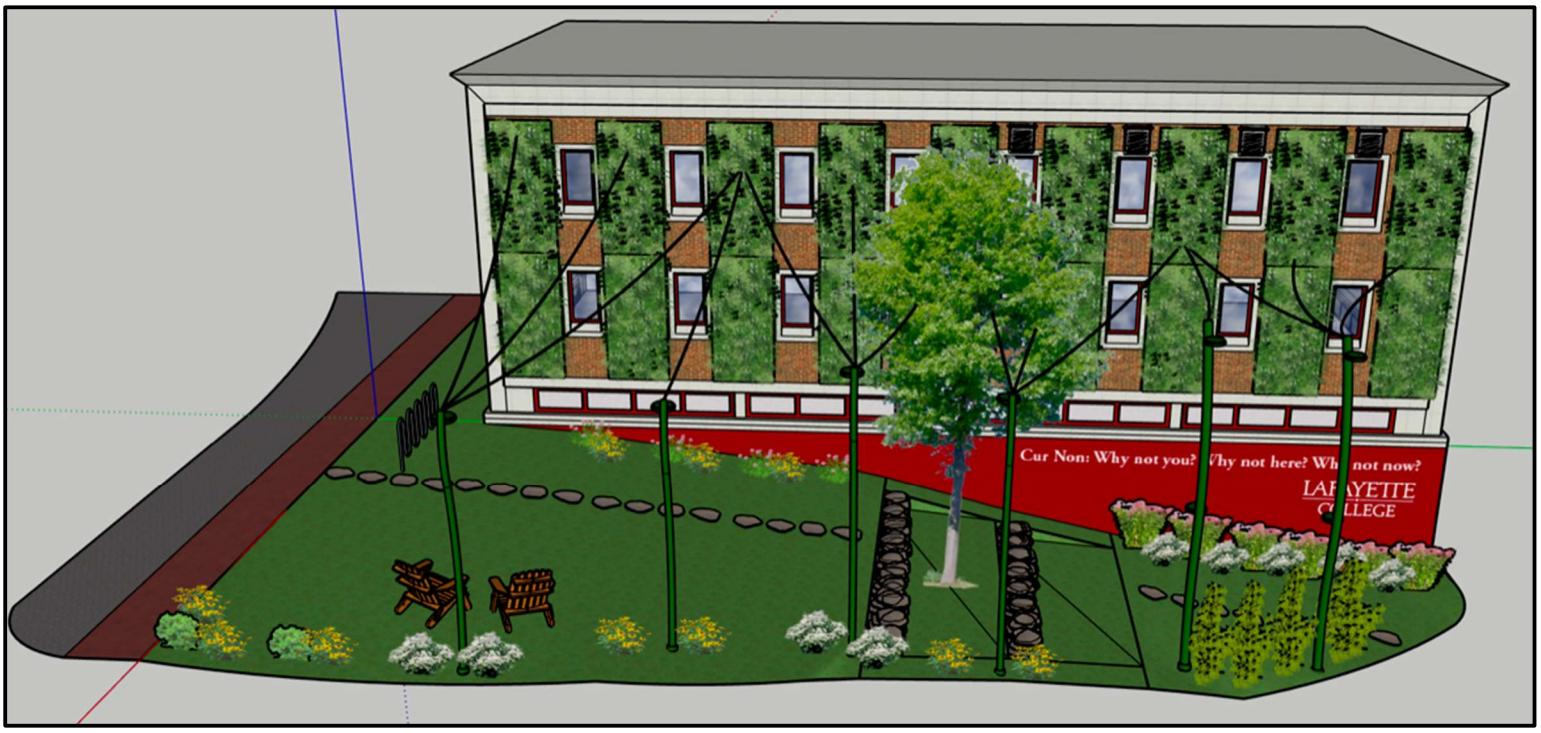
Spring 2020 EGRS 480.01 Presents:

Lafayette Gardens



Final Draft

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Executive Summary

Lafayette Gardens is a unique and memorable space designed to facilitate education, recreation, and place-making opportunities on campus. It consists of a living wall and an adjacent communal garden space that will be located on the northeast side of Acopian Engineering Center (AEC) and occupying the 0.08-acre area that extends toward Markle Hall. Initially inspired by previous Engineering Studies capstone projects, a team of five Engineering Studies students developed Lafayette Gardens for their Sustainable Solutions course project. By incorporating technological, artistic, and environmental aspects into the design, the team has created a welcoming place for all members of the Lafayette College community.

The living wall, constructed by LiveWall, will run across the brick exterior of the northeast side of Acopian in a vertical column pattern. Underneath it, where there is currently a bare concrete triangle, a mural will display Lafayette College's motto: "Cur Non? Why not you? Why not here? Why not now?". The surrounding ground space will contain sets of 6' diameter pollinator gardens as well as teaching and gathering areas. Seating options for Lafayette Gardens include Adirondack chairs and terrace seating, the latter of which will require modifications to the existing slope. The edge of the grass will be lined with six thin, curved spires that connect back to the living wall via wires. These spires and wires will help create a sense of calm enclosure and add three-dimensional definition to the space. Our research found that the project, considering construction and materials, would be in the range of $160,000 to $240,000, with the difference depending on plant choices, degree of LiveWall options, and degree of landscaping intensity.

The new space will provide a range of benefits to Lafayette College that expand its educational and social capabilities. In an environmental context, the incorporation of another green structure on an academic building will contribute to the college's Climate Action Plan. Additionally, the inclusion of various native plants will help rehabilitate the existing environment and increase biodiversity by creating a space that attracts birds, bats, and various pollinators. Construction of a living wall also has technical benefits, such as improving the thermal abilities of Acopian, and health benefits resulting from improved air quality and helping with stress relief. The space will not only improve the atmosphere of Acopian but that of the college too.

The Lafayette Gardens fully embodies the college's core values by encouraging collaboration, inclusivity, sustainability and education through its design. It is the team's hope that Lafayette College develops a multidimensional space such as this and continues to refer to the design as it strives to continue creating a united college community.

For more information about the project and to see the growth of the project in more detail, please visit the project website located at: https://sites.lafayette.edu/greeningacopian/

Thank you for your time and support!

Lafayette Gardens Through Vignettes

Over the course of the semester, our team focused on designing Lafayette Gardens as a multifunctional space for the entire Lafayette College community. As a result, we frequently considered two factors: the usage of the space and who it benefits. In an attempt to better understand the true impact of Lafayette Gardens, each team member has drafted a vignette about an experience in the space from the perspective of a community member. We hope that together, they will help the reader imagine the full potential of Lafayette Gardens.

From the perspective of an athlete:

> *Another day, I got up for breakfast at 8 am and ate until 9 am. I went down to the Bourger Varsity Field House for treatment and therapy at 9:30 am. Already the day is super busy and I did not even begin classes. The day went on and the class ran on, I had to go back to the cafe to make sure to eat a big lunch to fuel up for practice. I got another class from 1 pm to 2 pm. Once finished, back down to the Bourger Varsity Field House in the pouring rain as I am in a hurry to go watch film and lift. This beautiful Lafayette Gardens on the east side wall of Acopian is providing me an easy pathway down without slipping and falling. I watch film and review game plan adjustments for the week. Practice begins at 4 pm and does not end until 7 pm. Tired and exhausted from practice, I drag my way up the bleachers to head to dinner but I stop at the Lafayette Gardens to take a moment to finally sit down and relax. Thankful for the opportunity to rest, I acknowledge the beautiful sights and sounds of nature around me. I am glad I have a place to rest.*

From the perspective of a prospective student:

> *As my parents and I exit the parking deck, we walk into the backdoor of Markle Hall and are greeted by our smiling tour guide. We step out into the hot summer sun and I look around and take in my first glimpse of campus. To my right, I see vibrant colored plants on the side of a building with a gazebo-like space in front, I make a mental note to investigate the space later. After visiting Acopian Engineering Center, my tour guide explains that the space is called the Lafayette Gardens and was formed from a student-driven project. The space incorporates many core values of the College in it: sustainability, inclusivity, and collaboration. I turn to my parents and express that it's pretty impressive that the school listened to a student-driven project and constructed the space. We bid farewell to our tour guide in front of Markle and all sigh at the thought of getting back into the hot car and driving a few hours to our next college to visit. So, we first decide to sit and cool down for a bit. We decide the Lafayette Gardens would be the perfect place to do so. The Adirondack chairs provided us a comfy place to sit down, take a break from the hot summer sun, and reflect on our tour of Lafayette. After about 15 minutes, we felt recharged from the shade, sights, and smells and were ready to continue on our college road trip. As I walked down the rock path of the Lafayette Gardens, I smiled to myself knowing this wouldn't be the last time I found myself on this beautiful campus.*

From the perspective of a pollinator:

Life as a honeybee has never been easy. It's bad enough having to fear for your life whenever you fly near humans that try to squish you, but then you add on the fact that pesticides are used to a damaging extent and the ever-decreasing areas habitable for bees, and all of a sudden you are struggling to survive. So, when the space outside of the Lafayette College engineering building was redone, I was shocked. I cannot express enough gratitude to Lafayette College for its efforts to establish locations for us pollinators to live. The space referred to as the Lafayette Gardens is now full of new plants that never use to exist. The living wall towers above the small gardens that are growing up from the ground, and during the spring and the summer, the space flourishes with life and color making it my favorite place to fly. Ever since the establishment of this space, the stress that has been weighing me down during my daily routine of pollinating has been reduced and I can take comfort knowing that some colleges are trying to make a difference during times when the state of the environment isn't great.

From the perspective from a sibling of a student:

As we start driving up the hill, passing by Williams, I notice all the greenery surrounding the stairs leading up to campus. I would always hear it from my brother that this part of the hill was tough to go up through, but the view is always worth it. As we got closer to Markle Hall, I just could not help but notice all of the beautiful landscaping the school has worked on. The flowers blooming, the pink cherry blossom trees, the huge green trees, this was just getting started. Thinking about choosing Lafayette College as my own college would be exciting, but it still has not sealed the deal! Once my parents and I parked the car behind Markle Hall, we started walking by the side of Old Oeschle, up the stairs, and started walking towards Acopian, where my brother said he lived most of his time. Is that not an academic building? Well, anyways, once we got closer to Acopian, I noticed something like a little forest up ahead. My parents noticed it as well and wanted to check out. The space gave the vibes of a little getaway from all of the chaos college may give students. There were small benches made out of wood that blended in well with the rest of the greenery. The poles with vines coming down also made the space feel like a small little forest, especially with all the birds, butterflies, and all of the biodiversity surrounding us. Not only that, but the space felt enchanted and so unreal, that it made me want to stay there longer. There were a couple of other people there, but it felt so quiet and calm compared to the people walking around outside of this area. Soon, my parents wanted to go see the rest of the college, but I think this space will be something that will always stay on my mind. This looks like it might be my future spot.

Chapter 1 – Introduction to Lafayette Gardens

Lafayette Gardens is a space of education, recreation, and place-making for any past, present, or future member of the Lafayette College community. Designed by a team of Engineering Studies students, the proposed layout implements a combination of artistic, technological, and environmental aspects as a way to display Lafayette College's interdisciplinary approach to education and the liberal arts. For anyone making their way towards Acopian Engineering Center (AEC), Lafayette Gardens will become an eye-catching location that is filled with plants and seating, lined by a border of spires, and featuring a large living wall that runs across the northeast wall of the building's brick exterior. And while this unique design may be different from most of the remaining infrastructure on campus, its motivation falls perfectly in line with two of Lafayette College's core values: sustainability and inclusion.

In today's society, anthropogenic climate change is a major concern due to the threat it poses to biodiversity, human health, and the current environment. Human activity since the industrial period has released high quantities of carbon dioxide and other greenhouse gases into the atmosphere, especially through the burning of fossil fuels, resulting in the deeply troubling increases in global temperatures (IPCC, 2014, p.8). Many organizations and policy makers are taking steps to reduce problematic emissions by encouraging the transition to cleaner sources of energy and less wasteful behavior. Colleges and universities are among these climate actors and are showing their support by developing climate action plans and promises to go carbon neutral in the near future. Lafayette College has been part of this movement for several years and, in 2019, the Office of Sustainability produced an updated climate action plan with the goal to achieve carbon neutrality by the year 2035 (*2019 Climate Action Plan*, 2019, p.3).

Although the construction of Lafayette Gardens was not part of this outlined plan, it will still play a significant role in the effort to make the campus more sustainable. Research in the field shows that green structures are associated with numerous benefits. Vertical gardens have shown to reduce air pollution by absorbing harmful particles, especially carbon dioxide, and noise pollution by its ability to affect sound dissemination (Ghazalli et al., 2019, p.9-10). They have also proven capable of acting as a passive system for energy savings, particularly due to a green wall's ability to provide shadowing and insulation for the building, evaporative cooling capabilities, and a wind barrier helps improve a building's overall efficiency. (Coma et al., 2017, p.229). Aside from the more technical benefits, our research revealed that green walls are incredibly multifunctional. For example, a well-maintained green wall can be used as a source of food by selecting edible plants for the vegetation type (Nagle et al., 2017, p.35), but it also creates shelters and habitats for various organisms including birds, pollinators, and even herbivores. The specific functions and environmental effects of the wall, however, are dependent on the selected plants (Chiquet, 2014, p.143-144; Chiquet et al., 2013, p.458). Green structures are also thought to be capable of improving academic performance according to the Attention Restoration Theory and Stress Recovery Theory, both of which imply that nature can have a positive impact on an individual's mental state and brain functionality (Hodson & Sander, 2017, p. 17-18; McCullough et al., 2018). Any economic benefits that arise from the wall will typically stem from previously mentioned environmental or technical benefits (Sheweka & Magdy, 2011, p.595). While there are various criticisms directed towards green structures, many of which express concern about cost, risk, or functionality, it has been made clear that careful research and preparation can result in a successful system (Riley, 2017, p.230). Fortunately, this form of tentative optimism has made it possible for green walls to steadily grow in popularity.

There are numerous examples of living walls throughout the world, all of which use similar structures but have unique appearances. Among the different types of vertical garden structures, the two most common are the green façade, which implies that the plants start from the ground and grow up a wall, and the living wall, which refers to a structure that allows plants to grow off of the wall and its associated support system (Radić et al., 2019, p.2). In order to define the potential scope of Lafayette Gardens and understand the full capabilities of the structure, our project team investigated numerous locations that already have successful living walls. One such wall is located in a residence hall at Georgetown University. Motivated by its capabilities in sustainability, the school turned to the company GSky to develop the 828 square foot interior living wall using a pot system known as VersaWall (Figure 1.1) (*GSky Green Wall at Georgetown University - Washington, DC*, 2014).

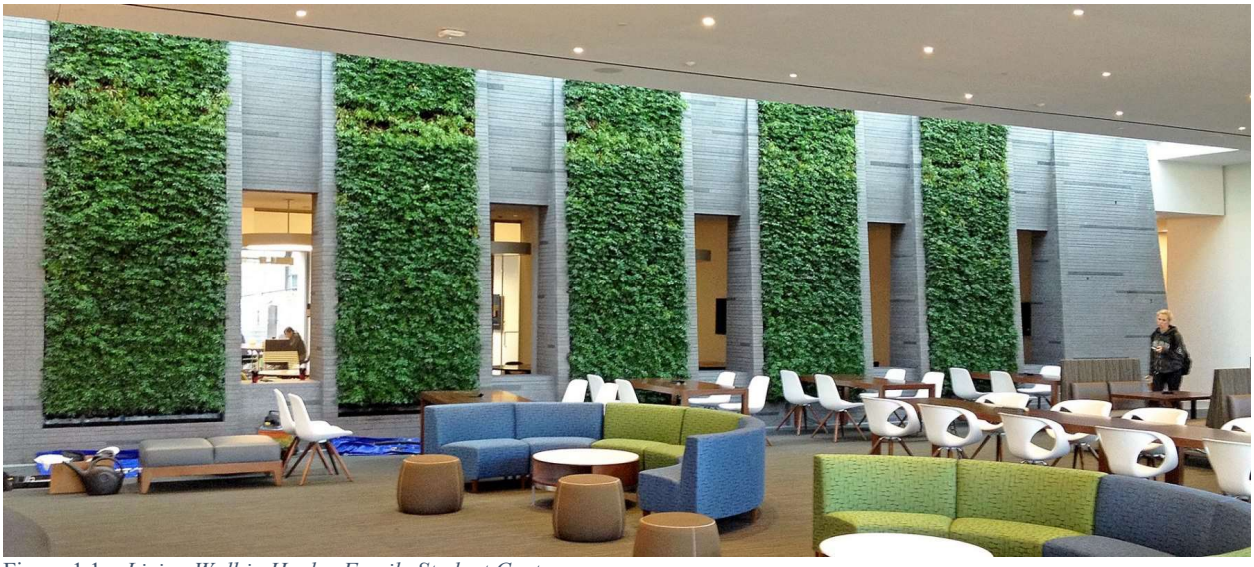

Figure 1.1 – *Living Wall in Healey Family Student Center.*
Developed by GSky in 2014, this living wall is 828 sq ft and uses 5,000 plants.
Image Supplied by GSky.com (https://gsky.com/wp-content/uploads/2020/02/gsky-green-wall-georgetown-university-washington-dc_1920x850_1_low.jpg)

Another case, which consists of several living walls that span a total of 57,307 square feet, is located at the Institute of Technical Education HQ & College Central in Singapore. The massive project that had been inspired by the school's efforts to be "eco-friendly whilst offering a

conductive learning environment" was constructed using a modular panel system provided by the company Elmich (Figure 1.2) (*Institute of Technical Education HQ & College Central, Singapore*, 2018; *VersiWall GM*, 2020).

Figure 1.2 – Living Walls at Institute of Technical Education HQ & College Central. Developed by Elmich in 2012 as part of the school's sustainability initiative. Image Supplied by Elmich (http://elmich.com/global/wp-content/uploads/2015/11/ITE-Central-05.jpg)

One final example is found at the Thomas Jefferson School of Law in California which chose to implement a green wall for its aesthetic appearance and sustainable nature. Located on the buildings terrace, the wall spans 85 feet and consists of panel system provided by GreenScaped buildings (Figure 1.3) (*TJSL's Green Wall Is Here!*, 2011).

Figure 1.3 - Thomas Jefferson School of Law Living Wall
Developed by GreenScaped in 2011, the living wall was implemented for aesthetic value.
Image supplied by TJSL (https://www.tjsl.edu/sites/default/files/website_photo.jpg)

The growing trend of living walls, in addition to the sustainability efforts present on many college campuses inspired our team to develop a design that would expand the wall's benefits into the surrounding space through the use of pollinator gardens. The current design of Lafayette Gardens will certainly be capable of assisting Lafayette's Climate Action Plan in its quest to improve air quality and biodiversity by acting as a miniature model of what sustainability looks like on campus.

The integrative design of Lafayette Gardens was developed over the duration of the fourteen-week semester in the spring of 2020, but the idea of combining art and the environment into an engineering setting derived from recent work by previous students in Engineering Studies (EGRS). EGRS is a unique major at Lafayette College that joins the engineering mindset with a liberal arts education, giving students the chance to develop skills necessary to approach problems in technical as well as economic, environmental, social, and political contexts (*Engineering Studies: Program*, 2020). As with many majors, EGRS requires its seniors to complete a capstone project, in this case, one that encourages students to realize how engineering

impacts society through solving a problem specific to Lafayette. In 2017 and 2018, two different EGRS capstone groups attempted to develop solutions that addressed the negative atmosphere associated with Acopian Engineering Center. Both teams found that Acopian is perceived as a stressful and intimidating environment by both engineering and non-engineering majors (Blake et al., 2017, p.11; Guarana et al., 2018, p.1). Many of the students surveyed in the reports noted that the competitive atmosphere within the engineering community increases stress for individuals in the discipline and creates a divide from non-engineers whose own efforts are sometimes written off as being easier or incomparable to the engineering workload (Blake et al., 2017, p.13; Guarana et al., 2018, p.17-18). Unsurprisingly, this atmosphere creates an unwelcome feeling in the communal building. Thus, in an attempt to relieve this negative tension, the capstone teams proposed altering the existing space through the inclusion of art. Public art has been implemented on college campuses for a variety of reasons including "embodying and reflecting the intellectual and creative mission of the institution, enhancing the aesthetics of a campus, fostering campus community spirit, and memorializing individuals or events significant to the institution's history" (Mankin, 2002, p.57). In the specific case of Acopian, the team hopes to use art to create a feeling of inclusivity, as well as creativity and innovation, into the building. While the 2017 capstone group looked at creating a river design in the main stairwell (Figure 1.4), the 2018 group focused their efforts on the northeast wall, proposing the use of a mural (Figure 1.5), light art (Figure 1.6), or a living wall (Figure 1.7) on the bare exterior. Both of the teams proposed solutions that applied art in a manner that mixed well with the engineering ideals as a way to show that Acopian is a place for all disciplines to work together. By looking at their analyses and solutions, our project team was able to expand on their ideas and develop a full design that incorporated the inclusivity goal.

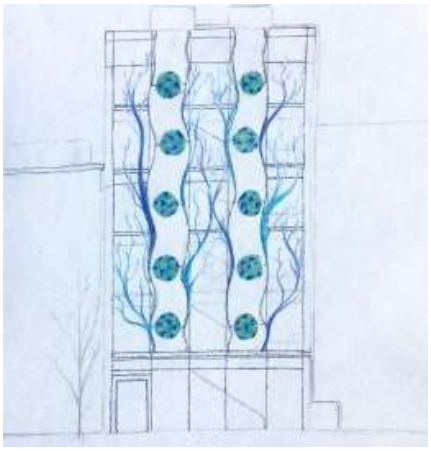

Figure 1.4 – Acopian Art Stairs
Developed for the 2017 Art in Acopian Capstone.
Millar, K. (2017).
(https://sites.lafayette.edu/egrs451-fa17/files/2017/11/IMG_4816-1-259x300.jpg)

Figure 1.5 – Final mural concept design.
Developed for the 2018 Art in Acopian Capstone.
Guarna, O. (2018). (https://sites.lafayette.edu/egrs451-fa18/files/2018/12/Scan-4-676x483.jpeg)

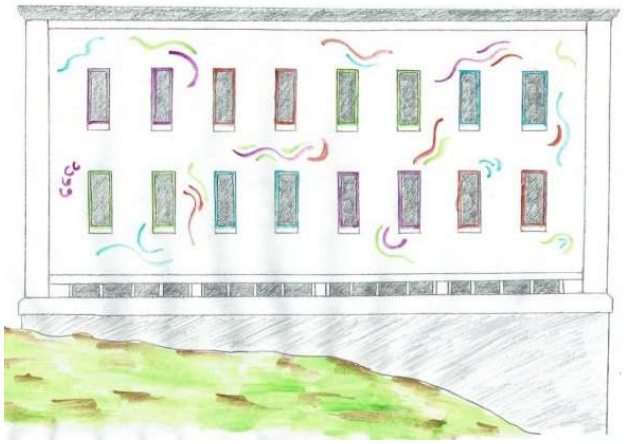

Figure 1.6 – Final light art concept design
Developed for the 2018 Art in Acopian Capstone.
Guarna, O. (2018). (https://sites.lafayette.edu/egrs451-fa18/files/2018/12/Scan-2-676x493.jpeg)

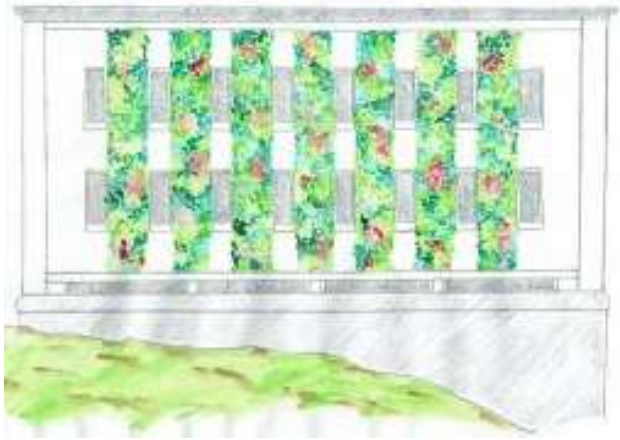

Figure 1.7 – Final green wall concept design.
Developed for the 2018 Art in Acopian Capstone.
Guarna, O. (2018). (https://sites.lafayette.edu/egrs451-fa18/files/2018/12/Scan-300x208.jpeg)

Whereas the capstone teams consisted only of senior Engineering Studies majors, the project team is made up of a small class section of the Sustainable Solutions course. This elective is an upper level Engineering Studies class that is open to all majors. It takes a real-world problem solving and requires the students to develop a solution, which in the case of the Spring 2020 class, focused on the plan to improve the atmosphere of Acopian Engineering Center. The project team, referred to as Greening Acopian at times, consisted of two juniors and three seniors in EGRS, in addition to the course professor (Cohen): Dominique (Nika) Cinicola, Bryce Currie, Diana De La Torre, Major Jordan, and Lisa Sholtz.

Each student had a specific role that was essential to the development of the final project. The team's acting Project Manager and course adviser was Professor Cohen. Having been the professor in charge of senior capstones in the past, he was familiar with the idea of integrating art and the environment into Acopian. In his role, he assisted in key communications with various resources on campus, ran the weekly meetings, and provided suggestions on the overall design. Nika Cinicola was the Communications Director, a role that required her to focus on organizing meetings, presentations, the final report, and the Greening Acopian website. Bryce Currie acted as the Chief Economist where he worked on determining the overall cost of Lafayette Gardens. By working with Professor Liu in the Economics Department, as well as contacts from potential vendors, Currie developed a cost estimate that accounted for both financial and non-financial attributes. A survey was created during the semester for the purpose of assessing the potential non-financial benefits, but was not distributed to the Lafayette community due to the sudden transition to virtual learning in March following the COVID-19 outbreak. The role of Environmental and Sustainability Engineer was taken on by Diana De La Torre. Throughout the semester, she investigated ways to ensure that the space became one for both the college

community and the various living organisms that will interact with it. She looked specifically at the possibility of incorporating native plants and bat boxes on the living wall to help increase biodiversity and also determined the plant types that will be used in the surrounding pollinator gardens. Major Jordan took on the role of the Structural Engineer where he was responsible for determining the various structural aspects for the proposed design and ensuring that the final structure will be both structurally sound and financially feasible. His role has thus involved accounting for all necessary parts of the structure, calculating the stress and load of the structure, and ensuring that the proper procedures for installment are outlined. Lastly, Lisa Sholtz was the team's Artistic Design Director and was responsible for developing the visual components of the project in a way that created a cohesive space that will be aesthetically appealing, practical, sustainable, and feasible. Sholtz has been in charge of creating a complete design plan for Lafayette Gardens, as well as developing a computer-generated rendering of the final design.

Together, this six-person team brought into reality a design that has the capacity of improving the atmosphere associated with Acopian. Through the assistance of on-campus resources, especially Professor Mary Wilford-Hunt, Professor Joe Biondo, Professor Jim Toia, and Professor Scott Hummel, the project team was able to develop an entirely unique and beneficial space for the Lafayette campus. While the project scope may have started off small, with the team looking only at the wall itself, it gradually expanded to include the surrounding ground area thus creating a collaborative space for community members of all different disciplines and interests to interact and learn.

The following report will explain in greater detail the process our team followed to arrive at the final design for Lafayette Gardens. Chapter 2 will specifically talk about the visual design aspects, describing the features included and the intentions behind them. Chapter 3 will expand

on the structural design of the space, including a discussion of the selected structures and any calculations used to support these decisions. Chapter 4 will go into greater depth on the environmental benefits as well as review how different sustainability factors played a role in the final layout. Chapter 5 will provide details on the economic portion of the project by discussing the cost of development and the non-financial benefits that Lafayette Gardens has to offer. Lastly, Chapter 6 will conclude the report and offer recommendations and suggestions for the college administration should they choose to progress forward with our project.

Chapter 2 – Design

Introduction

The goal of this project is to facilitate interaction between students from all areas on campus. With that in mind, the project's first step was to expand beyond the two-dimensional surface of the wall of the Acopian Engineering Center and consider a space that students could inhabit. The team determined that creating a communal space will be the most effective way to facilitate collaborative interactions. The proposal incorporates design elements that will make the Lafayette Gardens a space that students of all majors, faculty, and visiting families will seek out. A SketchUp design of the proposal is included in Figure 2.1. The design proposal is divided into four component areas: the wall, triangle, spires and wires, and the ground surface. This chapter reviews the design motivation, process, and choices the team made as we defined Lafayette Gardens.

Figure 2.1 – Lafayette Gardens Rendering: Design Overview
Sholtz, L. (2020)

Literature Review

Engineering educators have long recognized the need to "prepare engineering students to not simply be analytically and technically capable, but more importantly to be creative thinkers." Studies have shown that engineering students are not fully comfortable thinking creatively and considering their designs for real-world contexts. To accomplish this, educators and administrators must redefine engineering curriculum. This redefinition should include an increased focus on creativity and innovation to produce well-balanced students within the global economy. Artists and engineers have great potential in working together creatively to solve complex environmental issues (Constantino et al. 2010, p.49-52).

Nature is crucial for cognitive development and the mental and physical well-being of students. Particularly, reduced contact with nature could limit academic performance and success in life. Further research has linked exposure to urban green spaces with improved focus, increased vitality, and reduced stress levels, which could positively affect educational outcomes for individual students. This can be explained with two existing theories: Attention Restoration Theory and Stress Recovery Theory. The first suggests that students exposed to green environments may be able to focus more effectively for longer periods and thus should experience enhanced school performance compared to students without such exposure. The second, suggests that exposure to nature allows for recovery from stress which results in positive feelings related to safety and survival (Hodson and Sander 2017, p.16-18).

To build on the importance of nature, vertical greenery could act as art in public spaces. Increasing vertical greenery technologies on the walls of our buildings create "public art that is environmentally sound." Both public art and vertical greenery contribute to the quality of life as they "complement each other in terms of its aesthetic, environmental, and economic quality."

Research studies show that a combination of both will create public art that is high in aesthetic quality and environmentally sound (Bakar et al. 2014, p.236).

Our team was motivated by this review of the many mental, physical, and creative benefits of incorporating a living wall into a space. The next four sections of this chapter incorporate the research from the literature review into a design proposal for the wall, triangle, spires and wires, and ground surface. Each of the four areas provides a unique opportunity to incorporate plants, art, animal biodiversity, and relaxation into Lafayette Gardens. The sections outline the art forms the team considered the decisions that the team made, and future design considerations.

Wall

Initially, the team considered a number of different art forms to incorporate into the wall design. These included light, painting, fabric, and plants. Based on the environmental and creative benefits, as summarized in the literature review, plants quickly stood out as the art form to proceed with. Once the team made the decision to proceed with incorporating plants into the wall design, the next consideration was if these should be in the form of a green facade or a living wall. Both systems would achieve our goal of incorporating greenery to the area but in different ways.

A green facade is composed of climbing plants growing vertically to cover the facade of a building. Plants can grow directly on the facade or on a structure independent of the building. More often, a green facade is "composed of a continuous or modular trellis that supports the growth of vining plants installed above, on, or below the trellis" (Nagle and Tamminga, 2017, p.23). Our group considered an independent trellis system, as allowing plants to grow directly on the facade of Acopian would likely compromise some of the structural integrity of the brick

facade. A trellis system is implemented by installing planter beds at the base of a wall. The trellis system provides a structure for the plants to latch on to while growing. The planter beds contain all of the roots of the plants and therefore are the only piece of the structure that needs irrigating. One major limitation of a green facade is that plant selection is limited to climbing plants.

A living wall is "composed of continuous screens or modular trays, vessels, planter tiles, or flexible bags that hold the growing medium and the plants" (Nagle and Tamminga, 2017, p. 23). This independent structure allows plants to grow in containers off of the wall. These containers provide the structure with soil, irrigation, and drainage in a single system. Then, plants grow directly in these containers. A living wall system is structurally more complex than a green facade but provides greater flexibility in plant selections. As the plants are potted, any plant that typically grows in a pot and matches the sun exposure level of the wall can be grown.

From a design perspective, the big attraction that a living wall offers, over a green facade, is the ability to incorporate patterns into the wall. A living wall system exponentially expands the plant choice options that are able to grow on the wall. A trellis system would have limited the plant choice to vines and strictly vertical patterns. With a living wall system, the design can incorporate a wide variety of plants which can be arranged in various patterns on the wall. This wide variety of plant choice is important as it allows for four-season flexibility. We are able to intentionally select the plants so the wall remains green during all four seasons. Additionally, different plants bloom during different seasons, so a living wall allows for different patterns to be developed in different colors during different seasons. The team valued this flexibility in plant placement and patterns significantly, which made a living wall a better selection than a trellis system.

The next consideration was how much of the wall to cover in a living wall and what shape we wanted the structure to take. The team considered four different orientations: vertical stripes, horizontal stripes, diagonal stripes, and a gear-like shape to represent engineering. As a team, we recognized this was a major decision for the project because it will be a key component of the aesthetic value of the wall. The first design we decided to drop was the gear. We did this in order to maintain a collaborative space null of any favoritism towards one specific part of campus. Figures 2.2-2.3 displays vertical and diagonal stripes. Ultimately, the decision came down to what would be the most technically feasible. We determined vertical stripes, between each column of windows, would simplify irrigation, attachment points, and maintain some visibility of brick. Maintaining the visual anchor of the brick on the wall will help tie the building into the surrounding campus. Then, to break the strict linearity of vertical stripes, careful plant choice selection will add color and pattern to the design to help with aesthetic value. We have even thought of incorporating various types of plants that change their appearance throughout the year to paint a different picture on the wall depending on the season.

Figure 2.2 – Proposed Orientation: Every Vertical
Sholtz, L. (2020)

Figure 2.3 – Proposed Orientation: Diagonal
Sholtz, L. (2020)

Triangle

Upon initial observations of the wall, the large triangular concrete block stuck out as an area that was not being artistically utilized in any way. Figure 2.4 displays this space with a yellow arrow pointing to it. Currently, the face is a blank canvas and would be a logical area and a great opportunity to add another artistic component to our design. The concrete triangle sits between the brick portion of Acopian and the grassy hillside, which provides an artistic opportunity to transition between the living wall and the grassy area.

Figures 2.4 – Concrete Triangle: Location
Sholtz, L. (2020)

Due to the raw and undefined nature of the triangle, we had a variety of different options that we could pursue in its design. These included plants, a mural, or writing in the form of a free speech wall. Examples are displayed in Figures 2.5-2.7. Our team considered the core principles guiding our design ethos, as we discussed the best way to design the triangle. Because we are most interested in fostering a collaborative space that draws people together and includes as many campus stakeholders as possible, we decided to feature another big audience of the space, admissions! The mural will creatively express the school motto, Cur Non: Why not you? Why not here? Why not now? Figure 2.8 represents a possible mural design. When prospective students and their families arrive at Lafayette, they typically park in Markle Parking Deck. The College is planning on adding another story to the parking deck, so families will have a straight view of Lafayette Gardens. Additionally, when tours exit Markle Hall, the first thing that families see when they look to the right is the Lafayette Gardens area. The triangle is another opportunity to draw the eye and provide an anchor for tour groups and visitors. Our team is confident that the Lafayette Gardens would be a memorable addition to the admissions tour

experience. We believe the mural would be a great way to feature a student artist. The exact visuals of the mural will be defined when an artist is selected.

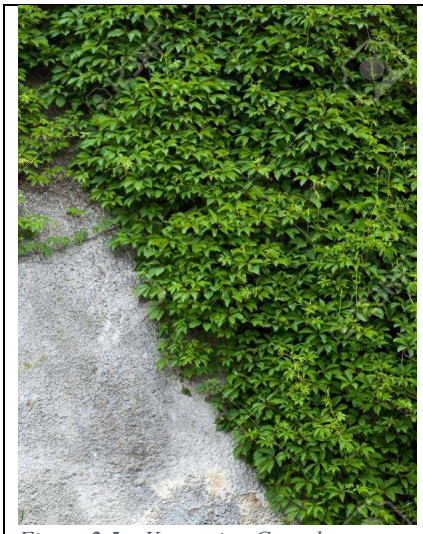

Figure 2.5 – Vegetation Growth
Image supplied by Rootstocks
(https://previews.123rf.com/images/rootstocks/rootstocks1410/rootstocks141000250/32426186-old-concrete-wall-covered-with-the-green-ivy.jpg)

Figure 2.6 – Mural (as seen in Easton)
Sholtz, L. (2020)

Figure 2.7 – Free Speech Wall
Image supplied by Charlottesville
(https://assets.simpleviewinc.com/simpleview/image/fetch/c_fill,h_500,q_75,w_718/https://assets.simpleviewinc.com/simpleview/image/upload/crm/charlottesville/freedom-of-speech-wall-e35e20a55056a36_e35e21a2-5056-a36a-06f897607666bfa1.jpg)

Figure 2.8 – Lafayette Gardens Triangle Rendering: Possible Mural Design
Sholtz, L. (2020)

Spires and Wires

In order to meet the project definition of creating a multidimensional collaborative space, the team decided creating a communal space would be the most successful. If the design proposal was composed of just a living wall and mural, we do not believe students would seek out the space. The team decided to incorporate spires and wires into the space to provide physical definition so the Lafayette Gardens feel like a destination to walk through, relax, and learn. The team anticipates that connecting six spires along the road to the wall with thin wires will create a canopy. We believe students are more likely to seek out the area as it will feel like a three-dimensional communal space. This section of the report is composed of a design analysis of both the spires and wires. There are two components to this section. Chapter 3: Structural outlines the technical feasibility of the spires and wires in greater detail.

Spires

For the spires, incorporating six curving spires into the space will add an artistic statement to the space while also providing definition to the space. Figure 2.9 represents a possible curving spire selection. Then, arranging the spires 12 feet apart in a snake-like pattern curving along the road will combat any fence-like feelings to maintain the area as an inviting space, as displayed in Figure 2.10. The six spires represent the six different disciplines of Engineering at Lafayette. Increasing the height of the wires as the hill slopes down will scale the space down to create a welcoming entrance while opening up the space as the user enters. The spires allow the opportunity for light to be included in the space. As part of this project, the team did not investigate the logistics of this. As the project moves to the next phase, additional planning should be completed to extend the space and incorporate more spires into the design.

The team does not anticipate these spires being connected to wires, but instead to expand the space of the gardens and invite students in.

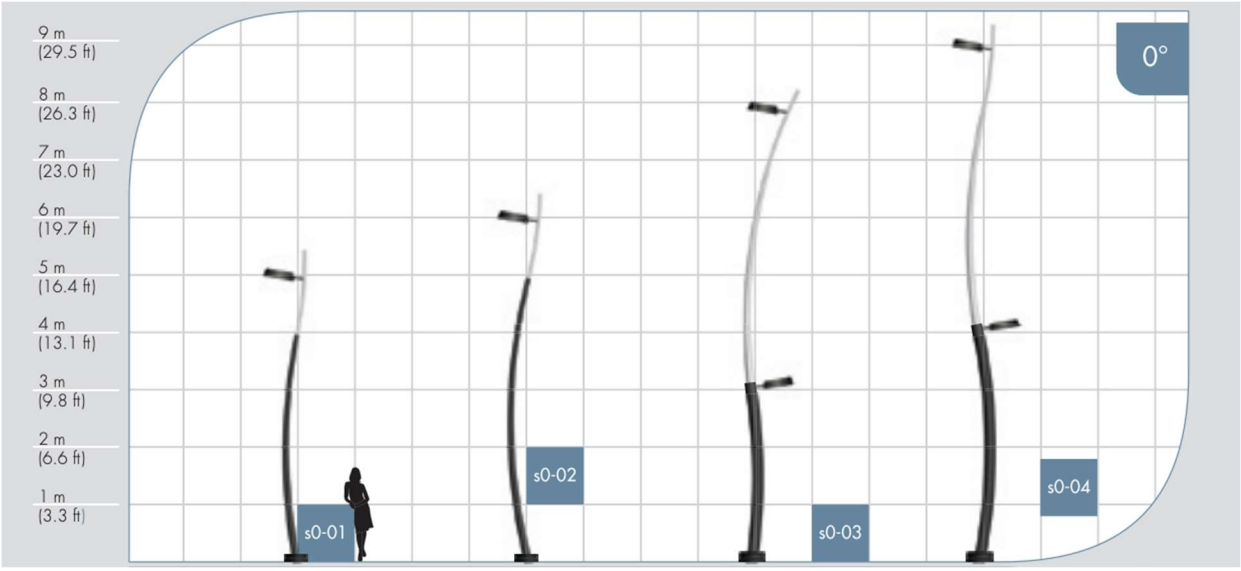

Figure 2.9 – Spires: RTA Idyline Sigma Pole
Image supplied by Valmont Structures
(https://webassets.valmont.com/valmontstaging/vsna-specification-pages/rta-idyline-sigma-(spc7245)-0215.pdf?sfvrsn=2)

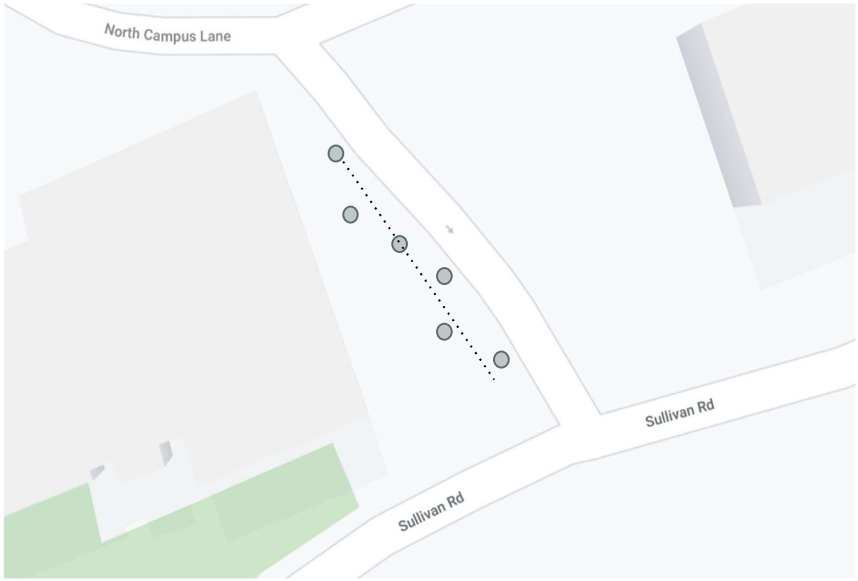

Figure 2.10 – Spire Location: Snake Orientation
Sholtz, L. (2020)

Wires

The team decided to connect the six spires to the wall of Acopian with thin wires. This will create the idea of an enclosed space without actually closing off the space. Selecting a thin 1/8th inch wire will allow vines to grow across the space while minimizing the weight of the load that the wall and spires will have to carry. Our team proposes that a wire be connected to the wall of Acopian in each section of the living wall. The living wall will mask the attachment points, so the metal bolts are not visible. The team decided that we would not limit our design considerations to one wire per living wall section. That being said, the team wanted to be conscious of the structural limitations of the spires. Since there are six poles to attach the nine+ wires to, Lisa Sholtz developed a wire pattern to balance symmetry and the structural limitations of the spires with the creation of a semi-enclosed canopy feeling. The pattern is represented in Figures 2.11- 2.12. The 14 wires will connect to the wall in a 1-1-3-1-2-1-3-1-1 pattern, while the same 14 wires will connect to the spires in a 3-1-3-3-1-3 pattern. Additionally, to maintain a consistent height to the canopy, we propose attaching the wires to the wall of Acopian in a parabolic curve. Figure 2.13 represents these attachment points on the wall. Additionally, these wires will provide an opportunity to grow vines across the space. We believe this will further solidify the natural elements of the space. Our team recommends that further research be done on an implementation plan for growing vines across wires.

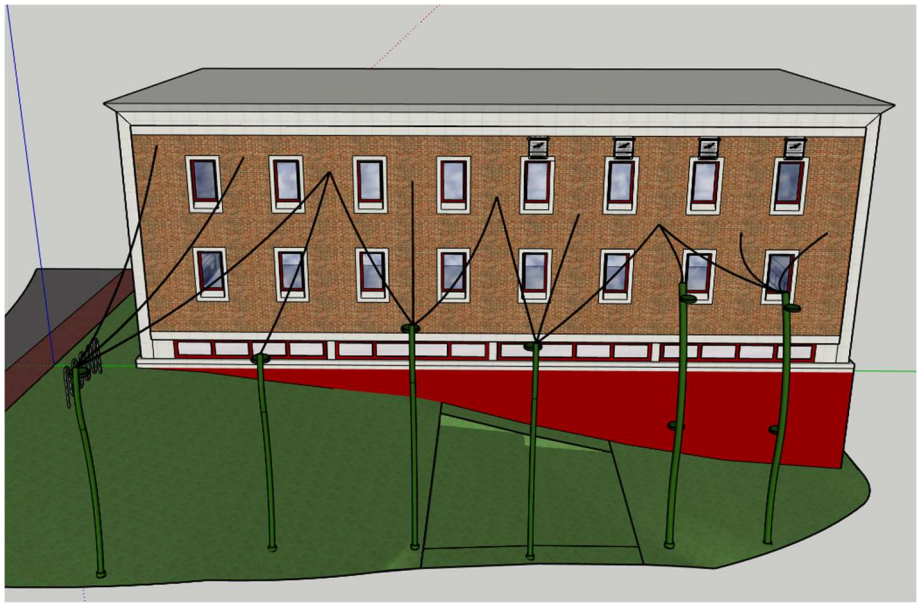

Figure 2.11 – Wire Pattern: Markle View
Sholtz, L. (2020)

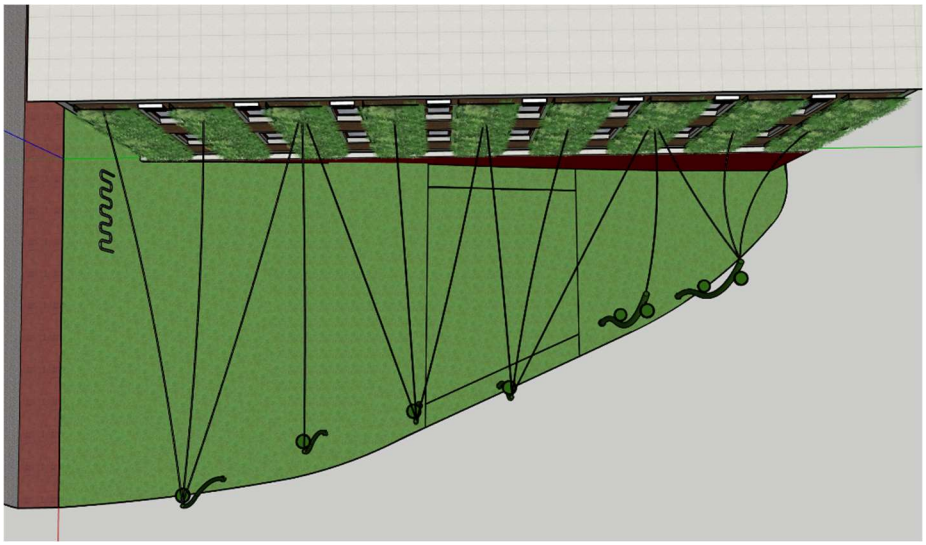

Figure 2.12 – Wire Pattern: Overhead View
Sholtz, L. (2020)

Figure 2.13 – Wire Attachment Points: Parabolic Pattern
Sholtz, L. (2020)

Ground Surface

Once the scope of the space was established, the team focused on maximizing the functionality of the area and aligning it with the sustainability initiatives of the College. Our team viewed the ground surface as an area to connect the space to the surrounding campus area. By using similar materials to Skillman Library, similar plant selections to the pollinator gardens that will be located in front of Acopian, and similar seating choices to the quad the area will be well integrated within the greater campus. There are three additional primary components within the ground surface plane: a stepping stone pathway, native plant gardens, and seating.

Path

One of the current primary uses of the space is to provide a pathway for students traveling down to the sports complex. This is apparent by the worn grass path in the existing landscape. The design proposal includes the pathway as an intentional and functional component of the space. As there is a sidewalk on the other side of the road leading down to the parking

deck, a stepping stone path is the best way to create an intentional, but informal, pathway. An example of this is represented in Figure 2.14. Pennsylvania Blue Stone will tie the space into its surroundings by connecting the space to Skillman Library and use a locally sourced material.

Figure 2.14 – Stepping Stone Path: Pennsylvania Blue Stone
Image supplied by Alex Smith Garden Design, Ltd.
(https://diy.sndimg.com/content/dam/images/diy/fullset/2013/3/6/0/CI-Alex-Smith_Garden-Design_stone-pathway-stone-arbor-wall_s3x4.jpg.rend.hgtvcom.616.822.suffix/1420762722041.jpeg)

Gardens

Adding native plants to the ground level will maximize the positive environmental impact the space has. This will provide critical habitats for pollinators. Aesthetically, the plants will add color and texture to the space. The team proposes that pollinator gardens be placed in front of the triangle and around the spires, as displayed in Figure 2.15. As different plants are alive and blooming during different seasons, this will add another seasonal dimension to the space. Chapter 4: Environmental will discuss the specific plant choices, layout, and benefits of incorporating additional plants into the space. Our team proposes that hedges be incorporated into the space to provide acoustic separation between the Lafayette Gardens and the road up

from Markle Parking Deck. As the project moves to the next phase, additional research should be done to incorporate acoustic separation into the space.

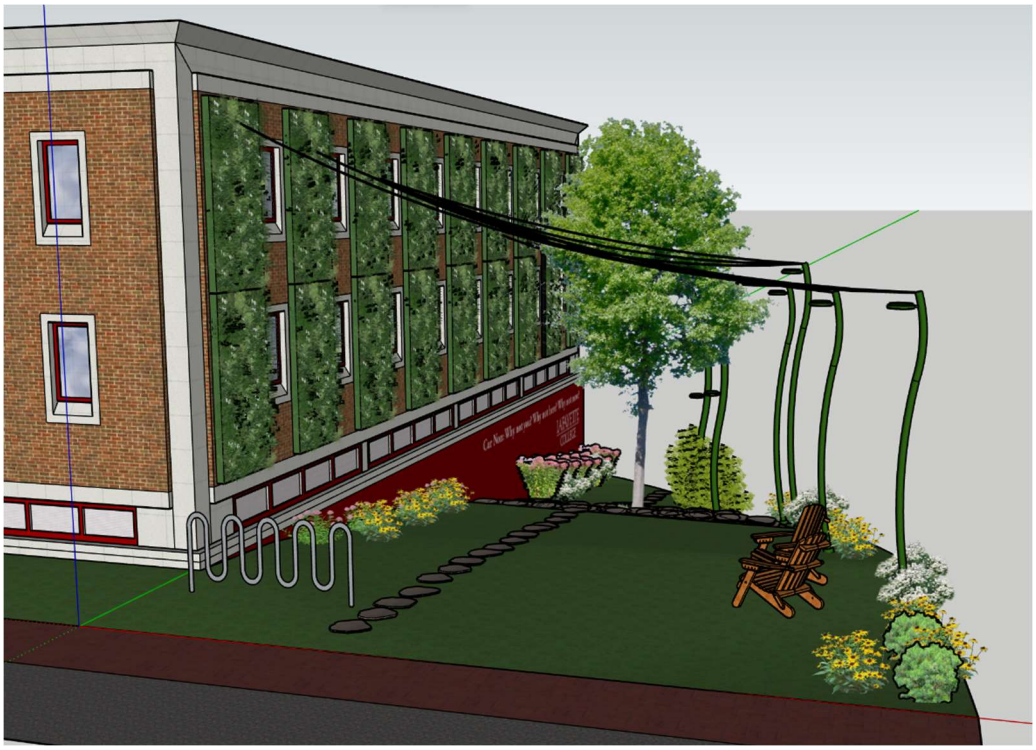

Figure 2.15 – Gardens: High Street View
Sholtz, L. (2020)

Seating

To further solidify the purpose of the space, there are two forms of seating in the space. Adirondack chairs will provide comfortable seating and tie into the aesthetics of campus, as they are sprinkled across the quad and various courtyards. As the area is situated on a hill, we propose these Adirondack chairs be placed in the area near the sidewalk, as represented in Figure 2.16. Further, two terracing notches will function and appear like a small amphitheater. Constructing this out of Pennsylvania Blue Stone will create further unity in the space. These terraces are inspired by the Scott Outdoor Amphitheater at Swarthmore College, as visible in Figure 2.17. The team has been in contact with Paul Deery, a landscape architect, to further develop the plan

for the space. As represented in Figure 2.18, Deery takes our design proposal and further develops the gardens and terrace structure and orientation. The digital sketch develops three terraces with a flat area for outdoor class instruction. In the next phase of the project, our team recommends that the College should follow up with Paul Deery to develop a more refined design proposal.

Figure 2.16 – Adirondack Chairs: Sidewalk View
Sholtz, L. (2020)

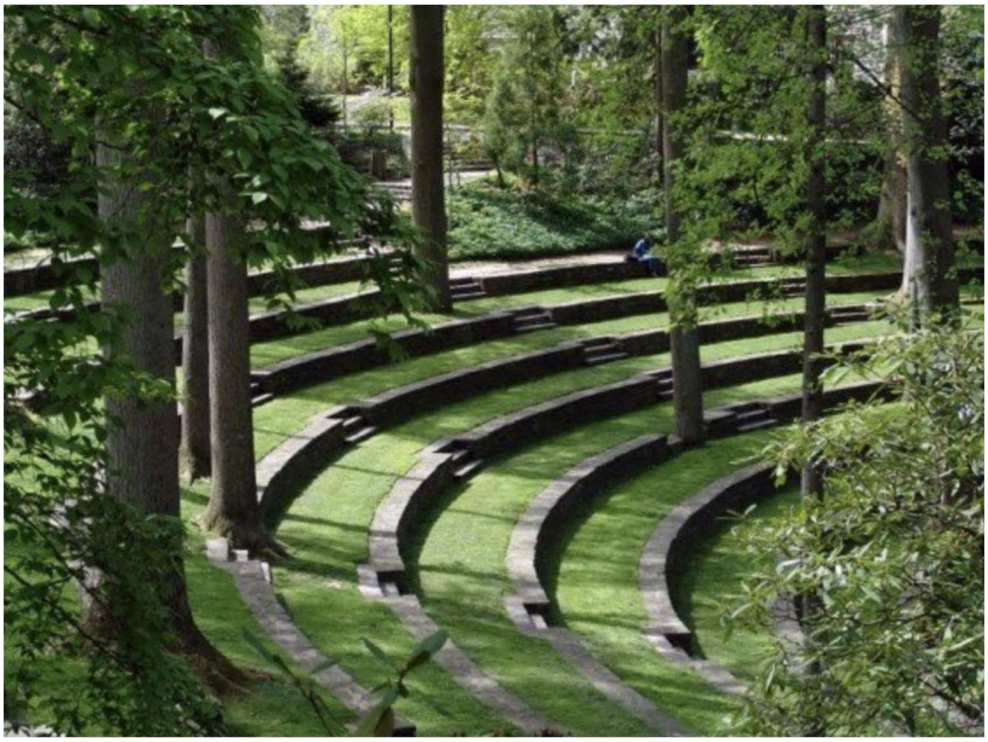

Figure 2.17 – Scott Outdoor Amphitheater: Swarthmore College
Image supplied by Swarthmore College
(https://www.swarthmore.edu/sites/default/files/styles/standard_page_header/public/assets/images/timeline/1929%20Scott%20Arboretum.jpg?itok=SmaGQVK4)

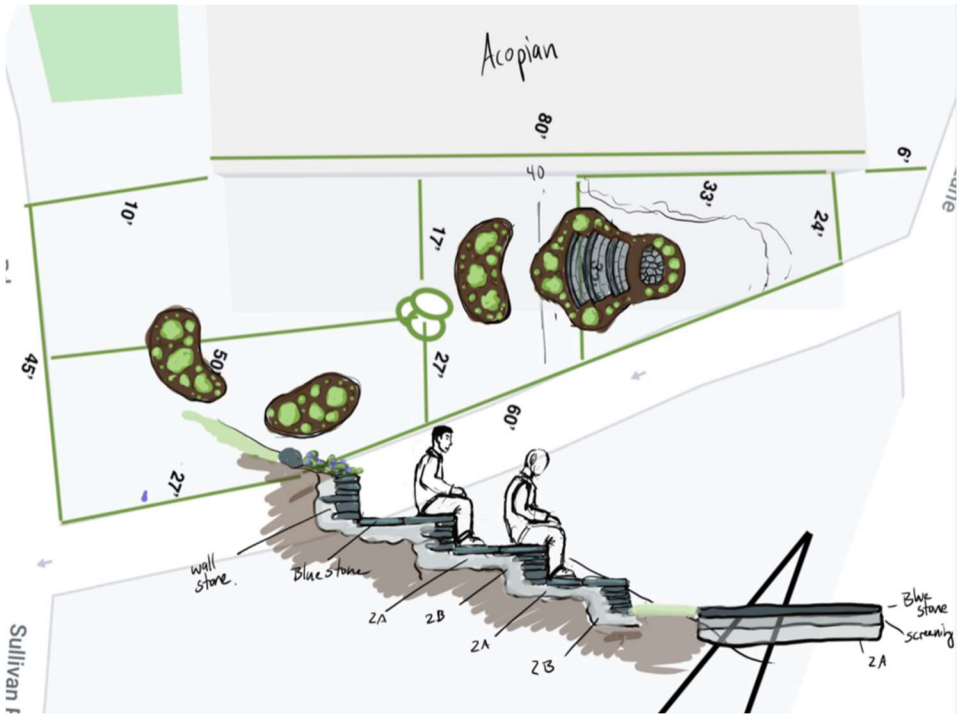

Figure 2.18 – Paul Deery Landscape Design: Google Maps View
Deery, P. (2020)

Conclusion

Each of these components as they relate to structural, environmental, and financial considerations are discussed more in-depth in the following chapters. In the next phase of the project, Our Team recommends that a landscape architect is hired in order to further refine the design proposal and investigate adding additional spires to extend the scope of the space, adding hedges between spires to increase acoustic separation, growing vines up the spires and across the wires, and adding light to the space. Design renderings were prepared using SketchUp Pro 2020. Figures 2.19-2.21 model a view of Lafayette Gardens from High Street, Markle Parking Deck, and Markle Hall. These represent the view a student walking to class, a professor exiting Markle Parking Deck, or a prospective student beginning their tour of Lafayette College could have. The technical feasibility of this design proposal is included in the following chapter. Later chapters detail the environmental and financial considerations of the project.

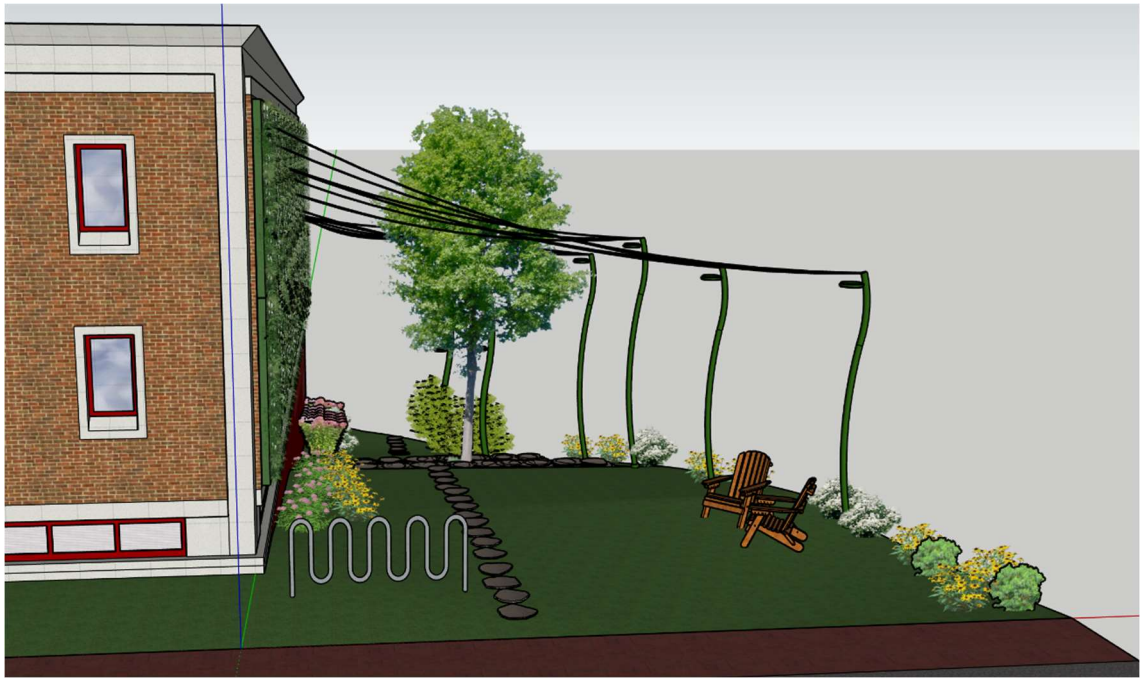

Figure 2.19 – Rendering of the Lafayette Gardens: High Street View
Sholtz, L. (2020)

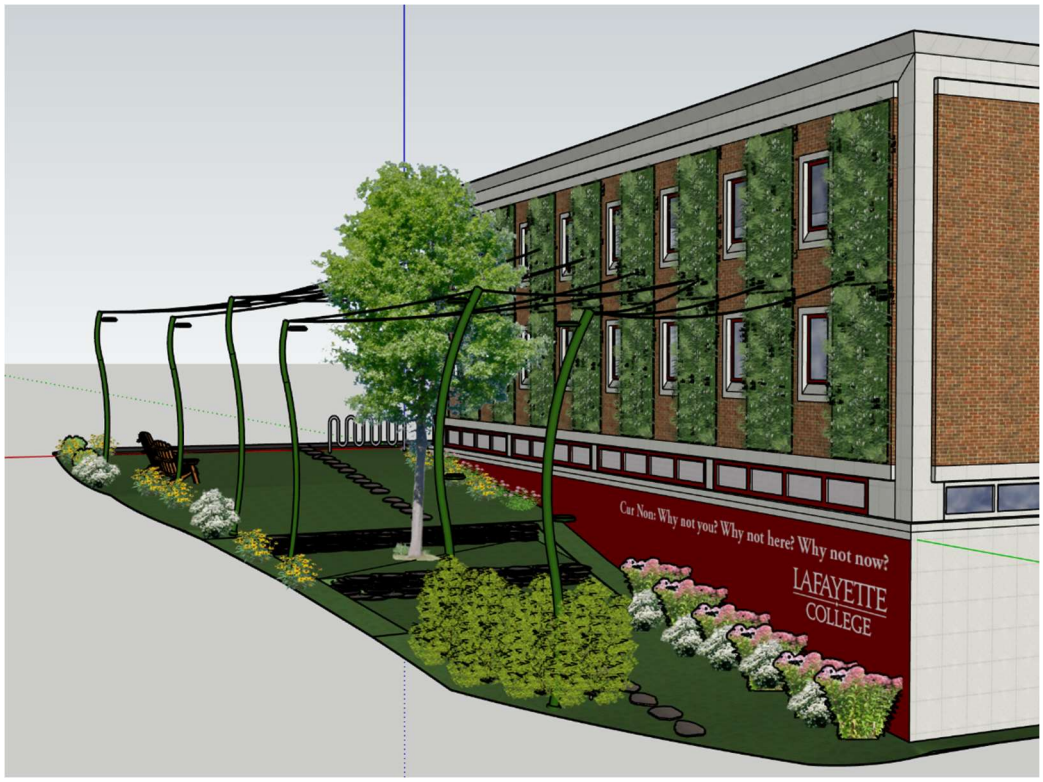

Figure 2.20 – Rendering of the Lafayette Gardens: Markle Parking Deck View
Sholtz, L. (2020)

Figure 2.21 – Rendering of the Lafayette Gardens: Markle Hall View
Sholtz, L. (2020)

Chapter 3 – Structural

Introduction

This chapter delves into the fundamental building blocks of the Lafayette Gardens project. The analysis will explain the process of selecting the company and specific products in regards to the living wall, spires, and wires. The chapter also further analyzes the final selected products and the reasonings for choosing them. It identifies the final components of the living wall, spires, and wires to ensure safety and structural integrity. Lastly, in this section we will provide basic structural engineering calculations on the LiveWall structure, wires, and spires. To ensure further safety, we encourage readers to refer to each structure's specification sheet on their respective website for more detailed information.

Literature and Sources

Information to find living walls was done through research methods to find various companies for the living wall project. With the help of the team, we ranked the components appropriately to ensure the best structures for the design. Living wall technology and companies have recently scattered across the United States, so the objective was to find a reliable and professional company for the job. This company must be reliable in terms of the structure of the living wall and the irrigation system that supplies water. For the wires, information was collected from US Cargo Control (*US Cargo Control*, 2020) and Knot and Rope (*Knot & Rope Supply*, 2020). The design required a wire and a rope that would connect from a spire at one end of the open space to the living wall at the other end of the space. As a result, the wire or rope that was selected must be sturdy and structurally supportive of the elements it may experience like snow or rain.

The spires for the project were very similar to the remaining components. The team gathered all information from research. Research began with using the Light Poles Plus (*LightPolesPlus.Com*, 2020) website to gain fundamental background information for material used for these spires. Light Poles Plus is a certified company that provides sustainable poles for municipalities in the United States. After gaining the basic knowledge, Valmont Structures is a company that provides the aesthetically pleasing and abstract design we desire. So the team gathered further information using Valmont Structures (*Valmont Structures*, 2020) to find the spire necessary for the project.

Living Wall

With the rise of this new technology, the goal was to select a company with professional knowledge and quality materials to ensure the safety of the Acopian building and the people near it. For the living wall, we considered four options and their companies for the implementation of the living wall. The main considerations for the company was a reliable, professional, aesthetically, and structural safe company product.

GrowUp

GrowUp was one of the candidates for the living wall structure (*GrowUp Greenwall*, 2020). It can be used for a variety of different projects, both small and large. This makes the system very flexible to fit the unique designs of different projects. The system includes a water tank that is on the ground to hold and contain the water for irrigation. One of the main considerations for the project was the orientation of the wall itself. We had to think of several possibilities including both vertical and horizontal implementations of the system. GrowUp's flexible system would allow considerations for various design options. The system includes a pump for irrigation purposes to keep the tank full of water. Next is the vertical rails, their main

purpose is to provide a connection component for the pots to adhere to the wall. Once again, our design standards can determine which way the vertical rails are installed. The next component is the pots. The pots are connected to the structural rails and hold the plants. The irrigation line pumps the water from the tank to the top of the wall, then the float sensor releases it to water the plants.

WonderWall

Next, we considered WonderWall (Wonderwall, 2020). The system is simple and efficient to use. WonderWall's website provides a video on how to install WonderWall, claiming that installation is so easy that children can do it (Wonderwall, 2020). The video is very encouraging because it presents a scenario much like Acopian's northeast wall. The video shows a brick wall, and the installment of the WonderWall to it using wooden boards as the anchors (batons) for the plant pots. The installment includes putting an 11-13 cm plant pot, placing it directly into the planters ensuring the pot is touching the reservoir base. Once the plant is inside, the user just has to make sure there are no impurities or leaves blocking the water pot outlet, which allows for downward irrigation. The system can be irrigated either by self-watering or installing a simple irrigation method. One square meter is composed of 14 planters,so a total of 42 plants are required. Large projects recommend using a waterproof membrane behind the structure to protect the wall. The toughest aspect of the WonderWall is not having a low maintenance watering system, but they have also provided information on that as well.

Tournesol

Tournesol was one of the top candidates for the Lafayette Garden wall (*Tournesol*, 2020). The trellis panels have an extra coating of zinc prior to powder coating to resist rust and corrosion. Panels are manufactured with 3" and 6" grid elements spaced 3" apart. Two modular

sizes are available with connecting brackets, larger panels are as easy to put together by using two screws. The gap between the wall and the trellis can vary depending on what design is wanted. Meaning it can be as far as 18" out from the wall if access to the wall still needs to be available. This can be helpful for protecting the wall and for structural wall purposes. Mounting to the wall will be a key part of the design. If panels are to be connected based on design, additional hardware will be required (1/4-20 x ½" Hex Bolt, Hex Nut, Lock Washer, and Flat Washer). Tournesol offered a safe and secure structure that would allow for a great living wall design. The modular trellis measurements were a great fit for the Acopian wall and would provide the pattern desired. It had the potential to take natural native growing vines from Lafayette College and allow them to grow up. Although it was a great candidate, the biggest concern for the modular trellis was the uncertainty. When working with a structure like this, the question was how were the plants or vines going to react to this structure? Along with that question, this structure was only capable of working with vertical growing plants like vines, which would then take away the aesthetic diversity green walls have to offer. Secondly, these vines will need to take time to grow up the trellis and reach certain desired heights. Instead, other designs can allow plants to grow throughout the entire wall all at the same time.

LiveWall

Our team decided the company most reliable and professional for the job is LiveWall (*LiveWall*, 2020). The LiveWall company and structure stood out because they are horticulture professionals with an elegant structure that embodies the natural orientation for plant growth. LiveWall's pots allow plants to grow parallel to those in nature, the natural orientation of plants.

LiveWall's system is efficient and composed of high-grade materials. The material and components are created with strict quality measures and allow for different compatible irrigation

systems from other manufacturers. The components are also clearly supported with various measurements to allow for installation in very diverse projects. Many other structures and companies considered were missing many pieces and required various parties to contribute to completion. The fact that LiveWall contributes most of the components needed to complete the project was very appealing to our team. LiveWall will provide a contractor-sourced breathable hanging protective backing which will allow the building to safely breathe while the living wall is in place. Tyvek Commercial Wrap D is one possible material for the outside. This will accommodate the Acopian wall's health and dexterity. Once installed the next component of the wall is the furring strips (VertiRail) usually centered at 16" using space wall anchors spaced 12" apart vertically. This will be the main source of connection for the living wall to the brick wall. LiveWall will provide a horizontal slot rain on the bottom row of the wall to hold the bottom row planters in place. This installment is based on the design desired by planter drainage and will allow the planters and rows to properly be aligned. We propose using bottom drain planters which will make the bottom of the slot rail align with the bottom of the furring strips (VertiRail). The installment of rainrails is the most crucial part of the LiveWall because it allows the planters to receive the water. A gap tool will be used to place rainrails in their correct orientations to allow for proper irrigation. The rainrails will be directly drilled through the v-notch with fasteners and anchored to the furring strips (VertiRail). The structures for water irrigation to the living wall are in place and just need to be connected and attached to the water main line. (*LiveWall*, 2020)

Rainrails come in various sizes, so LiveWall prepares a Rainrail Connector to connect adjacent Rainrails. They will provide a RainRail end plug at the end of each row to stop the water. They will also provide RainRail Adapters for systems with side irrigation which is what

we are considering. The RainRail Adapters will be used to connect to the irrigation structure. The irrigation structure or irrigation main line will need to be installed to a ¾" mainline with minimum 25PSI water pressure and 10 gallons per minute water volume to provide adequate water flow. Access to water a source at Acopian is located on the bottom floor and on the second floor. Typical mainline will include backflow preventer with an integrated air gap (required by code), and screen or disc filter. Descaling housing and cartridges may be included to prevent mineral buildup in nozzles or drip emitters. If fertilizer injector is included, follow instructions to dilute fertilizer solution and set rate of uptake. Fertilizer buckets must be placed below the fertilizer injector to allow uptake of solution. All the various components involved with the main line irrigation system is vital for the efficiency and sustainability of the system. (*LiveWall*, 2020)

The next step is to mount an irrigation controller and hook up to the electrical supply. LiveWall will provide pipe and fitting which are used to connect irrigation valves to pressure regulators and to RainRails to complete irrigation feed. Once finished, nozzles or drip emitters may be used along RainRails to control water release. Various spray nozzles and drip emitters are provided with desired flow rates. LiveWall will provide brackets to help hold the side irrigation feed. Refer to the installation manual (pg.12) provided by LiveWall for bracket configuration. LiveWall, after the irrigation system is finalized, advises for a facing material to be installed to cover the irrigation system. This, in turn, will cover the unpleasant view of the irrigation system and provide a more aesthetically pleasing view of a material. This material is usually made of aluminum painted sheet metal, cedar, or something similar. (LiveWall, 2020)

The last component LiveWall provides is the most important for the plants. The planters are the last item to be installed. Planters have an overlapping lip to ensure a tight fit, so they must be installed right to left. LiveWall includes limiting screws for the planters that are in areas of

risk for wind damage and theft, the limiting screws are used on planters 20’ above ground and those 8’ or less. With careful placement and proper design requirements, living wall planters will be the perfect fit to host plant life. The standard-sized planters are architectural quality moldings formed from the same polymer as car bumpers (PC/ABS). 100% recycled post-industrial content, 150 mil. thick walls, and no VOC content. Planters come in standard full width 16” and standard half-width 8” to accommodate diverse projects which will be very beneficial to our project. The planter will establish the best sustainable environment for the plants of the wall. (*LiveWall*, 2020)

Figure 3.1 – Full Size Planters
Image supplied by LiveWall
(https://livewall.com/wp-content/uploads/2019/07/livewall-large-planter.jpg)

In addition to the in-depth analysis of the components of LiveWall, they provide detailed drawings for each available design structure, such as side irrigation and behind irrigation. The drawings are deeply detailed with information on the location of each component and how many per row. They are also detailed for the indoor and outdoor LiveWall placement and provide multiple perspectives of the designs, like front view, side view, and irrigation side view. (*LiveWall*, 2020)

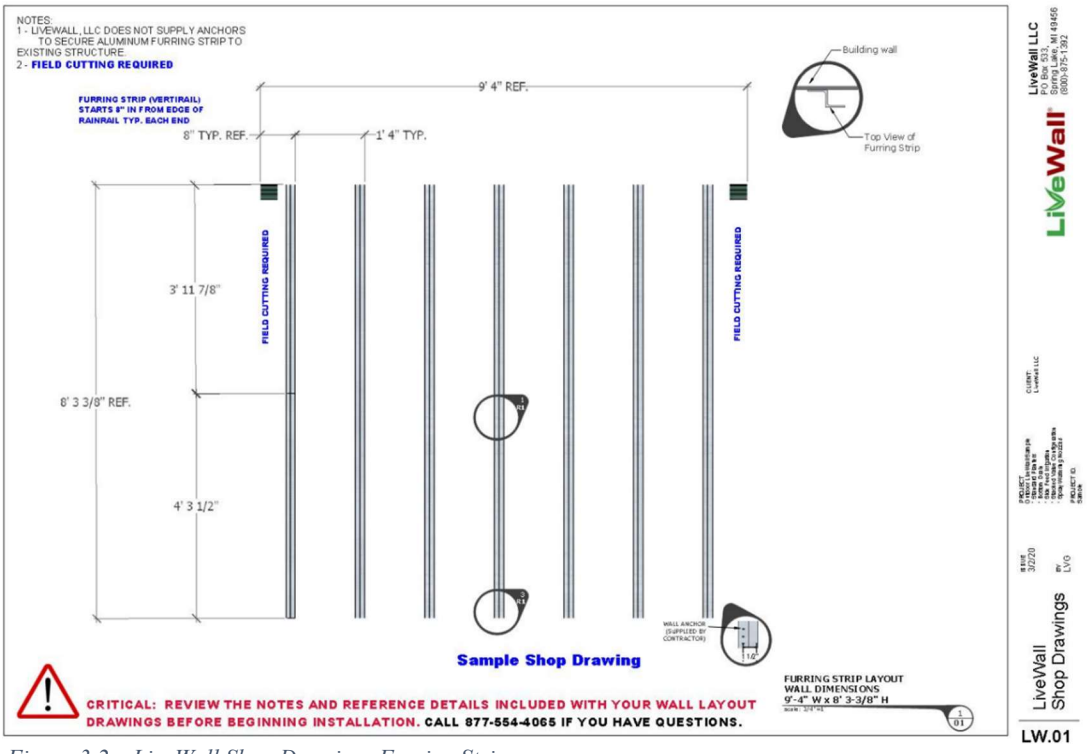

Figure 3.2 – LiveWall Shop Drawing: Furring Strips
Image supplied by LiveWall
(https://livewall.com/wp-content/uploads/2020/03/Outdoor-Side-Feed-website-LAYOUT-Sample_1-400x259.jpg)

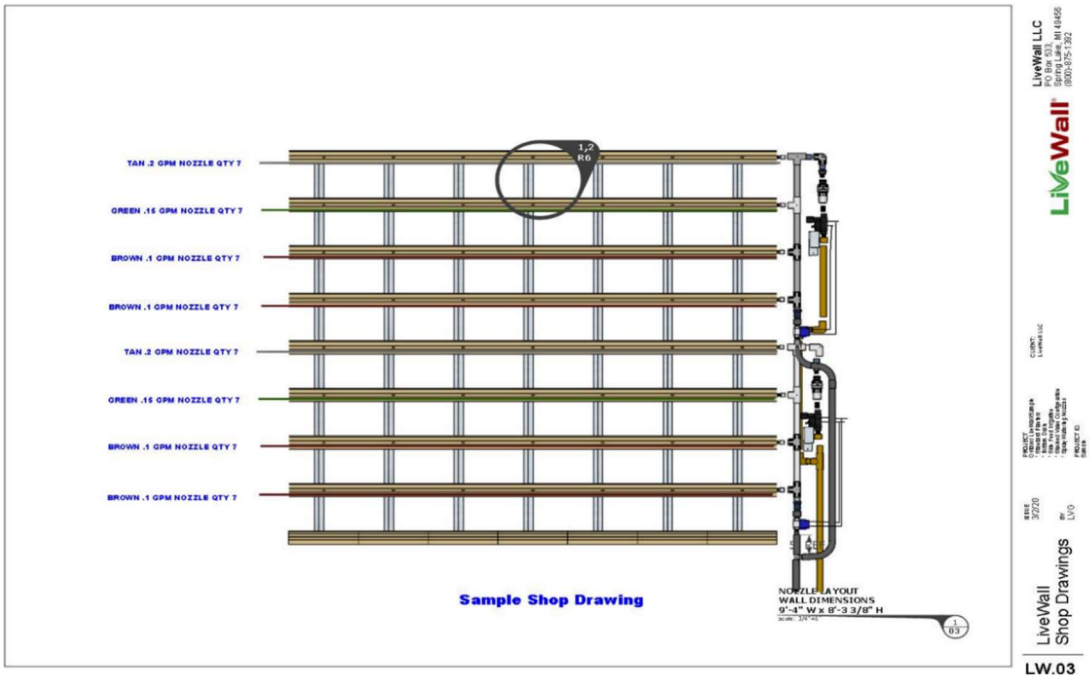

Figure 3.3 – LiveWall Shop Drawing: Irrigation Nozzle
Image supplied by LiveWall
(https://livewall.com/wp-content/uploads/2020/03/Outdoor-Side-Feed-website-LAYOUT-Sample_3-400x259.jpg)

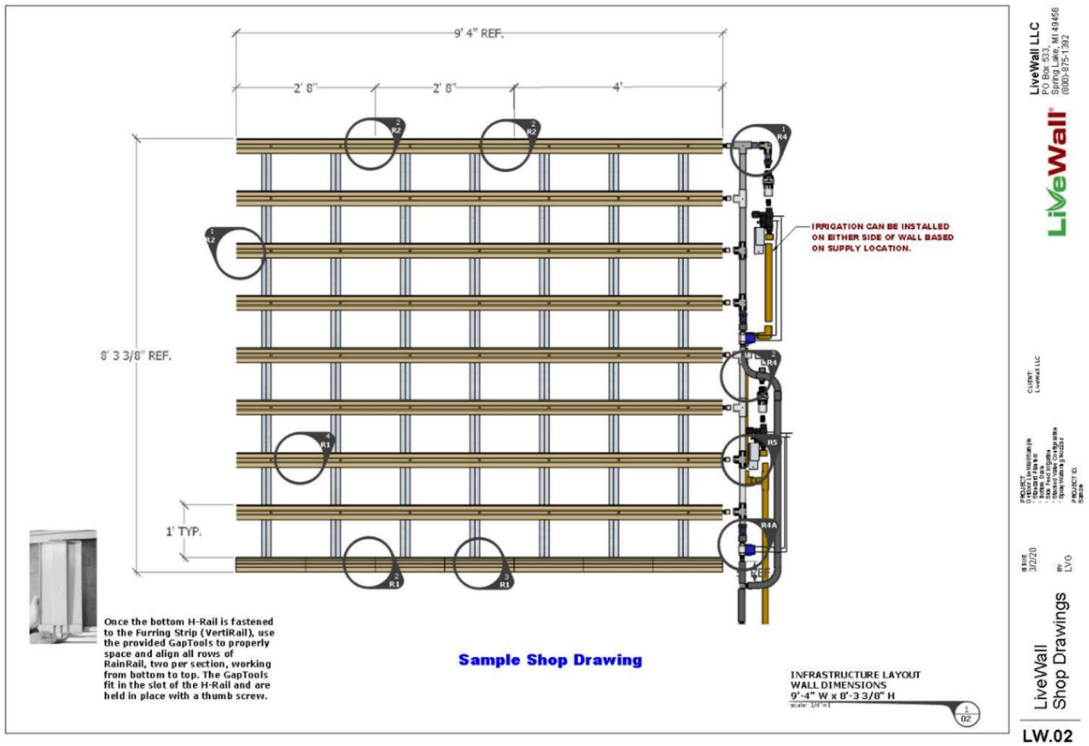

Figure 3.4 – LiveWall Shop Drawing: Irrigation System
Image supplied by LiveWall
(https://livewall.com/wp-content/uploads/2020/03/Outdoor-Side-Feed-website-LAYOUT-Sample_2-400x259.jpg)

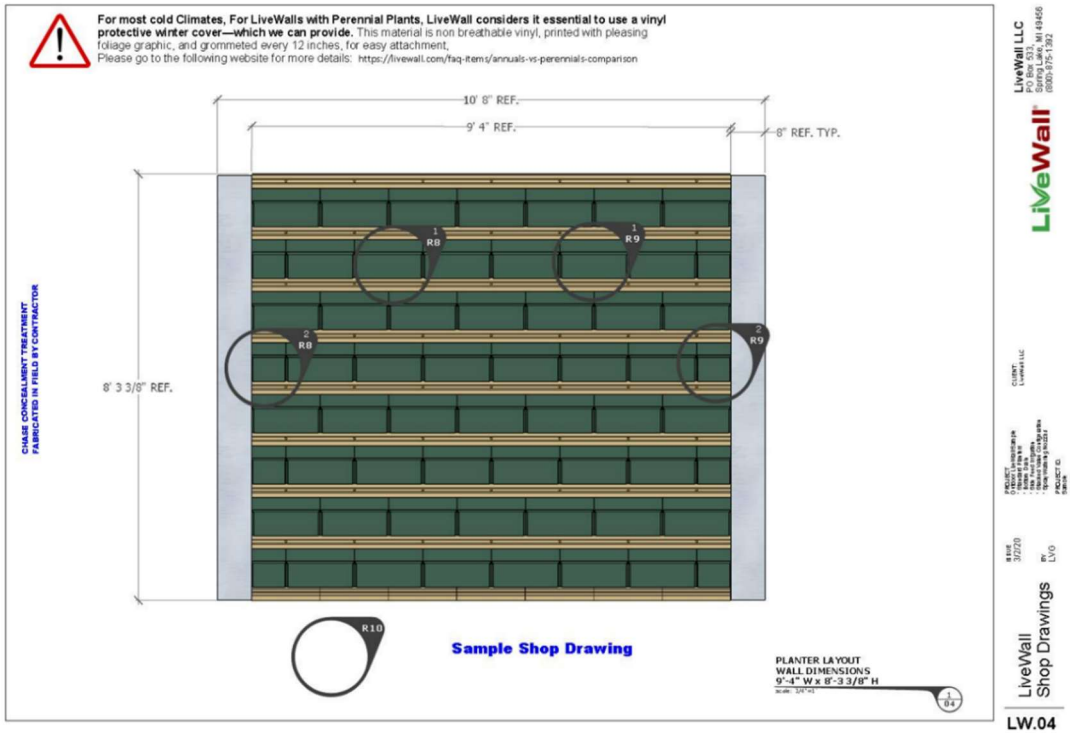

Figure 3.5 - LiveWall Shop Drawing: Planter Layout
Image supplied by LiveWall
(https://livewall.com/wp-content/uploads/2020/03/Outdoor-Side-Feed-website-LAYOUT-Sample_4-2-400x259.jpg)

One key part of our design process has been identifying reliable and trustworthy partners. LiveWall is designated as a professional company for this project because of their capabilities of completing diverse and unique designs. The living wall products from LiveWall contribute to stormwater control, provide habitat for wildlife, reduce cooling loads, and provide many other benefits. (LiveWall, 2020) Most importantly above all, LiveWall provides an in-depth installation guide for projects to be done personally and professionally by contractors. LiveWall provides an in-depth maintenance guide to follow as well to keep the LiveWall up to date. This includes information about how to set the water emitters to drip and the number of times required to water the plants per day based on temperature. It is truly beneficial as it explains fertility management and maintenance required for all 4 seasons around the year, which will be necessary for Easton, Pennsylvania. The preparedness and professional level that LiveWall presents makes it stand out from other competitors in their market.

LiveWall was chosen because LiveWall is a professional and reliable company that provides state of the art live walls. Our team is confident that LiveWall will be able to address the design and unique challenges of a living wall as part of Lafayette Gardens. The northeast Acopian wall is a complex project because of the design placement. Our team is proposing to install the LiveWall between the columns of windows. Because of this design, this provides challenges to the wall's irrigation system and location. Based on the design of LiveWall's structures it uses the RainRails to transport water horizontally across the wall. Since the proposed Acopian design does not have LiveWall RainRails going fully across the wall it creates a challenge for LiveWall. Variation to the traditional irrigation system must be done to accommodate the Acopian wall design and LiveWall has the reputation and professional ability to complete it.

Lafayette College's job after the implementation of the living wall is to maintain proper maintenance for the structure to ensure its longevity. Maintenance for the LiveWall system should be completed once every 1-2 weeks. This specifically refers to the irrigation system and the various components involved with it as it is the most vital piece for the plants. The first priority is making sure the irrigation system is not blocked and is fully functional. Also, due to the seasonal changes in Easton, Pa. refer to the maintenance manual provided by LiveWall to understand the changes LiveWall irrigation must undergo during the different seasons.

Calculations for LiveWall

LiveWall provides calculations to ensure the longevity and structural stability of the wall. The information provided about LiveWall and the structure is supported by structural load calculations and wind load calculations. They provide engineering considerations for the height of the structure and the effects of nature on it. In March 2016, UL LLC tested the LiveWall Structure according to TAS-202 "Criteria for Testing Impact and Nonimpact Resistant Building Envelope Components using Uniform Static Air Pressure," Section 1619 of the Florida Building Code. The structure passed the Uniform Static Air Pressure Test at exterior (positive) and interior (negative) design pressures of 105 PSF. The engineers also provide information with regards to the irrigation system and the amount of water needed to properly sustain the living wall and its plants. (LiveWall, 2020)

Wires

The material considerations for the wires consisted of nylon ropes and vinyl-coated galvanized wire. Our team utilized research from the knot and rope company and US Cargo Control. The ⅛" vinyl-coated galvanized wire from US Cargo Control provides a structurally stable wire that can appropriately hang from the spire to the wall creating the communal space.

The vinyl-coated galvanized wire cable is strong yet flexible, perfect for deck railings, porch railings, stair railings- anywhere you want to add a measure of safety without obstructing the view of the area. The vinyl adds an extra layer of protection to the wire while also making it easy to handle. The wire is an excellent multi-purpose cable for both indoor and outdoor use. The industrial uses for the wire provide evidence that it will be very suitable for our design in terms of loading and longevity. The addition of wire clips and wire rope thimbles to help keep stress off the looped end of the wire will be very useful for the project. A warning has been provided through P65 Warnings to alarm some health concerns associated with the metal. The wire is coated to prevent any chemical hazards it may pose to the environment. To ensure more safety and protection, a shrink and shield (nano) and shrink and shield protective coating may be used to cover the wire. This will help with the life of the wire and further protect potential dangers the metal wire poses. Wires will be connected to the brick Acopian wall with 3/8" x 4" Stainless Steel Shoulder Eye Bolt. The 3/8" x 4" Stainless Steel Shoulder Eye Bolt has a max working load of 1000 lbs and will be a great anchor for the wire. Information must go through Lafayette's masonry consultant before installation.

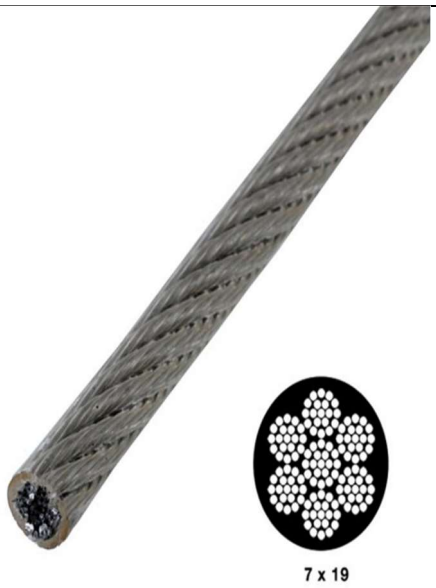

Figure 3.6 - 1/8" 7x19 Vinyl Coated Galvanized Wire
Image supplied by US Cargo Control
(https://www.uscargocontrol.com/SSP%20Applications/Clickstop/images/products/26131-1-8-7x19-vinyl-coated-galvanized-wire-by-linear-foot.01.jpg?resizeid=13&resizeh=1200&resizew=1200)

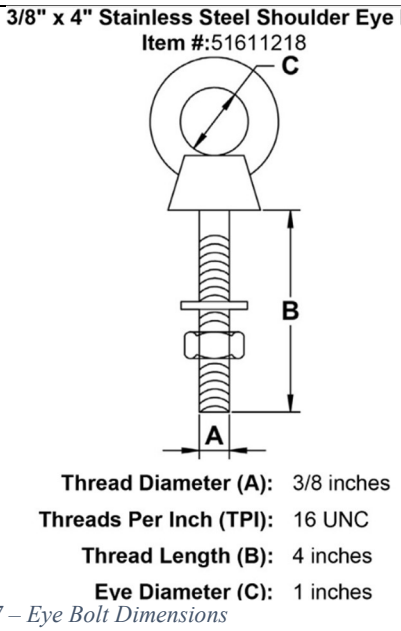

Figure 3.7 – Eye Bolt Dimensions
Image supplied by E-Rigging.com
(https://www.e-rigging.com/thumbnail.asp?file=assets/images/diagrams/product-specs/three-eighths-inch-x-four-inch-stainless-shoulder-eye-bolt-specification-diagram.jpg&maxx=600&maxy=0)

Calculations for Wires

Calculations for ⅛” vinyl-coated galvanized wire is provided in the appendix section of the final report. The calculations for the wire are basic structural calculations that ensure the security and stability of the wires. The calculations prove the wire will be able to withstand a weight of 210 lbs directly in the center of the wire rope. The allowable break strength of the rope is 2000 lbs. The wire will withstand a load up to 2000 lbs. In a realistic situation, the wire may experience weather elements like rain, wind, sleet, and snow. A snow weight calculator was used to demonstrate the various weight per inch and weight per foot the wire rope may experience (*Snow Weight Calculator*, 2020). The greatest weight the wire may experience is from rain and water at about 5.42 lbs for a 50 ft wire with width of 0.125 in and a snow depth of 2 inches. This is around 108 lbs/ ft or 0.009 lbs/ inch. The weight of the rain and water the wires may experience do not reach the threshold to cause failure of the wire.

Spires

The team considered steel as a potential option for the proposed spire section of the project. Ultimately though, aluminum provided the same results for our project as steel but at a much cheaper cost. Both material considerations originated from the Light Poles Plus Company. Originally simple basic linear spires were considered, but these did not provide the aesthetically pleasing and attention-grabbing design we desired. As a result, our team decided that Valmont Structures was the spire to proceed with, as they provided a structurally safe and abstract spire design. Valmont Structures is a highly recognized company for designing and engineering infrastructure for lighting, transportation, and wireless communications industries worldwide (*Valmont Structures*, 2020). Valmont Structures has a great reputation for creating customized engineered structures to fit the needs of the customers. The specific spire our team is proposing is called the RTA Idyline Sigma Pole. It is made of seamless alloy aluminum. The structure comes in a variety of heights that are structurally supported with calculations providing information on the effective projected area that may be affected by winds and forces. Caps for the spires will be furnished by contractors to create a design that allows for a wired connection.

Location and design: Note* Locations Start from bottom to top of hill

1st spire: S0-03

2nd spire: S0-03

3rd spire: S0-02

4th spire: S0-02

5th spire: S0-01

6th spire: S0-01

Figure 3.9 Spire Design
Image supplied by Valmont Structures
(https://webassets.valmont.com/valmontstaging/images/librariesprovider75/products-and-solutions/product-catalog/content/poles-and-posts/rta-16_-28_5-idyline-sigma-pole_590x600_0718.jpg?sfvrsn=2)

Calculations for Spires

Calculations for the Valmont spires are provided in the appendix of the final report. The calculations for the spires are basic calculations using estimated projected area (EPA) and simple shear stress formulas. The calculations provide information on the forces each different spire may face due to various heights. The northeastern United States normally receives a high wind pressure of about 70 mph according to the American Association of State Highway and Transportation Officials. In order to prove structural stability, the weakest known aluminum metal is 1100-0, with a known shear strength of 9,500 PSI. We tested that aluminum to see if it would fail from the greatest force it receives. Based on the calculations, evidence shows that there is no failure for any spires at any height.

Calculations for Cap of Spire with 3 wires

Calculations for the Cap of Spire with 3 wires are provided in the appendix of the final report. The designed spires created by Valmont Structures do not have a cap that allows for the

connection of the wire. As a result, fabrication of the wire caps must be done to accommodate to the spire diameter and design. The fabrication of the spire cap will be the deciding factor to determine the structural integrity of it. The structural integrity of the cap will be determined by the width of the cap loop where the wire rope will tie to. The calculations prove that the minimum amount of diameter of the cap loop needed to be structural safe is 0.0469 inches using the weakest aluminum metal model 1100-00 with an allowable shear stress of 9,500 PSI and the force of 3 wires 445.5 lbs.

Conclusion

The most important value to this project is to make sure the different structures are safe, sustainable, and aesthetically pleasing. The abstract designs of the spires and wires along with the structurally supported calculations provides significant evidence to prove structural integrity. The addition of the spires and wires will help provide the communal space that aligns with our project definition and allow Lafayette College to bring new value to the campus.

Where to Next?

As noted in Chapter 2: Design, Lafayette College should look into more additions of spires to make the space more attractive and break the linear standard model. This may be done by using smaller spires that do not have wire attachments to it. These extra spires will help define the space more and draw people into the space. Another aspect to consider with regards to the spires is the use of lighting. The spires contain the structural capacity to obtain lighting for the surrounding areas, but our team did not have the capacity to analyze the feasibility of powering these lights. We suggest that the next phase of the project consider this as we believe light will increase the safety of the area and make the Lafayette Gardens accessible at night.

Chapter 4 – Environmental Introduction

The Lafayette Gardens project was motivated to a large degree by attention to the current environmental debates, with the first among them being the climate crisis. Lafayette College, along with many other institutions around the country, has drafted a climate action plan that identifies their individual goals to become more sustainable. More specifically, Lafayette College has since updated its initial Climate Action Plan to the Climate Action Plan 2.0. The primary focus within the plan is to reach carbon net-neutrality before or by the year 2035 (*2019 Climate Action Plan*, 2019, p.3). There are different sustainable technological solutions that are being carried out to help the college reach this goal. Considering such goals, the implementation of a living wall, which covers an entire wall with plants, can help Lafayette College enforce its goals. Not only can it be beneficial to those on campus, but it can help with Lafayette's relationship with other schools and communities, and has the potential to inspire others to implement similar projects.

This chapter focuses on how installing a living wall has many components that our team must take into account to effectively implement and maintain a living wall for a long period of time. If the wall is implemented and properly maintained, not only would Lafayette College be one step closer to their plan, but the benefits would be reaped by the individuals using the space and the wildlife. A living wall has various benefits, whether it is improving the students' well-being, work productivity, or helping increase animal biodiversity through the choice of different plants (Perini et al., 2013). However, these benefits primarily depend on the plant choice, which leads to the second part of this section. Not only is the project focusing on the living wall that will be placed on the northeast side of the Acopian Engineering Center, but also the ground right next to it. Maximizing the benefits this area contains can help create a welcoming space that can

be used by anyone. In order to effectively use this space, there are a variety of components that we must take a closer look at.

Literature & Sources

Living walls are steadily increasing in popularity across the country and has led to an increase in research as well. Living walls are quite complex as the structure is filled with plants that need to be able to survive vertically. There are numerous critical components that we must consider as there could be negative impacts on the wildlife, individuals, and the environment. In order to reap the benefits of the living wall, plant selection is crucial. Use of a variety of plants on both the wall and the ground (the two areas for this project), can help increase wildlife diversity, support for native species, and rehabilitate the area. Prance et al. (2014) support such claims as well; "diverse organisms, ecosystems, and ecological processes provide economic, environmental, and social benefits when interacting with managed open greens space" (Prance et al., 2014, p.789). Not only does the selection of plants help the environment, but the plants can release different scents that can "provide relief from anxiety and enhance relaxation, while also reducing discomfort in a variety of ways" (*How Aromatherapy Can Help Students Achieve Academic Success*, 2018).

There are companies that help manufacture living wall systems such as LiveWall. LiveWall is an American company that has been working towards helping people implement successful living walls, and have adequate research on how to select the best living wall for campus. The LiveWall system has been seen to "better attendance… reduce fatigue… increase output… enhance performance… [patients] recover faster… ease[s] anxiety… reduce noise… reduced heat… reduced carbon… save energy" and many more (*Living Wall Benefits*, 2020). Furthermore, green spaces in general hold benefits in aiding an individual's well-being and can

have further social benefits, especially in urban areas (Barton, 2018). The findings that we have discovered through our extensive research exemplifies the additional benefits of living walls and how it can be part of the solution towards tackling the issues of climate change, such as increasing urban biodiversity or having positive effects of hydrology (Loh, 2008, p.3). Other researchers have found similar findings including improved thermal performance, reduction of air pollution and noise, social benefits, visual effects, educational effects, habitation for urban wildlife, and economic benefits (Radić et al., 2019). Furthermore, the living wall that will be located on Acopian will be an indirect greening system that holds specific benefits like energy conservation for heating and cooling (Perini et al., 2013).

Our team carefully researched the various benefits and opportunities a living wall can offer for our college. This chapter will focus on the environmental components, such as benefits for users, animal biodiversity, and choice of plants for the living wall and the ground. The information is supported through the research we have conducted over the course of the semester through literature reviews and organizations specializing in creating sustainable living walls.

Environmental Impacts

Benefits for Animal Biodiversity

In order to create this green space, the selection and placement of the plants can be critical to defining the space. The selection of the plants consists of a number of factors and each factor can impact the living wall and ground greatly. For example, the choice between perennial and annuals can impact the visual aesthetics of the wall or ground throughout the four seasons, and the maintenance required for upkeep. Perennial plants will return each year and do not require a replanting, whereas, annual plants must be replanted regularly. In order to help with native animal biodiversity, my team has unanimously agreed to the selection of native plants.

Our team consulted with Professor Mike Butler from the Biology department who revealed that there are different species of animals that need additional safe habitats. Through the integration of native plants in the ground space, our project will help native birds, especially because their population is slowly diminishing. In helping provide an environment for native birds, we chose plants that can help increase animal biodiversity; for example, the addition of other animals and insects, such as monarch butterflies, bees, and other pollinators can be seen in this space. The Edge of the Woods Native Plants states that having native plants help support "birds, insects, pollinators, butterflies, and other wildlife, and design landscapes that are visually pleasing and support the ecosystem" (*Maintenance, Design, Specialty Services*, 2020). This project is intended for both humans and helping animal biodiversity. Because the relationship between animals, plants, and humans is all interconnected, it is imperative that the choice of plants is chosen accurately. Living walls, known as vertical greening systems, can be beneficial in urban areas. Considering the Easton community and its location, implementing various living walls can help "create a habitat for microorganisms and also for smaller animals" (Perini et al., 2013, p. 269) especially in helping native animals from Pennsylvania. Such projects can have various benefits in the future for the community and can follow the college as an example.

In addition to the animals that can benefit from this space, implementing bat boxes at the top of the living wall structures can bring an additional benefit to the space. Bats do not have much natural shelter in Easton, so providing a sheltered space for bats not only helps keep them safe, but it also helps with pollinating plants. Because of the limited space offered, bat boxes must be placed at least 15 feet off the ground and must receive plenty of sun, thus only four bat boxes will be placed above the sections where the living wall structure is not placed (Brown, n.d.). The most successful types of bat boxes have three chambers, which can hold up to about

100 bats. Figure 4.1 shows the difference between a single-chambered versus a three-chambered bat house. The bat boxes can either be purchased or built with the help of the college; more information on how the college can help with the bat boxes is discussed in Chapter Five. This can be an opportunity to bring attention to the living wall, its benefits, and how students can interact with this space.

	
Image supplied by batmanagement.com (https://cdn.shopify.com/s/files/1/2378/9221/products/SingleChamber-8906_72812b3b-ef36-4806-bf05-30604d084795_800x.jpg?v=1511313721)	*Image supplied by Nature's Way (https://cdn.shopify.com/s/files/1/0156/3796/products/Holds_up_to_300_bats_BH6_1024x1024.jpg?v=1501783525)*

Figure 4.1 - Single-chambered vs Triple-chambered bat house
Compiled by De La Torre, D. (2020)

Benefits for Humans

The plants chosen have many benefits for both animals and humans visually and experiential. More specifically, when focusing on the people who will use this space there are many benefits they can experience. The plants chosen, which will be addressed below, were all chosen for specific reasons. For example, we considered fragrances, aesthetics, and plant growth patterns in deciding what plants to choose. The University of Delaware conducted an experiment focused on the benefits of a living wall. The findings include a "[boost of a] stronger sense of community, [cope] better with everyday stress and hardship. [perform] better on tests of concentration, and managed problems more effectively" (Barton, 2018). Due to the stressfulness of college for students and the lack of spaces to relax and escape from daily stressors, the addition of this space on the side of Acopian can be beneficial for such purposes. Furthermore, the research stated that "psychologists have found that access to plants and green spaces provides

a sense of rest and allows workers to be more productive" (Barton, 2018). The simple addition of greenery around different locations in colleges or the workplace can enhance an individual's satisfaction while working (Loh, 2008, p. 3). Living walls also have the potential of helping people have a closer relationship with nature especially in places where there is not enough greenery (Loh, 2008, p. 3).

While Lafayette College is known for its beautiful landscape, the addition of a living wall will bring the community closer and allow for individuals to have more green spaces they can interact with. The use of plants, whether it is in gardens, an individual pot or even a living wall can be therapeutic for those using the space or interacting with the plants (Perini et al., 2013). Some of the plants chosen have strong fragrances that can be calming to individuals; green spaces can work as therapy for many people. The scents from these plants can help students improve their productivity, mood, and overall well-being (*How Aromatherapy Can Help Students Achieve Academic Success*, 2018). A lot of these benefits help improve health and a person's well-being. Apart from the benefits, users can experience further advantages by being in this environment including "lowering energy consumption and greenhouse emissions, reduction of urban heat island effect, increasing the thermal performance of building (lowering energy costs), positive effects of hydrology… [and] reduction of noise pollution" (Loh, 2008, p. 1). With such research and benefits, the selection of the plants is not only critical to the ones in the wall but also the ones that surround the area on the ground.

Plant Choice

Living Wall Plant Choices

In order to decide the most ideal plants for the living wall, understanding the space is crucial to the success of the plants and the maintenance. Consequently, the northeast wall of

Acopian, which will be home to the living wall, receives very limited sunlight exposure. Understanding this information helps us narrow the selection of plants by choosing ones that can survive with limited light, but still take into consideration aesthetics, fragrances, and benefits. LiveWall has shared valuable information to help our team understand the different characteristics that we must consider to effectively grow different plants on the living wall. The initial list that was created includes:

- Bergenia cordifolia
- Blackeyed Susan
- New England Aster
- Common Yarrow
- Geranium
- Mint
- Lavender
- Sage
- Lemongrass
- Coleus
- Petunia
- Caladium Cultivars
- Golden Sword Yucca
- Golden Creeping Jenny
- Japanese Pieris
- Violas
- Winter Flowering Iris

These plants were chosen for various reasons such as their success in pots, color, scents, aesthetics, and plant growth patterns (perennial and annual). The goal was to have a variety of plants that have different patterns throughout the seasons; however, after speaking to Mike Haynes, a representative from LiveWall, it was revealed that all the living walls they have worked use approximately 3-5 different plants. The list above contains over 10 different plants, and after careful consideration and advice from Mr. Haynes, the list has been reduced to six plants while still taking into consideration the characteristics mentioned previously. The new, finalized list is the following:

- Coleus
- Bergenia cordifolia
- Fuschia
- Golden Creeping Jenny
- Japanese Pieris
- Violas

Figure 4.2 shows the finalized list of the plants for the wall. Their various colors can help create a creative pattern that will bring attention to the living wall. A possible pattern that can be made using the six plants is shown in Figure 4.3. Aside from the pattern and attention the wall will bring, during the first couple of weeks, there will be a need for high maintenance to ensure that the plants are growing well, receiving the right amount of water, and other requirements. The choice in plants were purposely chosen to show various colors throughout the four seasons and ensure people can enjoy the most of the green space. Most of these plants can be purchased from a local nursery, such as the Bowman's Hill Wildflower Preserve located in New Hope, PA. They also specialize in growing native plants, especially the ones that have been chosen for the ground, which can be found in the next section.

 *Coleus* *Image supplied by Fertile Ukraine Seeds (https://m.media-amazon.com/images/I/81xrHSzuGsL._AC_SS350_.jpg)*	 *Bergenia Cordifolia* *Image supplied by Outsidepride.com (https://www.outsidepride.com/images/products/detail/gardenflower/bergenia1.jpg)*	 *Fuschia* *Image supplied by Garden Lovers Club(https://www.gardenloversclub.com/wp-content/uploads/2019/06/Dollar-Princess-Fuchsia.jpg*
 *Golden Creeping Jenny* *Image supplied by Bluestone Perennials(https://bluestoneperennials.global.ssl.fastly.net/img/LYNU/650/LYNU_0_Lysimachia_Aurea.1491331733.jpg)*	 *Japanese Pieris* *Image supplied by Home Depot (http://community.homedepot.com/howto/servlet/rtaImage?eid=906500000000L0T&feoid=Body&refid=0EM500000000kly9)*	 *Violas* *Image supplied by Burpee (https://www.burpee.com/dw/image/v2/ABAQ_PRD/on/demandware.static/-/Sites-masterCatalog_Burpee/default/dw919af670/Images/Product%20Images/prod000422/prod000422.jpg?sw=322&sh=380&sm=fit)*

Figure 4.2 – Finalized Plant List for the Living Wall
Images Compiled by De La Torre, D. (2020)

Figure 4.3 – Possible Pattern for the Living Wall
De La Torre, D. (2020)

Ground Plant Choices

Lafayette Garden's ground surface can be further defined by the selection of plants. Taking animal biodiversity, the slope's water problems, and environmental benefits into consideration, the plants chosen include:

- Joe-Pye weeds
- Goldenrod
- Black-eyed Susan
- Milkweeds
- Wild bergamot
- New England Aster
- Purple coneflower
- Little bluestem
- Virginia Rose
- Viburnum dentatum (Arrowwood Viburnum)
- Jolly Red Winterberry
- Blackhaw
- Virginia Rose

One of the issues our team discussed regarded the slope of the space and the potential water problems. When it rains, a large amount of the water from the top of this slope descends to the bottom. The water causes this space to be dangerous for walking due to the slipperiness and the potential for people to fall. In order to prevent this from happening in the future, some of the plants will be intentionally placed at the top of the slope to avert some of the water from

descending, resulting in a safer path. Aside from this, the plants chosen are native to Pennsylvania, which will help with animal biodiversity and provide a habitat for species that need it. The plants will help define the space and can become an interactive place for people. The list above, though, contains far too many plants that may cause some issues, such as overcrowding. This list has been shortened to the following:

- Spicebush
- Spring-beauty
- Forest Goldenrod
- Violet, common blue
- Rosa Virginiana
- Wild Bergamot
- Inkberry
- Three-lobed Coneflower
- Cutleaf Coneflower
- Joe-Pye Weeds

Figure 4.4 shows the finalized list of plants for the ground. Some of the plants mentioned in the new list are newly added due to different characteristics we are considering. As was mentioned before, there are various environmental benefits in implementing green spaces. A lot of the plants above are native plants that offer a shelter or food for various species. Aside from these benefits, the placement of the plants can help bring the space together and solve the water issues. For example, Inkberry, Rosa Virginiana, and Spicebush will be placed at the top of the slope, by the sidewalk, to capture excess rain and prevent slipping where the slope is greater. Additionally, Joe-Pye weeds and Three-lobed Coneflower will be placed closest to the wall by the triangle that can be seen below the living wall in Figure 4.3. They prove to be a great fit because of their height and coverage ability. While others, such as the Spicebush and Spring-beauty will be placed around the spires (mentioned in chapter two and chapter three) to help with noise pollution. The location of plants can be moved in other locations, but the most essential are those by the triangle and at the top of the slope to help with the issues mentioned previously.

 Spicebush *Image supplied by Fine Gardening Magazine (https://s3.amazonaws.com/finegardening.s3.tauntoncloud.com/app/uploads/2018/01/23224917/lindera_benzoin_lg-main-500x500.jpg)*	 Spring-beauty *Image supplied by Lake Forest College (https://www.lakeforest.edu/live/image/gid/140/width/769/height/542/21718_spring_beauties.rev.1401301059.jpg)*	 Forest Goldenrod *Image supplied by Wikimedia Commons (https://upload.wikimedia.org/wikipedia/commons/a/af/2007-09-04-Goldenrod.jpg)*	 Violet, common blue *Image supplied by DreamingWood (https://thedreamingwood.files.wordpress.com/2014/05/violets.jpg)*
 Rosa Virginiana *Image supplied by Gardenia (https://www.gardenia.net/storage/app/public/uploads/images/detail/shutterstock_431565034Optimized.jpg)*	 Wild Bergamot *Image supplied by Outsidepride.com (https://www.outsidepride.com/images/products/detail/wildflowers/monardafistulosa.jpg)*	 Inkberry *Image supplied by Proven Winners (https://www.provenwinners.com/sites/provenwinners.com/files/imagecache/500x500/ifa_upload/gem_box_ilex_glabra-2.jpg)*	 Three-lobed Coneflower *Image supplied by Wild Seed Project Shop (https://cdn.shopify.com/s/files/1/0739/9053/products/Three-lobed_coneflower_1024x1024.jpg?v=1539198668)*
 Cutleaf Coneflower *Image supplied by 123ua (https://previews.123rf.com/images/123ua/123ua1609/123ua160900018/62103638-cutleaf-coneflower-rudbeckia-yellow-flowers-on-a-sunny-day-.jpg)*	 Joe-pye weeds *Image supplied by GrowJoy (https://www.growjoy.com/store/pc/catalog/eupatorium_little_joe_plant_1077_detail.jpg)*	 Jolly Red Winterberry *Image supplied by Summer Hill Nursery (https://www.summerhillnursery.com/photos/Ilex%20v.%20Jolly%20Red%20fruit.JPG)*	

Figure 4.4 – Finalized Plant List for the Ground
Images Compiled by De La Torre, D. (2020)

Conclusion

Living walls have many environmental characteristics that can help create a welcoming space with many positive effects for those using the space. The variety of plants that compose the space also offer a safe habitat for native animals and bugs. In creating an environmentally sustainable space not only further supports the goals set by Lafayette College within the Climate Action Plan 2.0, but allows for a change against the climate crisis. To successfully implement such a project, the team must also consider the required costs and further values of the project, discussed in Chapter 5.

Chapter 5 – Economic

Introduction

The next context we turn to in this report is the economic perspective surrounding this project. In this section, we will look at how much this project will cost, how funding will be secured, and how we plan to create a non-market valuation of this project.

What is the Cost?

To begin, Lafayette Gardens should be seen in the light of an investment, not in the light of just another cost on the balance sheet of the school. This project has tremendous value to bring to the college in a variety of different ways, including environmental, educational, recreational, and reputational pathways. For these reasons, it is logical that the project comes with some degree of financial investment in order to be completed. Through our calculated and revised estimates, we expect the project to be within the range of $170,000 to $260,000. This new estimate is a far development from our initial calculations in which we used other projects to extrapolate an estimated range of $50,000 to $300,000+ for the green wall alone (*Cost Considerations*, 2014). While not an exact number, we find this reduced range to be beneficial to the school in determining a magnitude of cost for the project.

Section	Component	Cost Low	Cost Medium	Cost High
The Green Wall				
	Provided Materials	$68,850.00	$91,800.00	$114,750.00
	Plants	$15,300.00	$22,950.00	$30,600.00
	Contractor Installation	$53,550.00	$68,850.00	$68,850.00
	Bat Boxes (4)	$160.00	$392.00	$780.00
	Additional Costs	Will be determined by consulting in the future		
The Triangle				
	Paint Components	$324.98	$324.98	$324.98
	Installation	Completed by students in the Art Department		
The Grounds*				
	Flower Beds			
	Plants			
	Terrace Construction			
	PA Bluestone Path	$20,000.00	$25,000.00	$30,000.00
Wires and Spires				
	Wires	$133.00	$133.00	$133.00
	Wire components	$29.43	$29.43	$29.43
	Connection piece to Brick wall	$112.42	$112.42	$112.42
	Spires	$11,174.40	$11,174.40	$11,174.40
	Pole Cap	Will be created by fabriaction later on		
Seating				
(4 Chairs)	Adirondack Chairs	$280.00	$400.00	$800.00
	Total Cost	$169,914.23	$221,166.23	$257,554.23

Chart 5.1 – Lafayette Gardens Budget
Currie, B. (2020)

Provided Materials include-
Furrings strips and Slot Rails with irrigation conduits (RainRails)
Irrigation main line components
Irrigation parts and fittings from valves to the RainRails
Wall Planters
Removable planter inserts (empty)
Contractor Installation
Fasteners for installation between LiveWall and building structure
Facing Material to cover the irrigation feed (typically wood or sheet aluminum)
UV Resistant Fittings and pipe from the mainline to the irrigation valves – SCH 80 Gray Pipe and Fittings recommended
Underlying backing material
Labor, equipment rental, and a fair profit
Additional Costs
Water source (plumbing) & drainage (sewage or stormwater)
Electrical and wiring for controllers
Paint Components (Sherwin Williams)
Primer (34.99) (2)
Base Color (Maroon) (85.00) (2)
Lettering (White) (85.00) (1)
Wire Components
Wire Rope Clips (28)
Wire Thimble (28)
Connection Piece
Stainless Steel Shoulder Eye Bolt (14)
Spires
Valmont Structures Signma Spire S0-01 (1,458.60) (2)
Valmont Structures Signma Spire S0-02 (1,724.30) (2)
Valmont Structures Signma Spire S0-03 (2,404.30) (2)
* - These figures were obtained through a rough estimate from Paul Deery

Chart 5.1 – Lafayette Gardens Budget (Supplemental Descriptions)
Currie, B. (2020)

In order to reduce our initial estimates, we made a number of assumptions. Chief among those assumptions was the decision by the team to pursue LiveWall as our living wall consultant and provider. LiveWall provided our team with the exact pricing ranges in order to narrow down our cost range significantly. LiveWall divided the costs into three areas: **provided materials**, **plants**, and **contractor installation**. If you look above at the supplemental information section of Chart 5.1 you can see that each of these three sections have multiple components with the exception of the plant line item which is purely focused on the vegetation for the project. The ranges for each grouping can be found outlined in the budget above (Chart 5.1). In addition to the specific price ranges provided, Live Wall has also acknowledged the need to think about maintenance figures. This is shown under the section of **additional costs** on Chart 5.1 and the subsequent supplemental descriptions. In this case **additional costs** include looking at fees associated with irrigation and electricity for the Live Wall.

Utilizing LiveWall's system was pivotal in our decision-making process because we were able to further explore the other aspects of the project once we had anchored the pricing and system design for the green wall. We are still in contact with the team at LiveWall and they are ready to work further on the project with the college when the time comes to move forward on Lafayette Gardens. The rest of the project costs were attained using a variety of resources including wholesalers, manufacturers, and estimates from outside consultants such as Paul Deery a contractor from a local landscaping company.

For products such as the spires, wires, and Adirondack chairs, we were able to obtain costs quickly and efficiently online. In the case of the spires, we spoke with Penn Lighting in Philadelphia in order to gain quotes on the various spire sizes. In Chart 5.1 under the Spires subsection you can see the individual costs for each size of spire. The smallest spire had a price

tag of $1,458.60, while the middle and large spires ran totals of $1,724.30 and $2,404.30 per unit respectively. When accounting for two spires of each size, the spires alone contribute over $11,000 to the final price of the project. The pricing for our wires came from US Cargo Control which priced our wire feature at $.19 per linear foot. Our Structural Engineer determined the necessary footage at 700 linear feet equating the cost of the wires to $133.00. In addition to the spires and wires alone there were several other components necessary to complete the spires and wires element of the gardens. These include the wire clips and thimbles as well as eyebolts for attachment to the wall. These features added an additional $141.85 to the total cost of the project. Though insignificant to the full budget the pieces play an important role in allowing the project design to be as realistic as possible.

For features such as the path, flower gardens, and terracing, it was necessary to utilize the expertise of a landscaping professional. The team turned to local landscaping contractor Paul Deery in order to obtain an estimate on the cost of incorporating a Pennsylvania Blue Stone pathway, terracing, and flower beds for our pollinator gardens. On short notice, he was able to provide us with an approximate range of $20,000 to $30,000 USD. A project including the $20,000 package would still have all of the features that the team is looking to include, but if the budget was pushed to the $30,000 level the landscaping could be elevated even higher looking at more intentional arrangements and a greater level of customization. In the case that this project is to proceed under guidance from the administration, our team would recommend pursuing Paul Deery as a landscaping contractor and or consultant on the project.

There are still a number of costs that we have not yet been able to determine. These include the cost of permitting, consulting with additional parties, and long-term maintenance. All of these figures will likely be determined by the school administration in the next phase of the

project. We would recommend increasing the number of gardeners on the facilities staff in the future so they would be able to maintain this area. According to Scott Kennedy, several members of the current gardening staff have retired this year and the current capacity of facilities does not have the manpower to maintain this area. Keeping the maintenance work on the gardens within the Lafayette employees would keep the area looking fresh and up to college standards. Hiring an outside contractor could possibly reduce the connection and responsibility the workers may feel to the project and its overall image.

When looking into the scope of funding, Scott Hummel of the Engineering Division determined the funding for the project will likely come through a donor to the college. As a result, our team determined the name associated with the gardens may change from "Lafayette" to the last name of the donor, as an appropriate measure of gratitude for the generosity of the individual or family. In addition, we are looking at securing funding from different departments and organizations here on campus for certain features of the project. This would effectively reduce costs, as well as gain community support and integration on the project. For example, the LEAP organization or the Environmental Studies department could donate the bat boxes, as it focuses on increasing biodiversity and animal populations. The top cost outlined for the bat box installation is $780.00 (Chart 5.1), we think this is a fair price and could be well within the means of both entities to provide. Similarly, admissions could possibly donate money for the mural as it is a direct tie to the school's image and would likely be pointed out on each prospective student and visitor tour. In addition to admissions donating funds for the triangle, Professor Jim Toia has recommended having students from the art department complete the installation. Professor Toia explains this project is well within the students' capabilities and

would serve to connect a greater group of the Lafayette community to the wall while alleviating the fees associated with hiring a professional artist or painter to complete the work.

Conclusion

Throughout this project, there has been a focus on quality, intentionality, and value. Each decision that has been made with those primary focuses in mind. For this reason, even though the price tag may seem steep for a “garden”, the investment is justifiable. This project brings values to the Lafayette community that ends up elevating the space far beyond that of a simple garden. This project showcases the college's ideals of growth, sustainability, and collaboration from all areas on campus. Lafayette Gardens stands to be a living example of what the college represents and strives to be, and that in and of itself is priceless.

Chapter 6 – Conclusion

Concerns surrounding climate change have motivated numerous adaptation and mitigation efforts around the world (IPCC, 2014, p.17). The aesthetic appearance of green structures, as well as their technical and environmental benefits, have turned vertical gardens into a developing trend in sustainable building efforts. Our Sustainable Solutions team chose to investigate the possibility of building a living wall on the northeast side of Acopian Engineering Center in the hopes of advancing Lafayette College's efforts in sustainability and community development. Our choice to further expand our design into the surrounding space was inspired by the hope of developing a welcoming and inclusive space that will be accessible to all members of the college community. The final design of Lafayette Gardens is a unique display of environmental, artistic, and technological characteristics interacting to create a unified appearance. The proposed living wall, which will be produced by LiveWall using a planter system, has been carefully calculated and planned in order to create the column design that runs between every other set of windows. Many factors had to be considered when choosing the final plant selection for the wall including their orientation and placement since it "is important to understand these microclimatic conditions [associated with a particular placement] as well as the amount to light required for plant survival" (Loh, 2008, p.4), and their expected functionality once placed. Similar considerations were taken into account when developing the layout for the ground space, especially regarding how the space will perform as a habitat for native species. The spires and wires influenced the visual effect of the space and required special attention to their potential performance, impacting the selected design and placement in the space. Together, the living wall, garden space, and spire border, combined with the stone path and various seating

areas, promises numerous benefits for the campus that makes the financial investment worthwhile.

What is the Value?

Now that we have covered the hard numbers surrounding what it takes to complete and implement this project, we can shift our focus to the tremendous value that this project is able to bring to the college. Our goal was initially to conduct a survey this semester within the Lafayette community in order to gain a pulse on the community's feelings towards the implementation of the Lafayette Gardens. Due to the recent world events with COVID-19, we were, unfortunately, unable to conduct such a survey. Instead, we have structured the survey and will include it in our final report to the administration for their discretion on whether or not they would like to see this survey used in the future. Even though we were not able to gauge what the community valued in the project, as a team we have determined there is significant opportunity within this project. By creating the Lafayette Gardens, the college is opening the door to educational, environmental, recreational, and reputational value. Each one of these four categories shares overlap and influence, creating a strong foundational reasoning for why this space is so important.

Environmental:

This project's main focus is to incorporate the environment into a dull and utilitarian area on campus in order to bring the community together. The living wall and pollinator gardens stand to benefit the natural environment of College Hill in a positive manner. As mentioned in Chapter 4: Environmental, not only will the living wall utilize native plants to improve air quality and biodiversity on campus, but it will also combat endangered bat populations through the implementation of bat boxes to provide shelter and safety for their populations. Our goal with the pollinator gardens below is to create an active haven for pollinators, such as bees and birds,

to increase the health of their populations here on campus. The environmental allure in this space is not only limited to nature but is also proven to benefit humans. Our usage of fresh plants on the wall and ground can create scents linked with improved memory and school performance as well as reduced stress levels (Barton, 2018). The environmental value of this project is also seen in its sustainable features aligning it with the goals of the Climate Action Plan 2.0 here at the college. Each LiveWall planter is made from recycled materials placing a focus on sustainability and reducing the new waste created by our project.

Educational:

The educational value that this project brings is directly connected with the environmental and reputational values as well. Below is a short excerpt on how students from different areas on campus may be able to work in this space.

> *"Many classes here at Lafayette are shaped and molded into a basic classroom learning experience. Rows of chairs all facing a set of chalkboards in a monotone utilitarian classroom. If students are lucky they may get the opportunity to change rooms and visit a laboratory setting once a week. With the addition of the Lafayette Gardens this monotony of learning is about to be changed for a handful of students taking courses within the Engineering Studies and Environmental Studies divisions. Instead their class will be a combination of traditional work in the classroom paired with field work on the northeast facade and surrounding area of Acopian Engineering Center, now known as Lafayette Gardens. Over the next 16 weeks these students will have the opportunity to study this sociotechnical system and evaluate its ever changing impacts on campus. For the environmental studies students they may look at a variety of different aspects such as biodiversity in the plants and animals on campus or they may evaluate the impacts of the new pollinator gardens and bat boxes on bee and bat populations. On the other hand the Engineering Studies students will be able to finally see a tangible representation of engineering and the world coming together to create a new experience apart from the blueprints and hard numbers of traditional engineering. These students will have an opportunity for hands-on research and work in areas that they previously could have only experienced through lectures or textbooks. The Lafayette Gardens has not only added a whole new aesthetic dimension to campus but also a new dimension to the Lafayette educational experience."*

In order to culminate the educational value of this project into a single streamlined experience, we have designed an exhibition trail guide that features all of the important

information on the space in one location. A layout of the information on the guide can be found below. Note the guide features different areas on the wall, pollinator gardens, bat boxes, and even a section on the background to the meaning of "Cur Non".

Recreational:

The original idea for this space was to provide an area away from the busiest parts of campus for students to relax and hangout. The space was also meant to be an escape from the intensity and draining seriousness of Acopian Engineering Center. The new gardens have created just this space for the community of Lafayette. No one person is more qualified than another to be in this space. If a viewer looks onto the mural on the triangle one of the statements they will notice is "Why not you." This is a message explaining that anyone belongs here at Lafayette, and similarly, anyone has the right to be in the Lafayette Gardens. This space has been shaped as an area of collaboration, discovery and development, but most of all this is an area for everyone to enjoy. The beauty of the space is that it is not meant for one singular purpose but instead it can be used in a variety of ways to provide each person their own unique experience. Creative yet refined, busy yet relaxing, there is no one way to live in the Lafayette Gardens.

Reputational:

The gardens stand to bolster and solidify Lafayette College as on the forefront of design, sustainability, and experience when it comes to college campuses and public domains around the world. The project falls right into line with the sustainability aspects of the ongoing and public Climate Action Plan 2.0 passed by the school in 2019. This project could provide a tangible example for people to see the work the college is doing every day to help reach their goal of a better tomorrow. Already known for tremendous value, Lafayette Gardens can help admissions

in selling prospective students in the College. The first sight that you currently see when you walk out of Markle Admissions and turn right is the barren landscape of the northeast facade of Acopian Engineering Center. The implementation of the gardens could change this into a focal point of tours. The mural painted onto the lower triangle sporting “Why not you? Why not here? Why not now?” will certainly leave prospective students and visitors thinking about and remembering all that this college has to offer.

Recommendations

Due to the fact that our team developed Lafayette Gardens over the course of a semester, we were able to complete the preliminary research into green spaces, as well as develop the proposed plan and associated report, but there are aspects that still need further investigation. We understand that the project will be unable to move forward until it has been reviewed and approved by Lafayette College’s administration but, in the hopes that the space receives approval, we leave this proposal and the following recommendations as a way to assist and guide the future development of this multifunctional space.

Design

From a design aspect, we recommend that, firstly, the college hires a landscape architect to further refine the current design proposal. Paul Deery, who has already provided some assistance, would be a strong candidate for the role since he is already familiar with the project and the motivations behind it. Additionally, the current design might benefit from the decision to extend the project’s scope by adding additional spires either within the space, to further define the area, or outside, to connect the space to the rest of campus. We were also unable to fully explore the use of hedges as a form of acoustic separation between the space and the neighboring road. Should this feature be of interest, we recommend that the architect consider placing them

between the spires. The inclusion of hedges or additional spires could also assist with efforts in traffic calming, an important function to consider given the location of Lafayette Gardens. Traffic calming will promote Lafayette Gardens as a place for relaxation, conversation, and learning. Lastly, for safety and aesthetic purposes, the team suggests that Lafayette investigates the logistics involved in lighting the space. Although the lighting would not have to be on at all times, it will be an important safety feature during the night time when students are traveling between Markle Parking Deck and Acopian Engineering Center.

Structural

Our team's communications with LiveWall proved to be incredibly helpful in developing the proposal for Lafayette Gardens, especially in the structural context. Yet, even with the assistance this resource provided with calculations and planning for the wall, there are still uncertainties associated with the entire space that the team could not determine within the semester. One of the biggest concerns the team has is the long-term performance and maintenance of the wall, particularly in terms of irrigation performance. We highly recommend further research into technical performance, especially if the school intends to maintain the space using its own staff. In regards to the spires and wires, careful basic calculations have been done by the team's structural engineer to ensure that the extension into the garden space is structurally sound. Even so, we suggest that more consideration is given to the space's performance in extreme weather, as well as the spire-wire and wire-wall attachments in order to ensure that they will not cause any significant damage to Acopian and can withstand potential loads (within reason) and time passing.

Environmental

Environmentally speaking, the largest concern has to do with maintenance as well. It will be important for Lafayette to fully understand the best way to care for the space such that the plant life thrives and the various living organisms inhabiting the space are not disturbed. While the current list of plants for the wall were planned to maximize the space during any season, decisions made by the school to change the proposed plant layout should be supported by research that ensures that there will be no negative effects. The college should also investigate how, specifically, the implementation of Lafayette Gardens will assist in its efforts to achieve net neutrality in the next fifteen years.

Economic

The economic context requires perhaps the most follow-up should the project be approved so that the school can get the most accurate estimate possible. As implied in earlier context recommendations, maintenance is perhaps the biggest unknown for the project. Therefore, it will be important for the school to fully consider the cost of a regular maintenance crew, as well as the long-term maintenance costs that are associated with keeping the wall and garden space performing at full capacity. The administration will also want to consider the costs of outside consulting, such as hiring a landscape architect or members from LiveWall, as well as obtaining the permits necessary for constructing and maintaining the space. Lastly, due to the inability to conduct our non-financial benefits survey during the semester, we recommend that Lafayette distributes our survey, or one of a similar function, at a later time to better gain a sense of how the space will perform.

Overall, the current design of Lafayette Gardens will not only have the impact of improving the atmosphere affiliated with Acopian Engineering Center, but it will further influence the campus community by embodying the school's core values and inspiring sustainable, creative, and inclusive ways of thinking. As a team, we are hopeful that Lafayette College will give serious consideration to the establishment of Lafayette Gardens.

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Sholtz, L. (2020). Figure 2.1 – *Lafayette Gardens Rendering:* Design Overview. [Image]

Sholtz, L. (2020). Figure 2.10 – *Spire Location:* Snake Orientation. [Image]

Sholtz, L. (2020). Figure 2.11 – *Wire Pattern:* Markle View. [Image]

Sholtz, L. (2020). Figure 2.12 – *Wire Pattern:* Overhead View. [Image]

Sholtz, L. (2020). Figure 2.13 – *Wire Attachment Points:* Parabolic Pattern. [Image]

Sholtz, L. (2020). Figure 2.15 – *Gardens:* High Street View. [Image]

Sholtz, L. (2020). Figure 2.16 – *Adirondack Chairs:* Sidewalk View. [Image]

Sholtz, L. (2020). Figure 2.19 – *Rendering of the Lafayette Gardens:* High Street View. [Image]

Sholtz, L. (2020). Figure 2.2 - *Possible Orientations: Every Vertical*. [Image]

Sholtz, L. (2020). Figure 2.20 – *Rendering of the Lafayette Gardens:* Markle Parking Deck View. [Image]

Sholtz, L. (2020). Figure 2.21 – *Rendering of the Lafayette Gardens:* Markle Hall View. [Image]

Sholtz, L. (2020). Figure 2.3 - *Possible Orientations: Diagonal*. [Image]

Sholtz, L. (2020). Figure 2.4 – *Concrete Triangle:* Location. [Image]

Sholtz, L. (2020). Figure 2.8 – *Lafayette Gardens Triangle Rendering:* Possible Mural Design. [Image]

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Appendix

Project Calculations

Calculations for Wires

Jordan provided basic calculations. To further analyze professional structural information of the product refer to US cargo control.

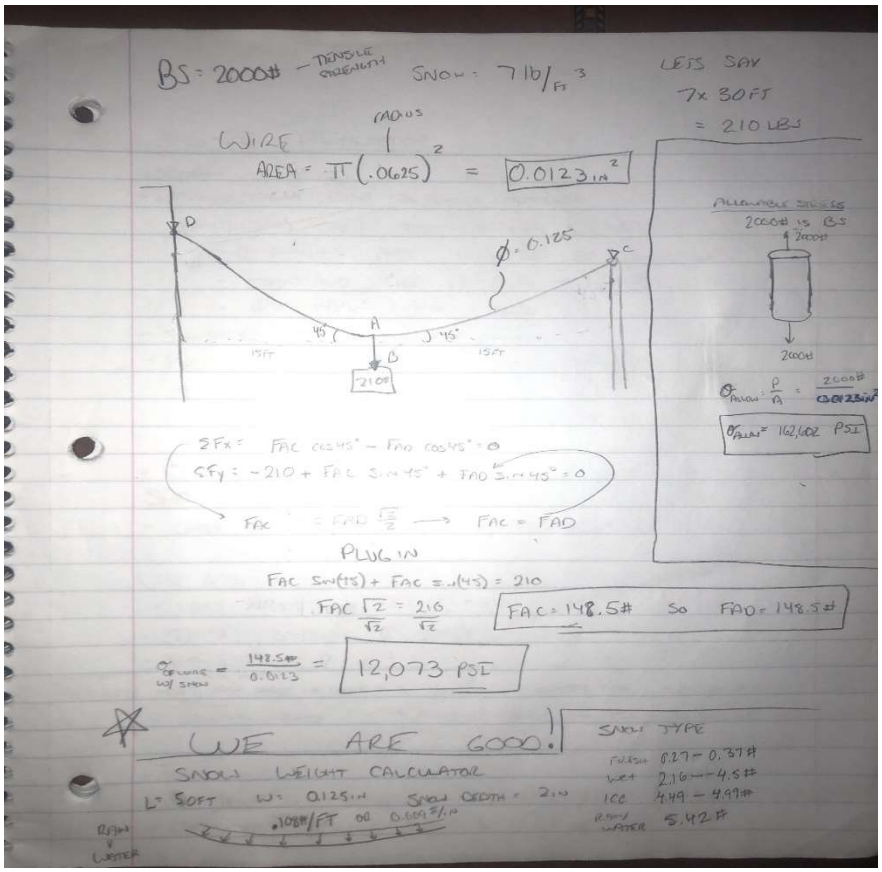

Figure 7.1 Calculations for Wires
Jordan, M. (2020)

Calculations have been provided to further the analysis of the wire

NOTICE: Calculation is an unrealistic representation of project design. Calculations are done this way just to provide evidence of sound structure requirements.

Assumptions:
210 lbs weight directly in the middle of the structured wire.
Assumed 45-degree angle exit point for wires
Knowns:
Area of wire= 0.0123sqin
Break Strength (BS)= 2000 lbs

Normal allowable stress:
Normal allowable stress= BS/A= 2000 lbs/0.0123sqin
Normal allowable stress= 162,602 PSI

Wire on each side of 210 lbs weight holds 148.5 lbs
Normal Stress on Wire= 148.5 lbs/0.0123sqin
Normal Stress on Wire= 12,073PSI

12,073 PSI < 162,602 PSI So wire is safe and will not break

Snow weight calculator- Done to provide realistic evidence on our wire
Wire width= 0.125in
Snow depth= 2 in
L= 50 ft max length of wire distance
Weights below are calculated based on
Fresh snow 0.27-0.37 lbs
Wet snow 2.16-4.5 lbs
Ice 4.49-4.99 lbs
rain/water 5.42 lbs
* No rain, snow, or water will be able to sit on ⅛ in diameter wire at 2 in

Taking the max weight of 5.42 lbs calculate the max load upon the wire as a whole for 50ft
Load=5.42 lbs/50ft
Load=.108 lbs/ft or .0009 lbs/in

Loads must be extremely heavy in one given point to cause failure of break strength. Due to the design of the project, the wire will not encounter any super heavy loads. Realistically the only loads it may experience are snow, rain, or a small animal, which will not provide enough stress to cause failure to wire rope.

Calculations for Spires

Jordan provided basic calculations. To further analyze professional structural information of the product refer to Valmont Structures.

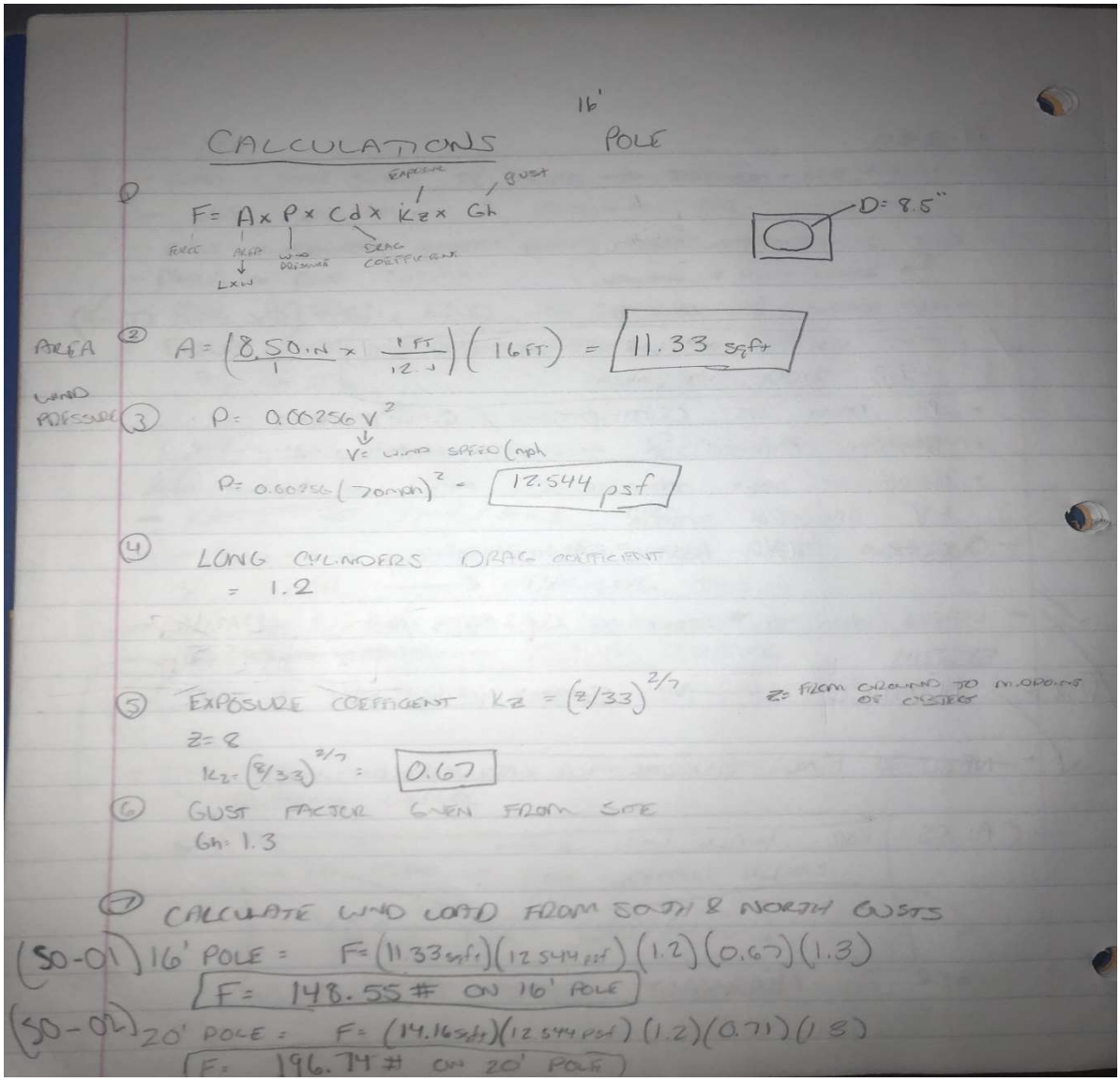

Figure 7.2 – Spire Calculations
Jordan, M. (2020)

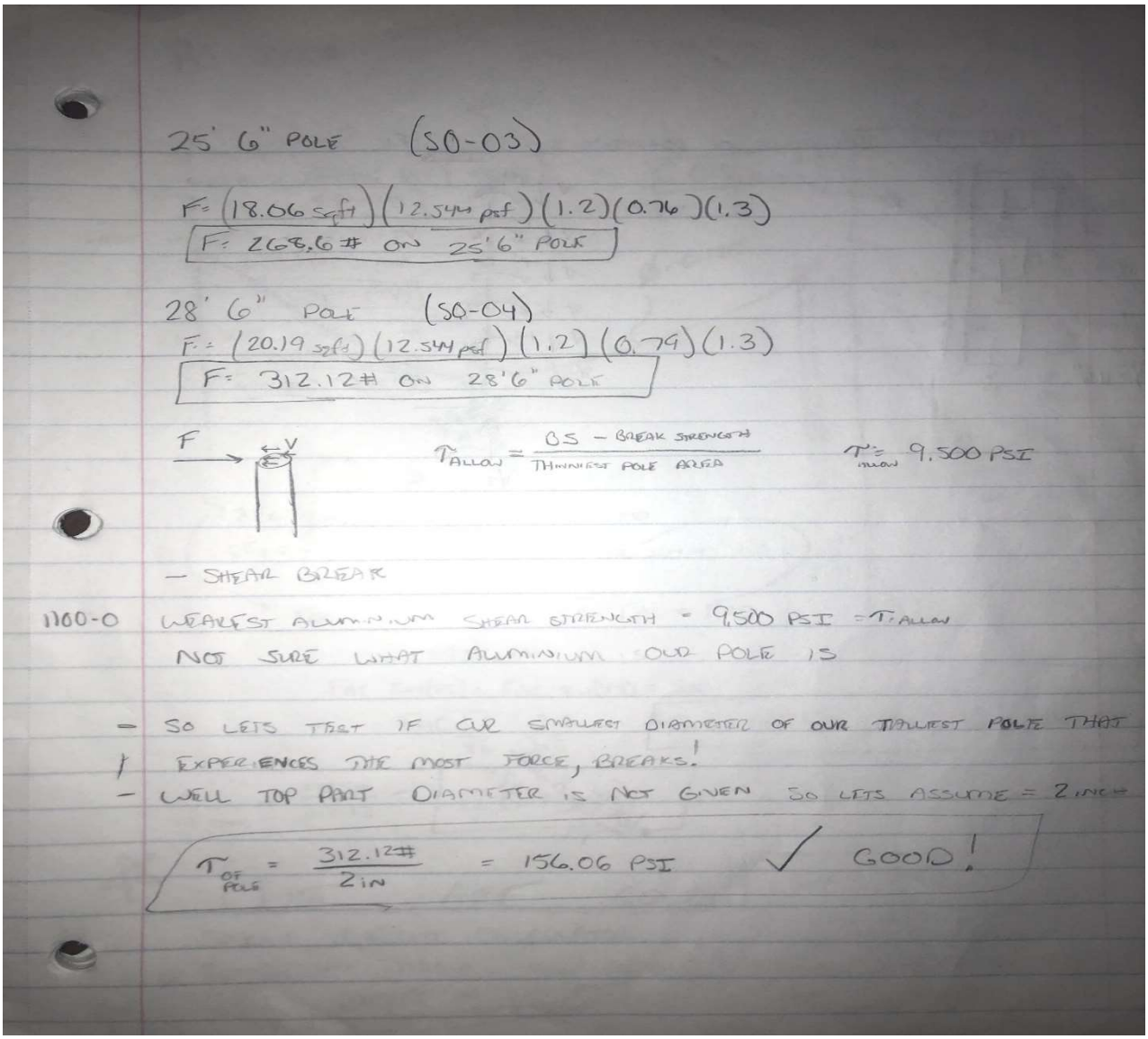

Figure 7.2 – Spire Calculations
Jordan, M. (2020)

Calculations provided further the evidence for this spire being the top choice. The calculations were completed using the estimated projected area calculations along with simple shear stress calculations. Based upon the equation engineers use to understand force from wind and the stress it places on the spire, the spire shows no results of failure.

Equation
F=A x P x Cd x Kz x Gh
A= area wind hits (Varied upon height of spire)
P=Wind pressure
Cd= Drag Coefficient
Kz= Exposure
Gh= gust factor

Wind pressure equation
P=0.00256(V)^2 where V is wind speed
V=70 mph based on American Association of State Highway and Transportation Officials

Cd Long cylinders standard coefficient
Cd=1.2

Kz equation
Kz=(z/33)^(2/7)
z= from ground to midpoint of structure

Gust factor
Gh=1.3 given from Valmont Structure website (load and dimensional data)

Wind Gusts from North and South will provide force
S0-01 16’ spire= 148.55 lbs
S0-02 20’ spire= 196.74 lbs
S0-03 25’6” spire= 268.6 lbs
S0-04 28’6” spire= 312.12 lbs

Shear strength
1100-0 is the weakest aluminum metal
Known shear strength (T) = 9,500psi

Test our structures greatest force applied to it to see if it fails

T= F/A
A= is smallest diameter of spire, most likely near top of spire

T=312.12 lbs/2in
T=156.06 PSI

Calculations for Cap of Spire with 3 wires

Jordan provided basic calculations. To further analyze professional structural information of the product refer to Valmont Structures and US Cargo Control.

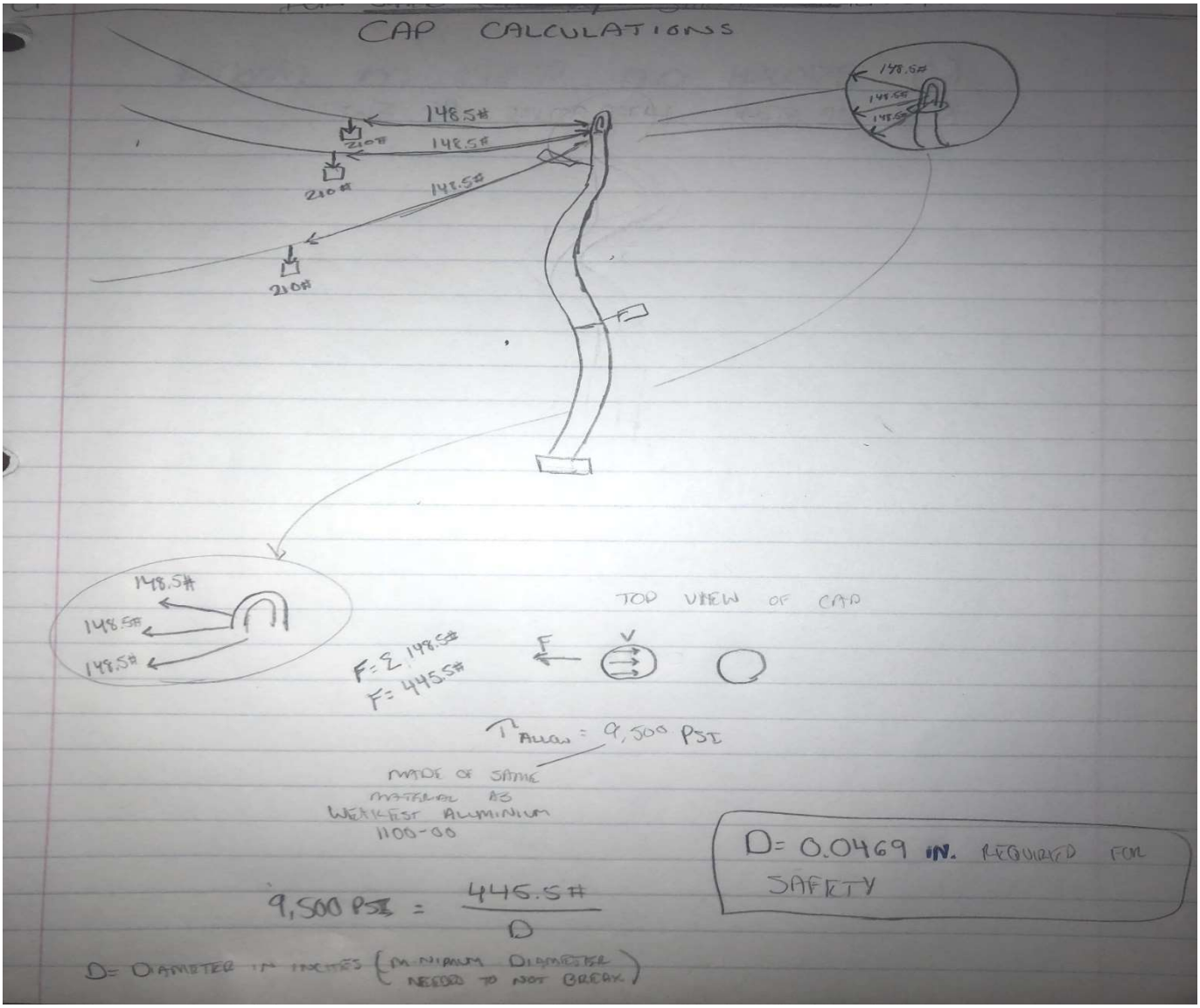

Figure 7.3 – Cap Calculations
Jordan, M. (2020)

Note* Structural integrity will most likely be determined by the furnishing of spire caps.

For the spires with three wires connecting to it, they will have the highest load and force applied to the spire cap. The calculations below determine the minimum diameter of the cap connector to ensure the wires do not cause failure to the connector.

1 Wire = 148.5 lbs refer to Calculation for Wire for more information.

Cap with 3 wires
F=445.5 lbs
Shear stress allowed (T)= 9,500psi from 1100-0 Weakest Aluminum Metal

Stress Equation
9,500psi= 445.5 lbs/D
D= minimum diameter needed for safe structure

D=0.0469 inches

Structure will be structurally safe as long as cap is furnished with aluminum and has a diameter equal to or greater than 0.0469 in.

All structures should be feasible for use.

Section	Component	Cost Low	Cost Medium	Cost High		Provided Materials include-
The Green Wall						Furrings strips and Slot Rails with irrigation conduits (RainRails)
	Provided Materials	$68,850.00	$91,800.00	$114,750.00		Irrigation main line components
	Plants	$15,300.00	$22,950.00	$30,600.00		Irrigation parts and fittings from valves to the RainRails
	Contractor Installation	$53,550.00	$68,850.00	$68,850.00		Wall Planters
	Bat Boxes (4)	$160.00	$392.00	$780.00		Removable planter inserts (empty)
	Additional Costs	Will be determined by consulting in the future				
The Triangle						**Contractor Installation**
	Paint Components	$324.98	$324.98	$324.98		Fasteners for installation between LiveWall and building structure
	Installation	Completed by students in the Art Department				Facing Material to cover the irrigation feed (typically wood or sheet aluminum)
The Grounds*						UV Resistant Fittings and pipe from the mainline to the irrigation valves – SCH 80 Gray Pipe and Fittings recommended
	Flower Beds					Underlying backing material
	Plants					Labor, equipment rental, and a fair profit
	Terrace Construction					
	PA Bluestone Path	$20,000.00	$25,000.00	$30,000.00		**Additional Costs**
Wires and Spires						Water source (plumbing) & drainage (sewage or stormwater)
	Wires	$133.00	$133.00	$133.00		Electrical and wiring for controllers
	Wire components	$29.43	$29.43	$29.43		
	Connection piece to Brick wall	$112.42	$112.42	$112.42		**Paint Components (Sherwin Williams)**
	Spires	$11,174.40	$11,174.40	$11,174.40		Primer (34.99) (2)
	Pole Cap	Will be created by fabriaction later on				Base Color (Maroon) (85.00) (2)
Seating						Lettering (White) (85.00) (1)
(4 Chairs)	Adirondack Chairs	$280.00	$400.00	$800.00		
						Wire Components
	Total Cost	$169,914.23	$221,166.23	$257,554.23		Wire Rope Clips (28)
						Wire Thimble (28)
						Connection Piece
						Stainless Steel Shoulder Eye Bolt (14)
						Spires
						Valmont Structures Signma Spire S0-01 (1,458.60) (2)
						Valmont Structures Signma Spire S0-02 (1,724.30) (2)
						Valmont Structures Signma Spire S0-03 (2,404.30) (2)
						* - These figures were obtained through a rough estimate from Paul Deery

Lafayette Gardens Vignettes

Written by Greening Acopian Team

As we start driving up the hill, passing by Williams, I notice all the greenery surrounding the stairs leading up to campus. I would always hear it from my brother that this part of the hill was tough to go up through, but the view is always worth it. As we got closer to Markle Hall, I just could not help but notice all of the beautiful landscaping the school has worked on. The flowers blooming, the pink cherry blossom trees, the huge green trees, this was just getting started. Thinking about choosing Lafayette College as my own college would be exciting, but it still has not sealed the deal! Once my parents and I parked the car behind Markle Hall, we started walking by the side of Old Oeschle, up the stairs, and started walking towards Acopian, where my brother said he lived most of his time. Is that not an academic building? Well, anyways, once we got closer to Acopian, I noticed something like a little forest up ahead. My parents noticed it as well and wanted to check out. The space gave the vibes of a little getaway from all of the chaos college may give students. There were small benches made out of wood that blended in well with the rest of the greenery. The poles with vines coming down also made the space feel like a small little forest, especially with all the birds, butterflies, and all of the biodiversity surrounding us. Not only that, but the space felt enchanted and so unreal, that it made me want to stay there longer. There were a couple of other people there, but it felt so quiet and calm compared to the people walking around outside of this area. Soon, my parents wanted to go see the rest of the college, but I think this space will be something that will always stay on my mind. This looks like it might be my future spot.

Another day, I got up for breakfast at 8 am and ate until 9 am. I went down to the Bourger Varsity Field House for treatment and therapy at 9:30 am. Already the day is super busy and I did not even begin classes. The day went on and the class ran on, I had to go back to the cafe to make sure to eat a big lunch to fuel up for practice. I got another class from 1 pm to 2 pm. Once finished, back down to the Bourger Varsity Field House in the pouring rain as I am in a hurry to go watch film and lift. This beautiful Lafayette Gardens on the east side wall of Acopian is providing me an easy pathway down without slipping and falling. I watch film and review game plan adjustments for the week. Practice begins at 4 pm and does not end until 7 pm. Tired and exhausted from practice, I drag my way up the bleachers to head to dinner but I stop at the Lafayette Gardens to take a moment to finally sit down and relax. Thankful for the opportunity to rest, I acknowledge the beautiful sights and sounds of nature around me. I am glad I have a place to rest.

Life as a honeybee has never been easy. It's bad enough having to fear for your life whenever you fly near humans that try to squish you, but then you add on the fact that pesticides are used to a damaging extent and the ever-decreasing areas habitable for bees, and all of a sudden you are struggling to survive. So, when the space outside of the Lafayette College engineering building was redone, I was shocked. I cannot express enough gratitude to Lafayette College for its efforts to establish locations for us pollinators to live. The space referred to as the Lafayette Gardens is now full of new plants that never use to exist. The living wall towers above the small gardens that are growing up from the ground, and during the spring and the summer, the space flourishes with life and color making it my favorite place to fly. Ever since the establishment of this space, the stress that has been weighing me down during my daily routine of pollinating has been reduced and I can take comfort knowing that some colleges are trying to make a difference during times when the state of the environment isn't great.

As my parents and I exit the parking deck, we walk into the backdoor of Markle Hall and are greeted by our smiling tour guide. We step out into the hot summer sun and I look around and take in my first glimpse of campus. To my right, I see vibrant colored plants on the side of a building with a gazebo-like space in front, I make a mental note to investigate the space later. After visiting Acopian Engineering Center, my tour guide explains that the space is called the Lafayette Gardens and was formed from a student-driven project. The space incorporates many core values of the College in it: sustainability, inclusivity, and collaboration. I turn to my parents and express that it's pretty impressive that the school listened to a student-driven project and constructed the space. We bid farewell to our tour guide in front of Markle and all sigh at the thought of getting back into the hot car and driving a few hours to our next college to visit. So, we first decide to sit and cool down for a bit. We decide the Lafayette Gardens would be the perfect place to do so. The Adirondack chairs provided us a comfy place to sit down, take a break from the hot summer sun, and reflect on our tour of Lafayette. After about 15 minutes, we felt recharged from the shade, sights, and smells and were ready to continue on our college road trip. As I walked down the rock path of the Lafayette Gardens, I smiled to myself knowing this wouldn't be the last time I found myself on this beautiful campus.