope to implement the addition to their house.

Is your project justified based on a return on investment? Are these returns monetary, or are they intangible?

The materials used to create the indoor landscape modular addition will allow for the multi season use and low cost to build and maintain. So, in a way the system will pay for itself in over time. Return on investments in tangible(money) and intangible (physical and mental wellbeing)

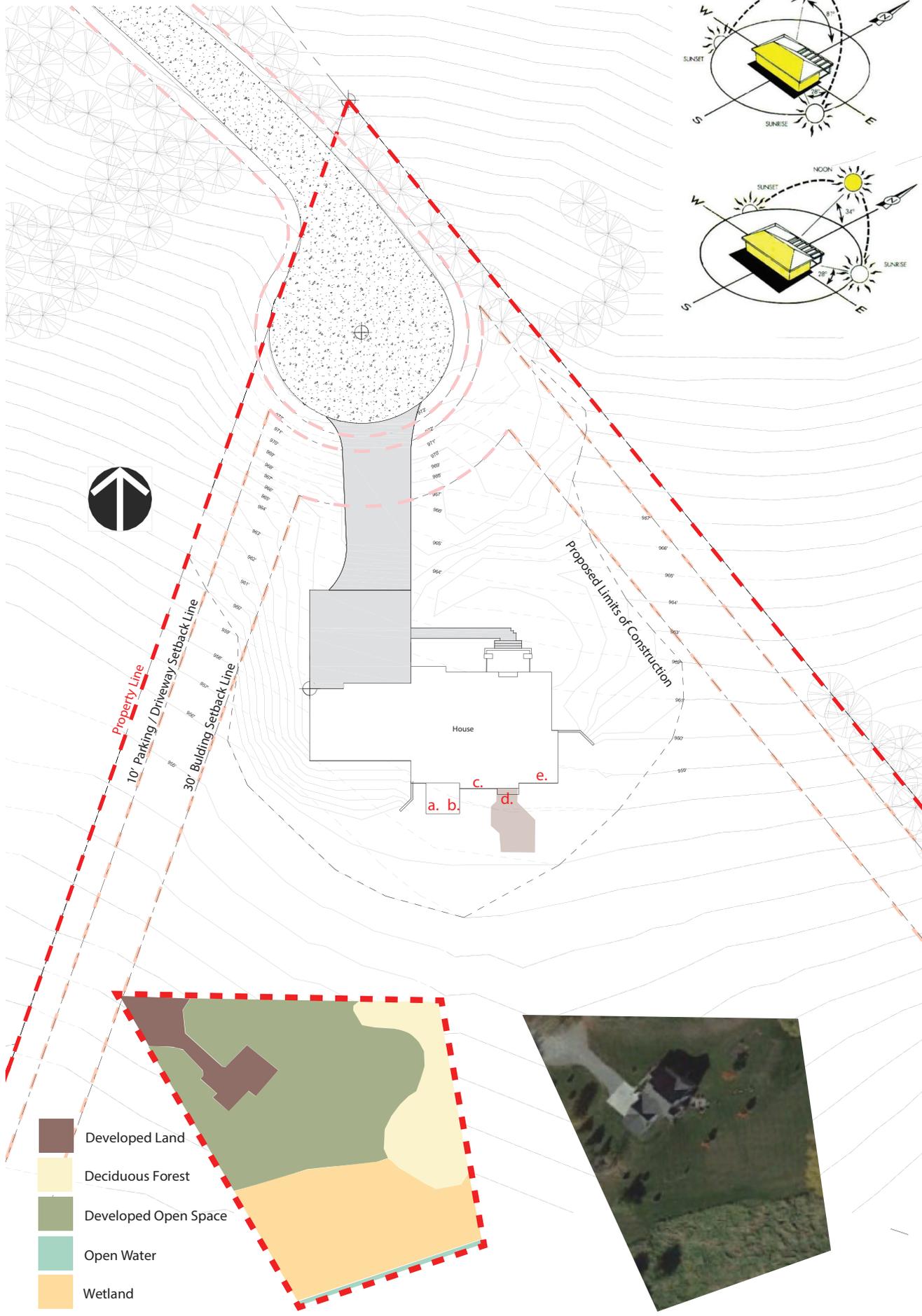
HISTORICAL, SOCIAL, & PHYSICAL CONTENT:

This thesis project is similar to interior landscapes designed throughout history because it will include elements commonly found in interior landscapes like: inground landscaping, raised planter, water feature, vertical wall and patio space. In various sizes and options these elements incorporate into an indoor setting isn't anything new. The part that will make my thesis unique and different from projects undertaken throughout history is that I will be implementing and designing a modular system for each of the project elements and they will be designed to puzzle piece together and will attach to an existing residential house. These modular components will be available to anyone with a residential house to select which modules they want in their interior landscape and then those modules will be connected together into a unified design.

The project will relate to the social trends and development within our society because there is multiple studies and increase of buildings incorporating landscapes and green spaces into their facilities because of the multiple benefits bestowed on those experiencing the space. With the goal of the thesis design focusing to promote the physical and psychological well-being of its residence. It utilizes the current studies and research and allows common folk to implement the benefits of indoor plants into their own homes in the form of an interior landscape.

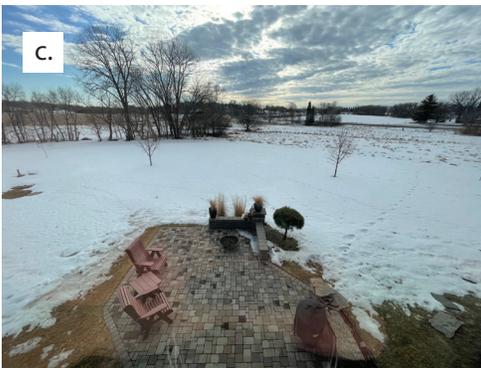
The physical and social context within which the thesis problem is set is that the availability of interior landscapes to average middle income households is lacking. The majority of people, and businesses that have an interior landscape are the wealthy and upperclass individuals, and businesses that have the revenue to encourage this kind of investment for its facility. I seek to make interior landscapes available to everyone. That they can have an addition to their house that allows for them to have greenery all year round and that they can reap in the benefits of having an interior landscape, positive physical and mental well-being.

SITE ANALYSIS:



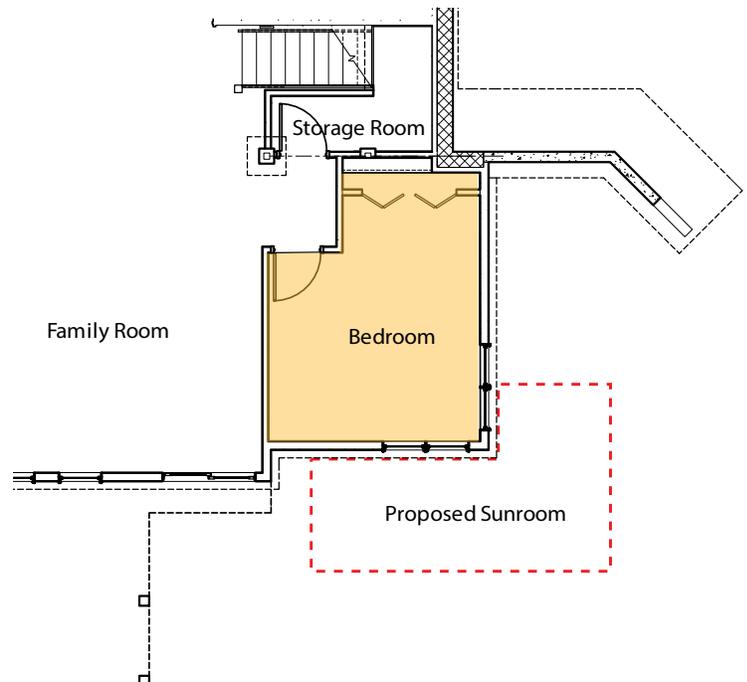
SITE ANALYSIS

Property



The house sits on a 3.3 acre plot of land. The graphic in the lower left corner of the following page shows a breakdown of the land. With the images labeled to the left correlating with the site plan locations of the views out onto the yard. The purpose of the analysis is to observe what is existing on the site so to use the views out into the yard to choosing the best location and views for the interior landscape addition.

The graphic in the top right corner of the following page shows the sun's path through the summer and winter. In addition to where the shadows fall. The purpose for this analysis is to select a location for the addition that will receive enough sun for the plants but not too much that it will create a harsh environment for them. The proposed sun room addition will be located in the Southeast side of the building.



SITE ANALYSIS

House

The house was built in 2013 by Thoma Construction and designed by SDK Architects. It has two levels, a main level and a lower level, graphically shown on the following page. The reason behind the house analysis is for selecting the location for the addition to shelter the interior landscape. The location should be a place easily accessible and preferably on the ground floor. Ideally it would be best near a part of the house that has a high to average amount of activity so the interior landscape can become incorporated into the residents' daily life. The lower level family room was selected to be the connection point of where the addition will be accessible. With the southeast bedroom being the alternative option, depending on the design need. Images below are of the exterior of the house to better visualize the layout of the house.



Back of House (South Side)



Front of House (North Side)



West Side of House

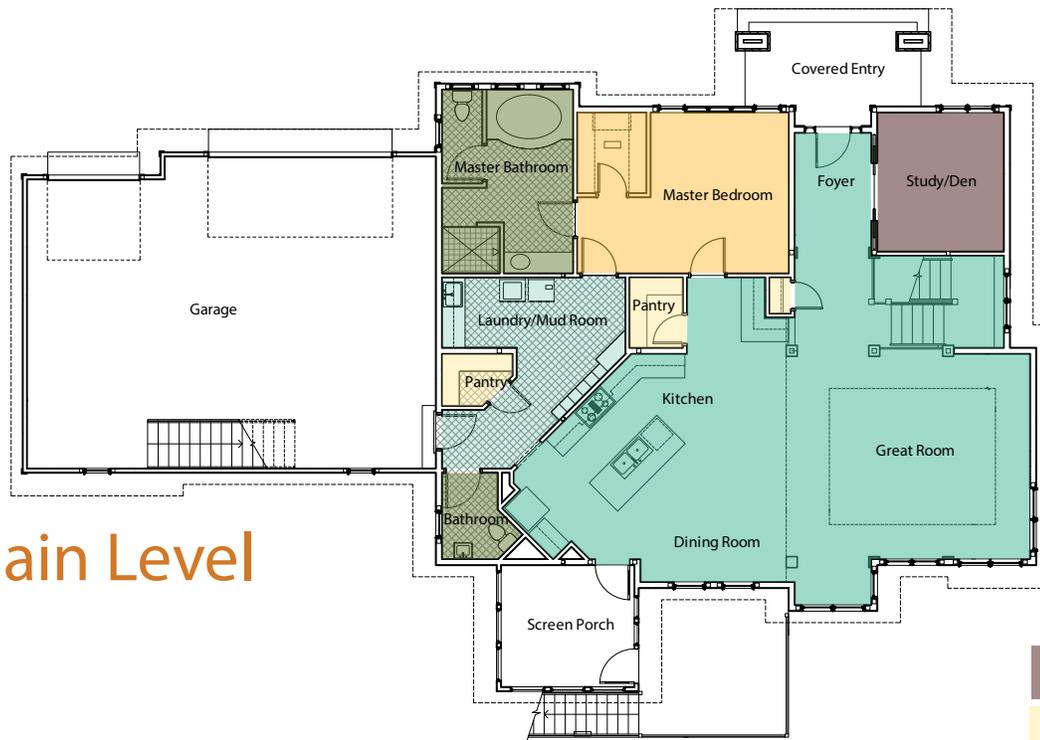


East Side of House

SITE ANALYSIS

House

Main Level



- Personal Space
- Non active space
- Public space
- Active space
- Private Space

Lower Level



PERFORMANCE CRITERIA

The performance criteria for this thesis is based on the NASA clean air study recommendations of 1 plant for every 100 square feet of space. If the design of the interior space has plants more than the recommendations it will be deemed a success. In addition to the plant selection choice that the plants in the design will be ranked based off the amount of VOC that they eliminate from the air. The plants that remove 4-5 of the 5 different air pollutants in the study will be ranked the best plants, with plants removing 3 different air pollutants being better, and any plant that removes less will be ranked good. To include a variety of these plants from all the categories with a larger percentage of the plant selected from the best plants group. With the Peace lily and the florist chrisanthimum ranking the highest on the chart.

 <p>Trichloroethylene</p> <p>Symptoms include excitement, dizziness, headache, nausea, and vomiting followed by drowsiness and coma.</p>	 <p>Formaldehyde</p> <p>Symptoms include irritation to nose, mouth and throat, and in severe cases, swelling of the larynx and lungs.</p>	 <p>Benzene</p> <p>Symptoms include irritation to the eyes, drowsiness, increase in heart rate, headaches, confusion and in some cases can result in unconsciousness.</p>	 <p>Xylene</p> <p>Symptoms include irritation to the mouth and throat, dizziness, headache, confusion, heart problems, liver and kidney damage and coma</p>	 <p>Ammonia</p> <p>Symptoms include eye irritation, coughing and sore throat.</p>
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The Best

							
	Common Name	Scientific Name	Trichloroethylene	Formaldehyde	Benzene	Xylene	Ammonia
	English Ivy	<i>Hedera helix</i>	X	X	X	X	
	Varigated Snake Plant	<i>Sanserveria trifasciata 'Laurentii'</i>	X	X	X	X	
	Red-Edged Dracaena	<i>Dracaena marginata</i>	X	X	X	X	
	Peace Lily	<i>Spathiphyllum 'Mauna Loa'</i>	X	X	X	X	X
	Florist's Chrysanthemum	<i>Chrysanthemum morifolium</i>	X	X	X	X	X

Better



	Common Name	Scientific Name	Trichloroethylene	Formaldehyde	Benzene	Xylene	Ammonia
	Devil's Ivy	<i>Epipremnum aureum</i>		X	X	X	
	Flamingo Lily	<i>Anthurium andraeanum</i>		X		X	X
	Lilyturf	<i>Liriope spicata</i>	X			X	X
	Broadleaf Lady Palm	<i>Rhapis excelsa</i>		X		X	X
	Barberton Daisy	<i>Gerbera jamesonii</i>	X	X		X	
	Cornstalk Dracaena	<i>Dracaena fragrans 'Massangeana'</i>	X	X	X		

Good

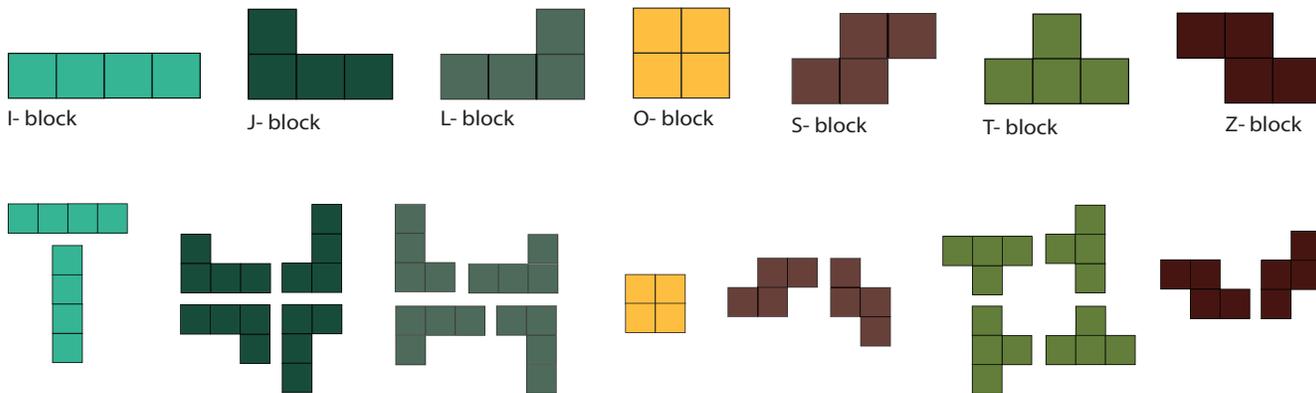


	Common Name	Scientific Name	Trichloroethylene	Formaldehyde	Benzene	Xylene	Ammonia
	Dwarf Date Palm	<i>Phoenix robelenii</i>		X		X	
	Boston Fern	<i>Nephrolepis exaltata</i>		X		X	
	Kimberly Queen Fern	<i>Nephrolepis oblitterata</i>		X		X	
	Spider Plant	<i>Chlorophytum comosum</i>		X		X	
	Chinese Evergreen	<i>Aglaonema modestum</i>		X	X		
	Bamboo Palm	<i>Chamaedorea seifrizii</i>		X		X	
	Weeping Fig	<i>Ficus benjamina</i>		X		X	

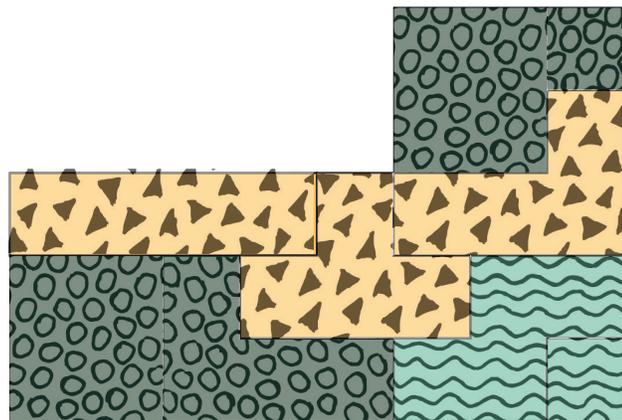
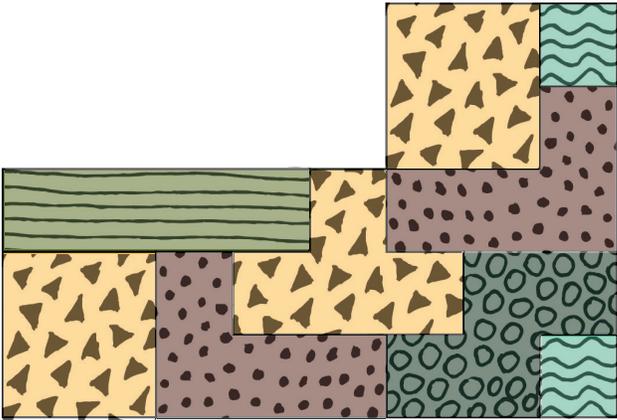
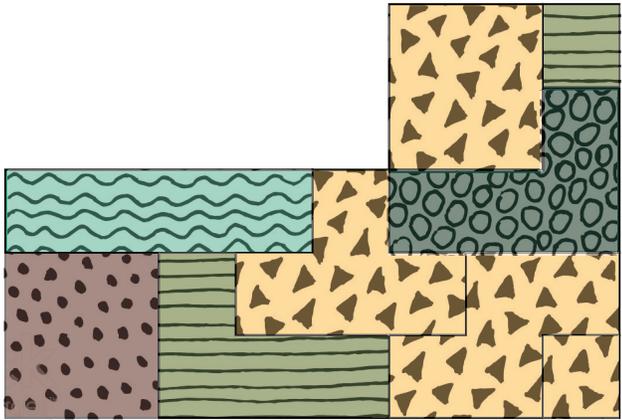
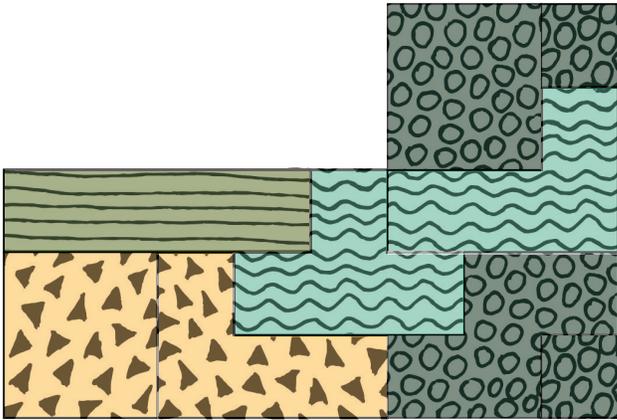
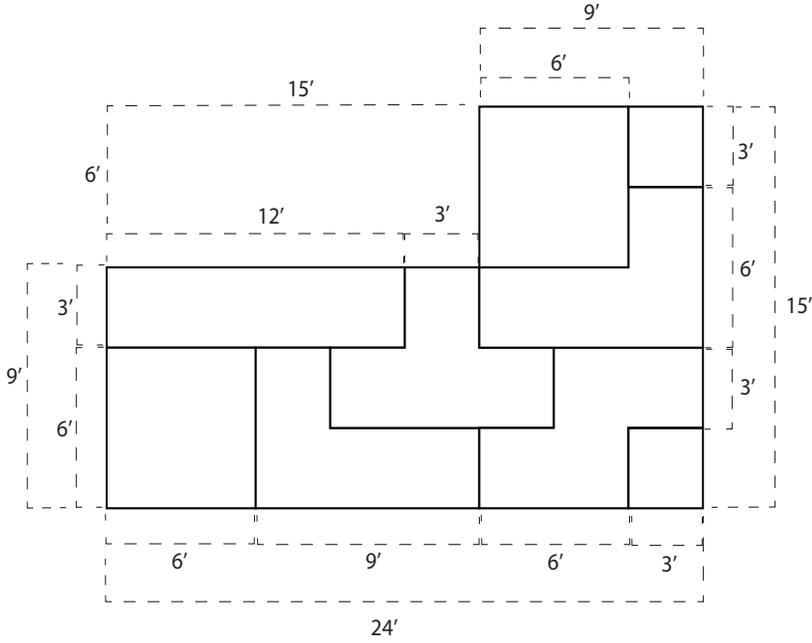
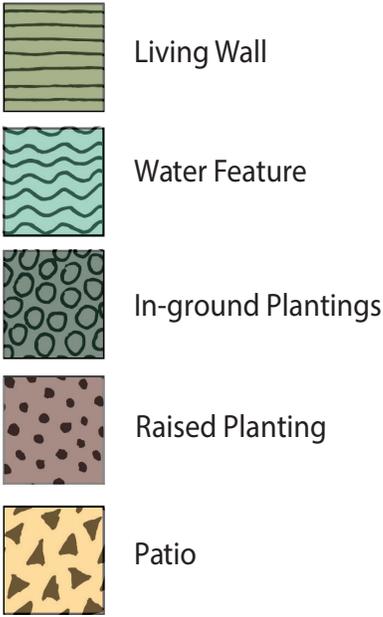
DESIGN CONCEPT:

The design of the residential interior space will be based off the theme selected by the resident to better suit their needs. There will be three themes that will available: therapeutic interior landscape used for relaxing and restoration, an educational interior landscape design used for learning and playing, and the last theme is a mix use interior landscape utilized for work and social needs.

The themes will be deisigned using a modular system that is dynamic and can be taken apart and rearranged allowing the space to be changed over time. The modular system is inspired by the tile-matching video game, Tetris, where there are 7 key shapes that are able to be arranged in a variety of ways and can be duplicated for the designs need. Each modular: water element, living wall, patio, in-ground planting and raised planters, have the option to be interchanged within these tetris like shapes so they can be arranged in a assortment of ways to meet the needs of the client.



APPLICATION OF RESULTS: Modular System



STATEMENTS:

The Problem Presented:

According to the Environmental Protection Agency (EPA), the average American spends 93% of their life indoors. Almost 70% of which is at home. By being indoors there is a greater chance of being exposed to higher concentrations of airborne pollutants, including cold and flu viruses. In addition to creating a disconnection with nature that can negatively impact mental and physical health.

Thesis Statement:

To design a residential interior landscape that will promote physical and mental well-being to those who experience it.

Solution Proposed:

To clean the air utilizing indoor plants from the NASA clean air study known to filter out the airborne pollutants, to promote physical well-being. To design the space as one of three themes that promotes the mental well-being to those who experience it, depending on their needs. Making the interior landscape available to anyone through the modular systematic approach to the design of the spaces. Using each of the five design elements commonly found in interior landscapes: patio space, raised garden, inground planting, water feature and living wall, for each of the modules.

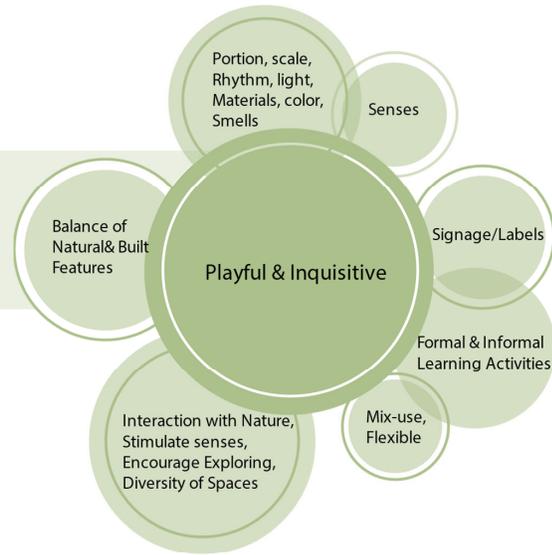
DESIGN DEVELOPMENT Themes



Educational Design

Playful & Inquisitive

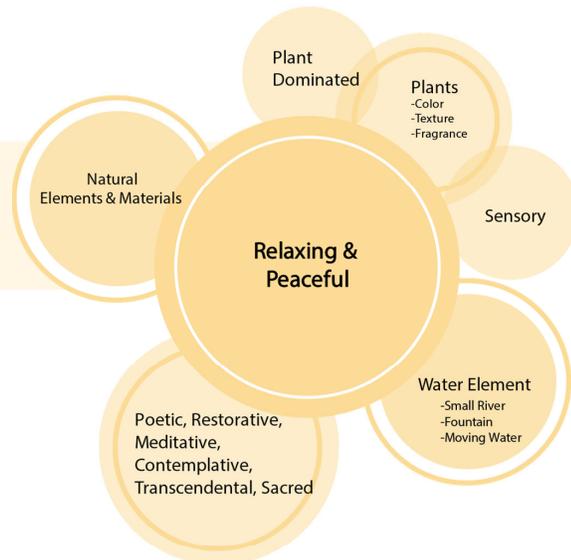
Letting your kids help grow an indoor garden can be a great hands-on way to teach them about responsibility. It also teaches caring for a living thing and creating a routine. Additionally, it can be an excellent tool to teach kids about plant biology, life cycles, and sustainable farming.



Therapeutic Design

Relaxation & Peaceful

Pruning, watering, re-potting, and other tasks associated with caring for your garden can be calming and therapeutic. Having plants in the home can reduce stress and depression while creating a sense that a person isn't alone. Some doctors even prescribe gardening as a way to get exercise and improve mental health. Lowering stress is the goal. If you lower the stress, the body can do its healing.



A therapeutic garden is “a plant-dominated environment purposefully designed to facilitate interaction with the healing elements of nature. Interactions can be passive or active depending on the garden design and users’ needs.” Sensory gardens, healing gardens, meditative garden and restorative gardens are simply different types of gardens that brings so many health benefits to it users.



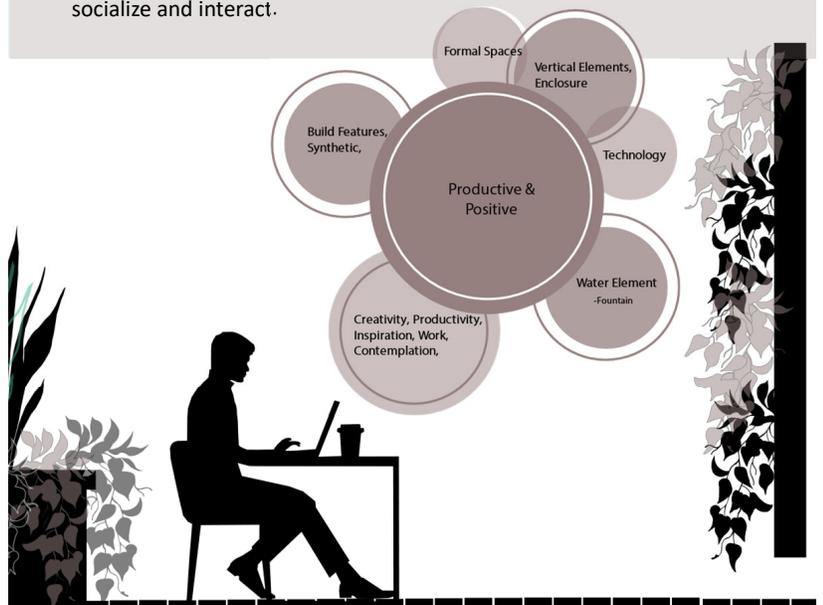
Social Design Interactive & Supportive

For those working at home, indoor plants has also been proven to have a calming influence, yielding a higher concentration while performing tasks. To take a break and allow their creativity to come to the forefront.



Work Creativity Design Productive & Positive

People are innately drawn to gardens and have an instinctive tendency to want to meet and talk with each other in natural settings. Encouraging people to use the garden as a place to socialize and interact.



DIGITAL MODELS: Educational Design



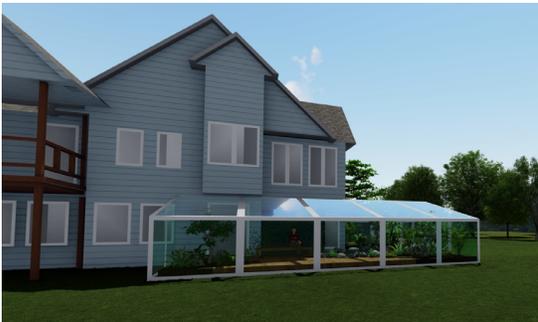
DESIGN GRAPHICS: Perspectives/Modules



DIGITAL MODELS: Therapeutic Design



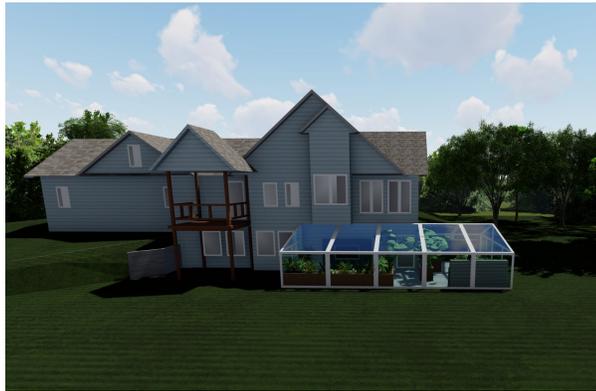
DESIGN GRAPHICS: Perspectives/Modules



DIGITAL MODELS: Work/Social Design



DESIGN GRAPHICS: Perspectives/Modules



PERFORMANCE ANALYSIS: NASA Plant Calculations

*The results of the NASA clean air study recommended to have at least one plant per 100 square feet.

Therapeutic Design Relaxation & Peaceful

Plant Count: **165**
Area of Space: **750 sq.ft**



Tree

Common Name	Scientific Name	#
Dwarf Date Palm	Phoenix roboravi	0
Bamboo Palm	Chamaedorea seifridii	1
Weeping Fig	Ficus benjamina	3
Broadleaf Lady Palm	Rhaps excelsa	2
Comstalk Dracaena	Dracaena fragrans 'Massangeana'	1
Red-Edged Dracaena	Dracaena marginata	0

Flower

Common Name	Scientific Name	#
Peace Lily	Spathiphyllum 'Mauna Loa'	3
Florist's Chrysanthemum	Chrysanthemum morifolium	4
Flamingo Lily	Anthurium andraeanum	7
Lilyturf	Liriope spicata	3
Barberton Daisy	Gerbera jamesonii	0

Herbaceous

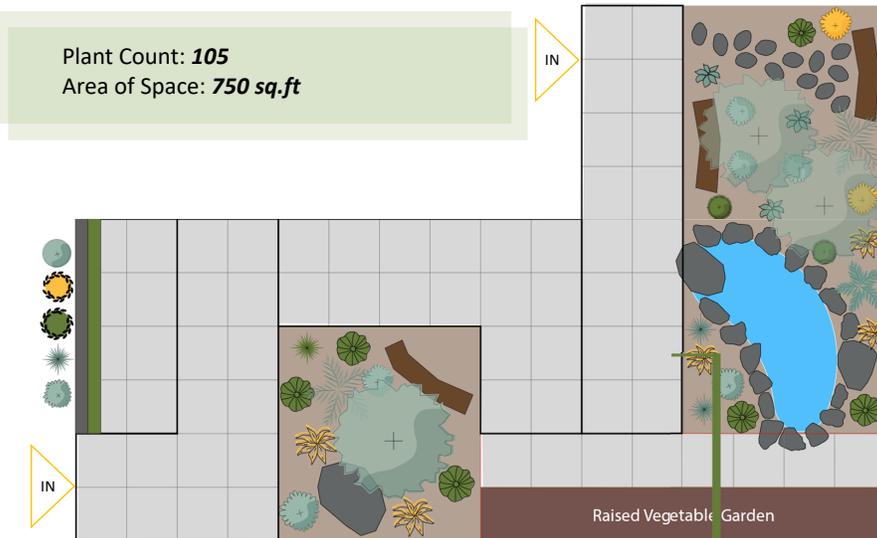
Common Name	Scientific Name	#
Boston Fern	Nephrolepis exaltata	27
Kimberly Queen Fern	Nephrolepis obliterata	20
Spider Plant	Chlorophytum comosum	30
Chinese Evergreen	Aglaonema modestum	0
Variiegated Snake Plant	Sansevieria trifasciata 'Laurentii'	4

Ivy

Common Name	Scientific Name	#
Devil's Ivy	Epipremnum aureum	30
English Ivy	Hedera helix	30

Educational Design Playful & Inquisitive

Plant Count: **105**
Area of Space: **750 sq.ft**



Tree

Common Name	Scientific Name	#
Dwarf Date Palm	Phoenix roboravi	1
Bamboo Palm	Chamaedorea seifridii	2
Weeping Fig	Ficus benjamina	3
Broadleaf Lady Palm	Rhaps excelsa	0
Comstalk Dracaena	Dracaena fragrans 'Massangeana'	2
Red-Edged Dracaena	Dracaena marginata	0

Flower

Common Name	Scientific Name	#
Peace Lily	Spathiphyllum 'Mauna Loa'	6
Florist's Chrysanthemum	Chrysanthemum morifolium	0
Flamingo Lily	Anthurium andraeanum	5
Lilyturf	Liriope spicata	0
Barberton Daisy	Gerbera jamesonii	0

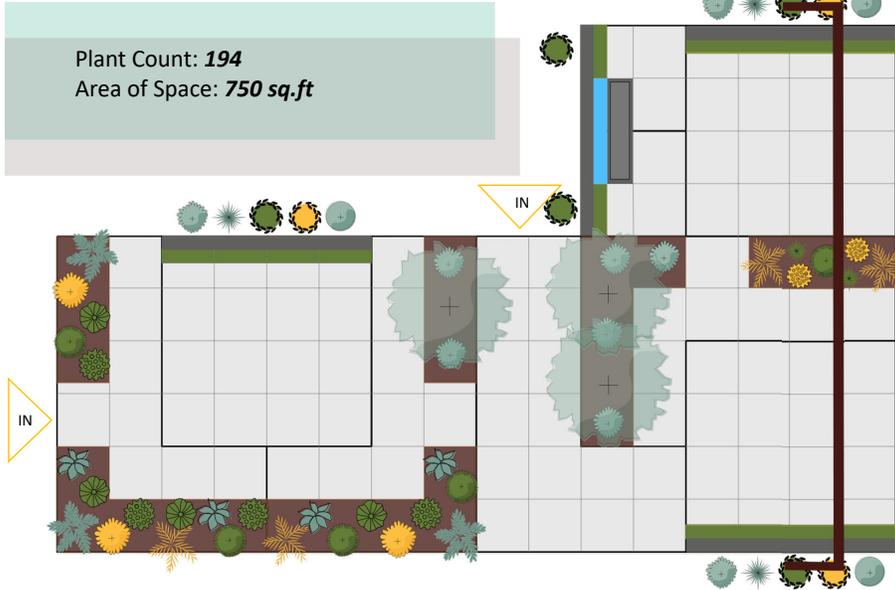
Herbaceous

Common Name	Scientific Name	#
Boston Fern	Nephrolepis exaltata	21
Kimberly Queen Fern	Nephrolepis obliterata	15
Spider Plant	Chlorophytum comosum	15
Chinese Evergreen	Aglaonema modestum	3
Variiegated Snake Plant	Sansevieria trifasciata 'Laurentii'	2

Ivy

Common Name	Scientific Name	#
Devil's Ivy	Epipremnum aureum	15
English Ivy	Hedera helix	15

Work/Social Design



Common Name	Scientific Name	#
Tree		
Dwarf Date Palm	Phoenix roborator	3
Bamboo Palm	Chamaedorea seifridii	0
Weeping Fig	Ficus benjamina	3
Broadleaf Lady Palm	Rhapis excelsa	4
Cornstalk Dracaena	Dracaena fragrans 'Massangeana'	3
Half-Edged Dracaena	Dracaena marginata	2
Flower		
Peace Lily	Spathiphyllum 'Mauna Loa'	4
Florist's Chrysanthemum	Chrysanthemum morifolium	4
Flamingo Lily	Anthurium andraeanum	0
Lil'Vurf	Lilippe spicata	0
Barberton Daisy	Gerbera jamesonii	2
Herbaceous		
Boston Fern	Nephrolepis exaltata	30
Kimberly Queen Fern	Nephrolepis obliterata	30
Spider Plant	Chlorophytum comosum	30
Chinese Evergreen	Aglaonema modestum	4
Variegated Snake Plant	Sansevieria trifasciata 'Lauretti'	5
Ivy		
Devil's Ivy	Epipremnum aureum	40
English Ivy	Hedera helix	30

PERFORMANCE ANALYSIS:

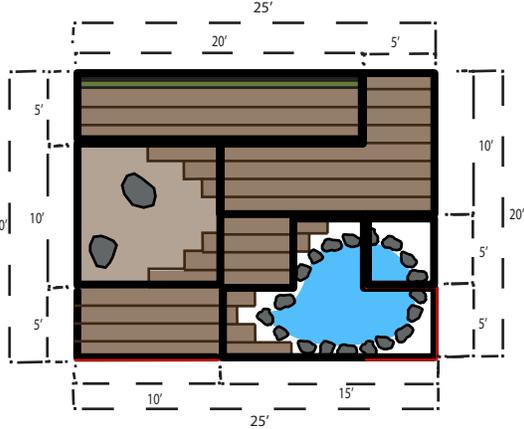
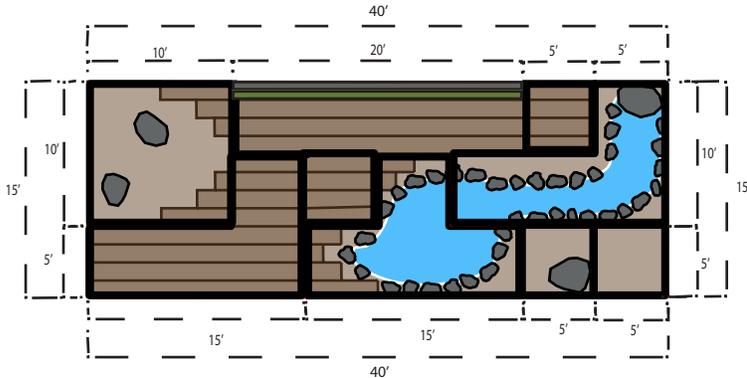
Response to Goals and Project Emphases

Each of the design themes and the plants selected from the NASA clean air study meet and exceed the plant requirements of 1 plant per 100 square foot of space, based off the results of the study. The size of the addition for this particular site is 750 square feet. Which would mean that for the design to be successful it would have to contain more than 7.5 plants. Which all of the designs meet and exceed the expectations.

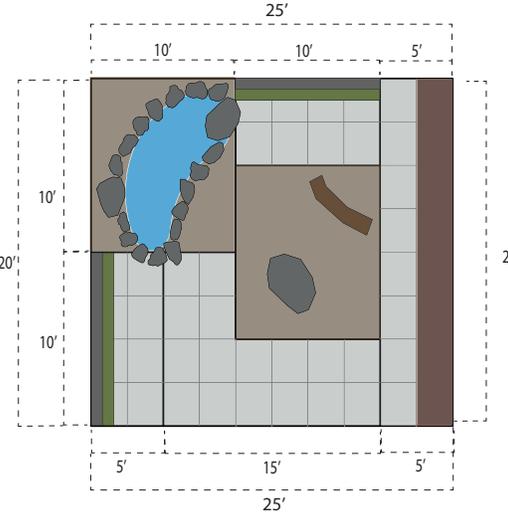
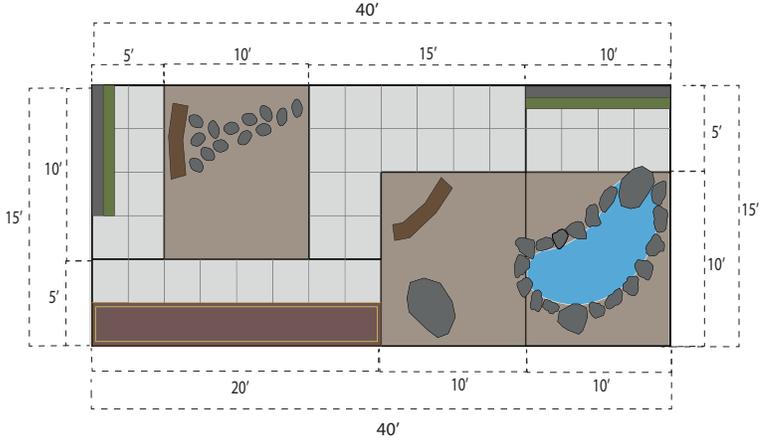
For the design to promote mental well-being the three themes for the design are specially created to encourage multiple positive benefits. Each design theme will encourage specific moods and emotions. The therapeutic interior landscape promotes relaxing and restoration for those who struggle with anxiety, depression, health issues, to name a few. To help them find healing in the plant dominated design. The educational interior landscape design promotes learning and playing for children and a place to go to explore. The last design theme is a mix use interior landscape utilized for work and social needs that can be used for productive work environment stimulating creativity and focus for those working from home. In the evening the space can serve as a social gathering space to promote interaction and community. All of the designs are able to be rearranged and can be adjusted to be dynamic and flexible for the needs of the residents.

PERFORMANCE ANALYSIS: Alternative Variations of the Designs

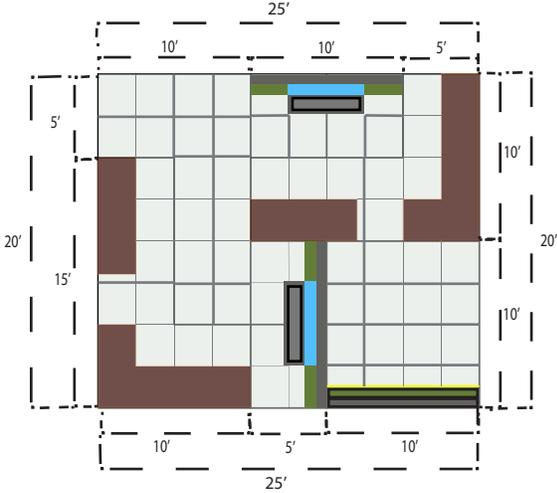
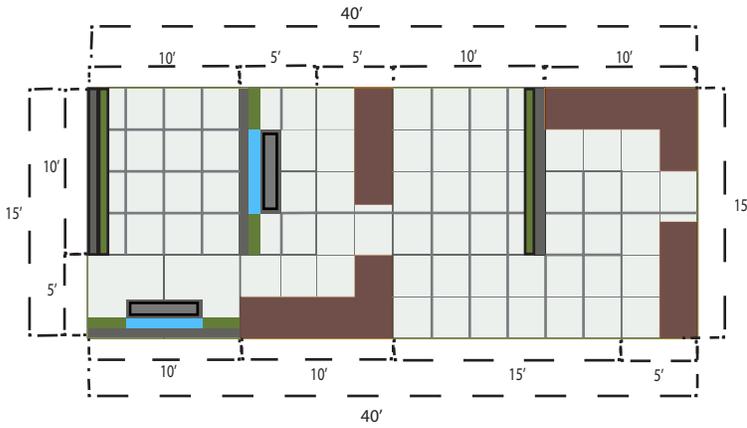
THERAPUTIC DESIGN



EDUCATIONAL DESIGN



WORK/SOCIAL DESIGN



THESIS APPENDIX:

REFERENCE LIST

Design Tools Utilities:

- Research : NDSU library Database, Google scholar, Journal.
- Site inventory/ Analysis : Arc GIS pro, Google Earth,

Map

- Graphic design: Photoshop, Illustrator
- Digital design: Auto CAD, Sketchup, Luminon.
- Physical Tool: Laser Cutting, 3D printer, CNC machine.

Lituarture Resource:

Fediw, K. (2015). The manual of interior plantscaping : A guide to design, installation, and maintenance / kathy fediw (First edition ed.) Retrieved from <https://ezproxy.lib.ndsu.nodak.edu/login?url=https://www.proquest.com/books/manual-interior-plantscaping-guide-design/docview/1803132327/se-2?accountid=6766>

Phillips, G. (1999, September). Interior Green. EBSCOhost Web. <https://www.questia.com/magazine/1P3-45195681/interior-green>

Smith, A., Tucker, M., & Pitt, M. (2011, April 5). Healthy, Productive Workplaces: Towards a Case for Interior Plantscaping. Discover Journals, Books & Case Studies | Emerald Insight. <https://www.emerald.com/insight/>

THESIS APPENDIX: REFERENCE LIST

Case Studies:

Jungles, R. (2020, November 4). Ford Foundation Center for Social Justice. Raymond Jungles, Inc. <https://www.raymondjungles.com/project/ford-foundation/>

Docomomo US. (2020). Ford Foundation Center for Social Justice. Docomomo US. <https://www.docomomo-us.org/register/ford-foundation-headquarters>

Bindelglass, E. (2016, April 20). Landmarks Approves Upgrades for Ford Foundation Building, 320 East 43rd Street. New York YIMBY. <https://newyorkyimby.com/2016/04/landmarks-approves-upgrades-for-ford-foundation-building-320-east-43rd-street.html> (images)

Caballero, P. (2020, November 9). Hotel Jakarta / SeARCH. ArchDaily. <https://www.archdaily.com/899081/hotel-jakarta-search>

Cosentino. (2021, March 25). Hotel Jakarta. Cosentino Professional. <https://pro.cosentino.com/da/flagship-projects/hotel-jakarta>

WestCord. (2019, July 5). The building. Hotel Jakarta Amsterdam • by WestCord. <https://hoteljakarta.com/sustainably-built/building/>

Scotscape. (2020, August 4). Green Wall for Jaguar Land Rover Showroom, Sunbury on Thames. Living Walls UK. <https://www.scotscape.co.uk/news/living-wall-jaguar-landrover-showroom>

ANS Global. (2021, February 25). Jaguar Land Rover chooses living wall for Paris Motor Show. ANS Global. <https://www.ansgroupglobal.com/blog/jaguar-land-rover-chooses-living-wall-paris-motor-show>

THESIS APPENDIX: REFERENCE LIST

Research

Multiple Authors. (2019, February 4). NASA Reveals A List Of The Best Air-Cleaning Plants For Your Home. Bored Panda. https://www.boredpanda.com/best-air-filtering-houseplants-nasa/?utm_source=google&utm_medium=organic&utm_campaign=organic

Wolverton, B. (1989, July 1). A Study of Interior Landscape Plants for Indoor Air Pollution Abatement. NTRS - NASA Technical Reports Server. <https://ntrs.nasa.gov/citations/19930072988>

Phillips, G. (1999, September). Interior Green. EBSCOhost Web. <https://www.questia.com/magazine/1P3-45195681/interior-green>

Mashrita. (2019, November 16). 29 Best air purifying plants from NASA clean air study. Landscaping Garden Indoor Office Plants Online India. <https://www.mashrita.com/29-best-air-purifying-plants-nasa-clean-air-study/>

THESIS APPENDIX: PREVIOUS STUDIO EXPERIENCE

2nd Year:

Fall 2017

Kathleen People

- Tea House
- Landscape Garden

Spring 2018

Dominic Fischer

- William Marshal Park; Winnipeg, Canada.
- Viking Ship Park; Moorhead, MN

3th Year:

Fall 2018

Jason Kost

- Spicy Pie, Fargo, ND
- Mid-American Steel; Fargo, ND

Spring 2019

Anna Maria Visilia

- Fargo/Moorhead Theater; Moorhead, MN
- Olive Grove, Greece.
- Minto & Velva, ND

4th Year:

Fall 2018

Domic Fishcher

- Low East Side Manhattan, NY

Spring 219

Jason Kost

- Este Park, CO

5th Year:

Fall 2020

Matthew Kirkwood

- North Country Trail, ND

PERSONAL INFORMATION

The Author



Rachel Borgert
From: Maple Lake, MN



