Greenhouse #3 Final Report

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Abstract

The following report details the design process for the construction of a greenhouse structure designed with the intent of satisfying the needs of the community members of the Algonquins of Barriere Lake. This report draws upon primary sources such as the interviews with the client, Monique Manatch, and firsthand observations. This report will offer a close examination of the design thinking process, and its implementation in a real-world situation. Firstly, the empathize step of the design thinking process was utilized through interviews with Monique Manatch, where she expressed the community's dissatisfaction with the inefficient system that exists. From that information, the team was able to make a list of needs, from which a problem statement was constructed. During the ideate stage of the design thinking process, secondary sources were used for benchmarking to draw an understanding of what already exists on the market. Many sketches were drawn to increase the efficiency of communication between the team, the Project Manager, and the Dr. Majeed. After a general design was chosen, 3 different comprehensive, physical prototypes of different level of detail were built to improve spatial understanding of the design. Lastly, the structure was built and put on display on design day.

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2.0 Introduction

This report will cover our design process of building a greenhouse for a client. It will list the needs that were gathered from client meetings, the brainstorming process, the several prototypes that were made, and the construction process of our final product. It will close with the lessons that were learned throughout the process.

This report is oriented towards future engineering students who will have similar projects. It aims to help future engineers gain knowledge on simple civil engineering concepts. Students can use the information provided in this report to build their own similar structures.

3.0 Main Body

This section of the report will cover the design process of building our greenhouse in detail. It will describe the customer needs and the problem statement, the brainstorming process, the prototyping process, and the construction process for the final product.

3.1 Customer Needs and Problem Statement

Our initial introduction to the project came in the form of the first client meeting, where we were given details about the problems that the remote Algonquin community at Barriere Lake were facing due to a deficiency of fresh fruits and vegetables. This client meeting provided details about the causes of the issues which we then compiled into a list of interpreted needs that our structure should satisfy.

Needs relating to the structure:

- Materials that will keep out mice, bugs, and other animal
- The material used to construct the greenhouse must be insulating.
- Temperature inside the structure must be restricted within a certain domain to ensure proper growth of vegetation.
- Must be self-sustaining (electricity)
- Materials that can withstand the extreme temperatures without being damaged
- Able to be easily taken apart, transported, then reconstructed.
- Pieces of the structure do not exceed 2x8

Needs relating to the vegetation:

- Ability to grow enough food to support up to 50 community members
- Vegetation that is easily sustainable throughout the year.
- Takes into consideration cultural needs (for example, able to grow tobacco)

Needs relating to upkeep of the system:

- Some way of removing snow or minimizing snow buildup

- Some way of providing water from a nearby (on-site) source
- Some way of providing the electricity necessary to run the system
- A long lasting structure that will require minimal repairs that the community members would be capable of doing themselves

Overall needs:

- Inexpensive
- Easily used
- Will fit in with the culture of the community and take into consideration their specific cultural needs.

Problem Statement

The Algonquin community at Barriere Lake is in need of an inexpensive, self-sustaining greenhouse capable of growing appropriate vegetation to feed as many of their 50 community members as possible. This structure will need to be transported, must be able to withstand the extreme winter temperatures, and keep out all wildlife.The students from lab section B04 of class GNG1103 at the University of Ottawa will design and construct a greenhouse to be delivered to the Algonquins of Barriere Lake that meets all of the previously stated requirements.

3.1 Brainstorming

After we listed the needs of the client and sorting them into functional and non-functional needs, we started our research on the different types of greenhouses and their components. We looked into potential shapes, materials, and accessories that would help satisfy our customer's needs. However, we had a few constraints that we also had to consider for this project: the structure had to be capable of being broken down into panels of maximum dimensions 4ft by 8ft, the structure had to be capable of being rebuilt easily, the height of the greenhouse could not surpass 6-8ft, the width could not surpass 4-6ft, the length could not surpass 6-8ft, and the budget was $250 Canadian dollars.

First, we did some benchmarking. Throughout this process, we were able to get a better understanding of the materials that were used to build greenhouses, the different components of the structure, and the pricing of certain materials. Table 1 depicts the three greenhouses that we compared.

When researching the possible shapes for our greenhouse, the main priority was finding an ideal roof shape for snow removal. At the time, we looked at triangular roofs and one-sided slanted roofs. We also calculated the optimal angle of inclination of the roof panels to maximize sun exposure as well as the ease snow removal. In addition, the size had to be considered due to the greenhouse's need of being mobile and the constraints.

	Cedar Greenhouse	**Twin Wall**	**RION 702471**

Specifications		**Greenhouse**	**greenhouse**
Company	Outdoor Living Today	Palram Hybrid	Echo grow
Materials	Red cedar Polycarbonate	Twin-wall Polycarbonate	PVC Resin Frame, Polycarbonate Panels
Dimensions	Height:1.09 m Width: 2.2m length : 1.2m	Width: 1.85 m Heights:2.08m Length:1.26 m	Width:2.04m Height:1.98 m Length: 3.87m
Price	3499.00	699.00	2677.56
Weight	850lb	Unknown	74 lbs
Picture			
Frame	Wood	Aluminum	Aluminum
Add-ons	- Heat activates roof vents - 2 lower wall vents	- Galvanized steel base - Manual roof vent	- Manual roof vent

Table 1. Benchmarking

There were many factors that were required to consider when choosing our materials. For the frame of the greenhouse, we needed to find materials that were animal proof, that would be able to withstand severe weather conditions, and that would be easy to repair. For this reason, we chose wood as it is a material that is rather strong, easy to manipulate, and easy to acquire. Originally, we had planned on having a tin mouse barrier to prevent mice from chewing through the base of our greenhouse; however, we were unable to make one due to the budget. Instead, we decided to make half walls using oriented strand board (OSB) in order to provide insulation and an animal barrier. For the materials of the windows, we prioritized finding a material that would minimize heat loss and maximize heat absorption. For this reason, we considered plastic planes and film. In the end, we used polyethylene sheets because of their low cost.

Some of the accessories we considered installing in our greenhouse included fans for ventilation, electric power distributions for a solar panel, and a structure to elevate a water tank. Gutters were also necessary to collect rain. Unfortunately, we were unable these additions with the exception of the gutters due to budget.

After carefully considering our options from the research, we made a sketch of the greenhouse. Our first design is depicted below in Figures 1, 2, and 3. It can be seen that our dimensions changed throughout this process.

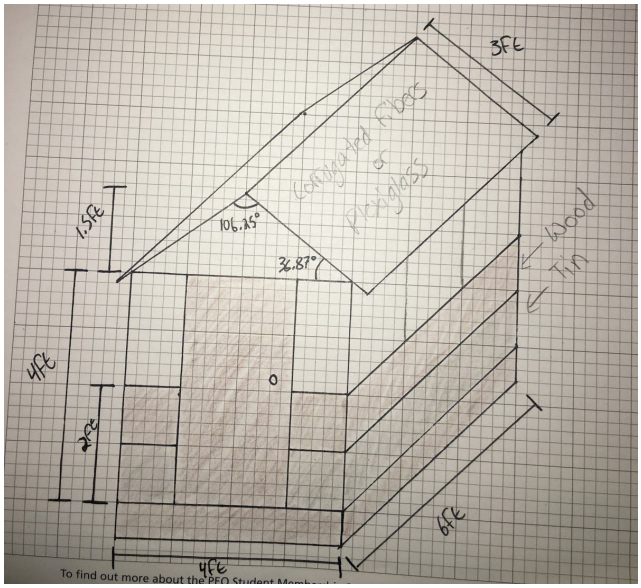


Figure 1. First sketch of the whole greenhouse

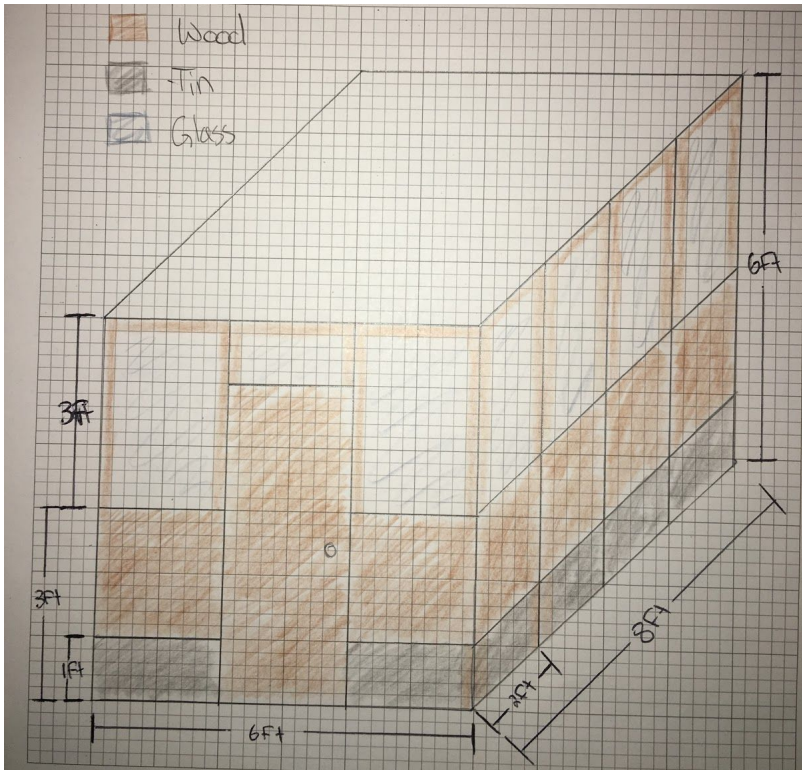


Figure 2. Sketch of walls of greenhouse

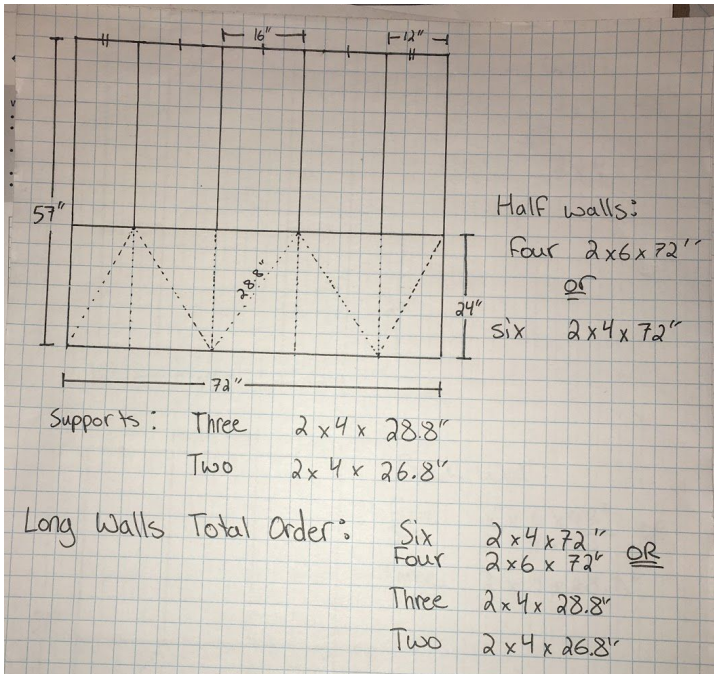


Figure 3. Dimensions of the walls

Some adjustments were made during the construction process. A significant change implemented was the change in the shape of the roof. In the original sketches, it can be observed that the original plan for the roof shape was a dual-pitched style roof. However, after further

discussion with Dr. Jamal, it was suggested that the roof shape be changed to a gambrel style roof. The reason for this change is not only due to aesthetics, but also to increase efficiency and usability. A gambrel style roof will provide a steep angle that will decrease the amount of snow buildup, which will increase the amount of sunlight penetrating through to the structure. This roof style will also provide the ideal angle for the amount of sunlight that the solar panel is able capture. Another significant change implemented to the final design is the added oriented standard board (OSB) to the walls. This addition was put in place to provide structural support, protect the structure against rodents or other pests, and to increase the degree of heat conservation within the structure. The original plan for the design of the greenhouse included aluminium walls added to the base of our structure. The purpose of these walls was to provide a foolproof way to protect the contents of the greenhouse against pests. However, due to budget constraints, instead of using aluminum, wood was used.

Costs:

Here, are the costs of the materials used in our Greenhouse model. The materials we used were, Wood, Polytarp plastic drop sheets and Corrugated fiber. The reason we used these were because of its low associated cost, which if we were to have chosen metal, would have definitely put us over the budget. The Wooden base cost us $30.70, the sidewalls, $79.70, and the back wall came out to be $27. We also had a wooden Gambrel roof which cost $46.62 and the front Door cost was reduced by using scraps left over from other groups. The polytarp plastic drop sheets came out to be $29 and the Corrugated fiber was $45. Lastly the total expenses was $286.51. This high cost associated with our Greenhouse Model Design, was due to the fact that its functionality was our main priority. For the average person to be able to sustain with minimal effort, we decided to go for a 6 feet tall Model. By using a conservative approach to using our materials, we opted for a mostly wood efficient design.

Cost analysis:

Material	**Element of structure**	**Amount**	**Dimensions**	**Cost**	
Wood	Base	2	2”x6”x6’	$12	
		3	2”x6”x8’	$16.2	
		1	⅝”x4”x8’	$ 2.5	
	Walls (length)	12	2”x4”x6’	$41.6	
		6	2”x4”x8’	$21.9	
		3	2”x6”x8’	$16.2	
	Door	4	2”x6”x8’	$21.6	

		1	2’x4’	$6.98	
	Back wall	5	2”x6”x8’	$27	
	Roof	1	6”x4”x4”	$8.46	
		2	2”x4”x10’	$11.5	
		3	2”x6”x6’	$15.86	
		2	2”x6”x8’	$10.8	
Aluminum	Long walls	2	6’x0.5’’	$19.12	https://www.metalsdepot.com/aluminum-products/aluminum-sheet
		1	4x0.5	$14.58	
	Short walls	2	1’x0.5’’	$7.15	
Poly tarp plastic drop sheet	Long sides	1	24 ft^2 6x2 72x24	$28.97 (500 sq ft: can be used for all walls, lots of extra)	https://www.homedepot.ca/en/home/p.102-inch-x-500-sqfeet-heavy-poly-drop-sheet.1000113368.html
	Door wall	1	4 ft^2 48x24		
	Back wall	1	94”x21”		
Corrugated fiber	Roof	3	36ft^2 26 in. x 8 ft	14.98x3 =$44.94	https://www.homedepot.com/p/Palruf-26-in-x-8-ft-Green-PVC-Corrugated-Roof-Panel-101479/100052613

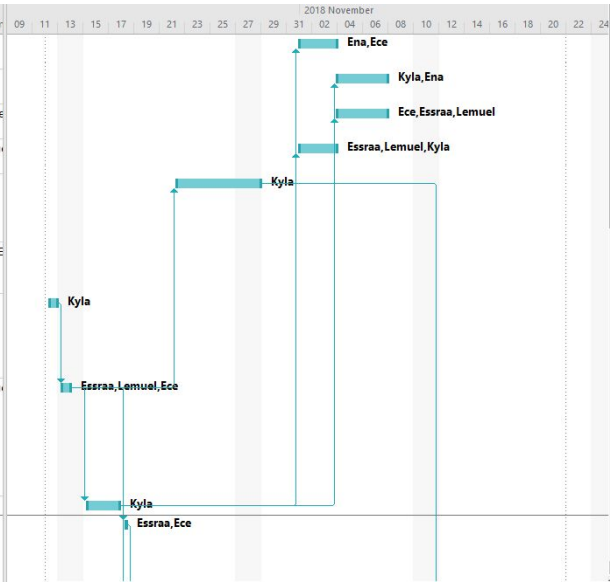
Metal	Gutters	2	6ft long	15.3$	https://www.homedepot.com/b/Building-Materials-Roofing-Gutters-Gutters-Accessories-Gutters/6-in/N-5yc1vZc5qrZ1z0t1o7

Table 2. Cost Analysis

Project Schedule

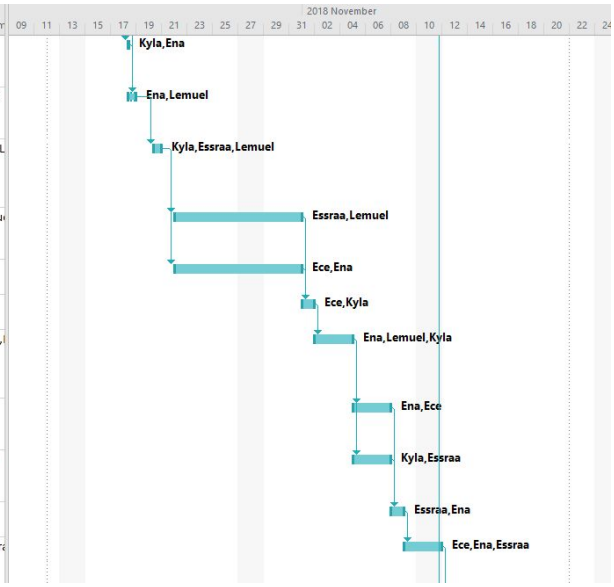
GANTT CHART

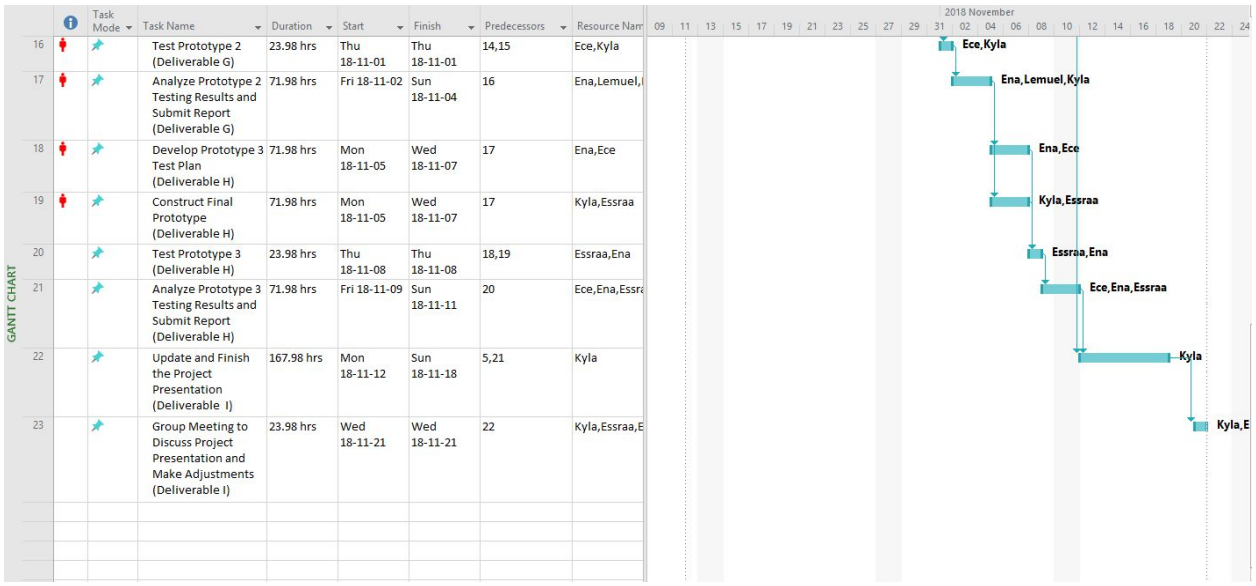
	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Nam
1		Building the Base (Deliverable H)	9 days	Thu 18-11-01	Sat 18-11-03	9	Ena,Ece
2		Building Wall 1 and 2 (Deliverable H)	12 days	Sun 18-11-04	Wed 18-11-07	9	Kyla,Ena
3		Building Wall 3 and 4 (Deliverable H)	12 days	Sun 18-11-04	Wed 18-11-07	9	Ece,Essraa,Le
4		Building Roof (Deliverable H)	9 days	Thu 18-11-01	Sat 18-11-03	9	Essraa,Lemue
5		Preparing the Design Day Presentation and Pitch	19.94 days	Mon 18-10-22	Sun 18-10-28	8	Kyla
6		Final Construction and Finishing Touches				21	Kyla,Essraa,E
7		Finalize Design Including Dimensions and Materials (Deliverable E)	2 days	Fri 18-10-12	Sat 18-10-13		Kyla
8		Calculate Required Amounts for Materials and Adjust Design According to Budget (Deliverable E)	2 days	Sat 18-10-13	Sun 18-10-14	7	Essraa,Lemue
9		Order Materials	61.5 hrs	Mon 18-10-1	Wed 18-10-1	8	Kyla
10		Construct Small-Scale Prototype 1 (Deliverable F)	2 hrs	Thu 18-10-18	Thu 18-10-18	8	Essraa,Ece



GANTT CHART

	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Nam
11		Develop Prototype 1 Test Plan (Deliverable F)	2 hrs	Thu 18-10-18	Thu 18-10-18	8	Kyla,Ena
12		Conduct Prototype 1 Testing (Deliverable F)	2 days	Thu 18-10-18	Fri 18-10-19	10,11	Ena,Lemuel
13		Analyze Prototype 1 Testing Results and Submit Report (Deliverable F)	2 days	Sat 18-10-20	Sun 18-10-21	12	Kyla,Essraa,L
14		Develop Prototype 2 Test Plan (Deliverable G)	30 days	Mon 18-10-22	Wed 18-10-31	13	Essraa,Lemue
15		Construct Prototype 2 (Deliverable G)	239.98 hrs	Mon 18-10-22	Wed 18-10-31	13	Ece,Ena
16		Test Prototype 2 (Deliverable G)	23.98 hrs	Thu 18-11-01	Thu 18-11-01	14,15	Ece,Kyla
17		Analyze Prototype 2 Testing Results and Submit Report (Deliverable G)	71.98 hrs	Fri 18-11-02	Sun 18-11-04	16	Ena,Lemuel,I
18		Develop Prototype 3 Test Plan (Deliverable H)	71.98 hrs	Mon 18-11-05	Wed 18-11-07	17	Ena,Ece
19		Construct Final Prototype (Deliverable H)	71.98 hrs	Mon 18-11-05	Wed 18-11-07	17	Kyla,Essraa
20		Test Prototype 3 (Deliverable H)	23.98 hrs	Thu 18-11-08	Thu 18-11-08	18,19	Essraa,Ena
21		Analyze Prototype 3 Testing Results and Submit Report	71.98 hrs	Fri 18-11-09	Sun 18-11-11	20	Ece,Ena,Essra





	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Nam
16		Test Prototype 2 (Deliverable G)	23.98 hrs	Thu 18-11-01	Thu 18-11-01	14,15	Ece,Kyla
17		Analyze Prototype 2 Testing Results and Submit Report (Deliverable G)	71.98 hrs	Fri 18-11-02	Sun 18-11-04	16	Ena,Lemuel,
18		Develop Prototype 3 Test Plan (Deliverable H)	71.98 hrs	Mon 18-11-05	Wed 18-11-07	17	Ena,Ece
19		Construct Final Prototype (Deliverable H)	71.98 hrs	Mon 18-11-05	Wed 18-11-07	17	Kyla,Essraa
20		Test Prototype 3 (Deliverable H)	23.98 hrs	Thu 18-11-08	Thu 18-11-08	18,19	Essraa,Ena
21		Analyze Prototype 3 Testing Results and Submit Report (Deliverable H)	71.98 hrs	Fri 18-11-09	Sun 18-11-11	20	Ece,Ena,Essra
22		Update and Finish the Project Presentation (Deliverable I)	167.98 hrs	Mon 18-11-12	Sun 18-11-18	5,21	Kyla
23		Group Meeting to Discuss Project Presentation and Make Adjustments (Deliverable I)	23.98 hrs	Wed 18-11-21	Wed 18-11-21	22	Kyla,Essraa,E

Figure 4. Project Schedules

3.2 Prototypes

The first prototype constructed was a comprehensive, physical prototype. It was constructed in two parts from simple materials such as cardboard and glue. The first part was the roof, and the second was the wall and base structure. The purpose of the first prototype was to have a broad overview of the overall design as well as serve as a communication aide with the client. This prototype experienced many limits, such as a lack of representation of all the materials included in our design, lack of representation of the hydroponic system, as well as the absence of the system that will be used to attach and detach the walls and roof in order to make it easy to transport, among others. Overall, the first prototype provided a much better spatial understanding of the space and helped identify key areas that require refining.

From that design, three main issues were uncovered. The first issue that will be addressed is the method of making the greenhouse completely disassemblable. While constructing prototype 1, it came to notice that making the greenhouse easily transportable, yet still sturdy will be a challenge. The team realized that the original plan of having a bracket system be the main method of support will not be sufficient as it will no provide the sufficient support required, especially considering the high wind nature of the geographical location that the greenhouse will be located. Thus, a new method of having a bolt system will be utilized.

The second issue that will be addressed in regards to the structure of the design was that the overall roof design must be revised. It was noticed that the roof is too high, which will decrease the efficiency of the greenhouse due to the warm air rising above the plants. As a result, it was decided that having a lower roof will be more beneficial

The third issue that the team took notice of was that the half wall was too high, which will cause issues that result in decreased efficiency of the greenhouse due to it decreasing the amount of sunlight able to penetrate through the structure. Figure 3 depicts the first prototype.

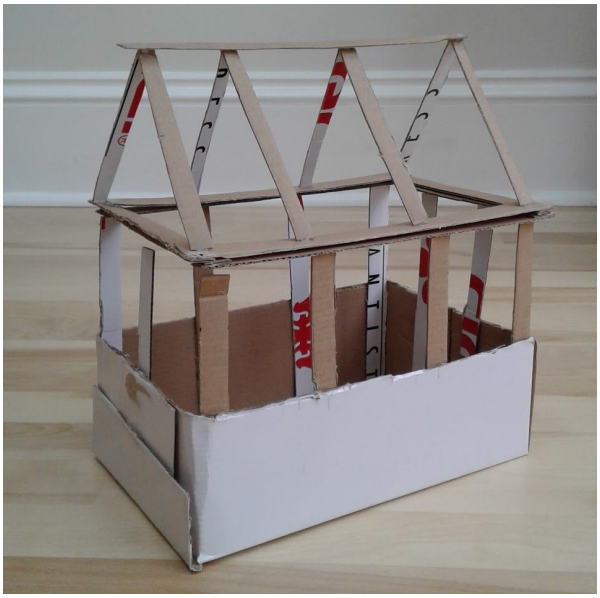


Figure 3. First Prototype

The second prototype, as seen in Figure 4, was constructed to model the final design was composed of cardboard, glue, and aluminum foil. Its purpose was to have a more detailed look at the foundation structure of the design to determine whether the dimensions will meet the client's needs, but also stay within the budget. This prototype experienced limits, including a lack of representation of the hydroponic system, and the absence of clear materials used for the walls and the roof. From this prototype, the team decided on three main courses of action.

After sharing the findings from the first prototype with the client, it was decided that we will keep the roof shape the same, as it is best in dealing with snow buildup. However, we decided to make it shorter, which will increase its efficiency as it will limit the amount of warm air floating up and away from the plants, which are located towards the lower half of the structure.

Secondly, we decided to implement a bolt system as a method of structural reinforcement, without having a bracket system to offer more support, as it was deemed unnecessary and not in the budget. Lastly, we decided to decrease the height of the half wall by a factor of two. This will provide the necessary amount of protection against mice and other rodents, while still allowing a sufficient amount of sunlight to enter the structure.

Figure 4. Prototype 2

3.4 Construction Process

Base

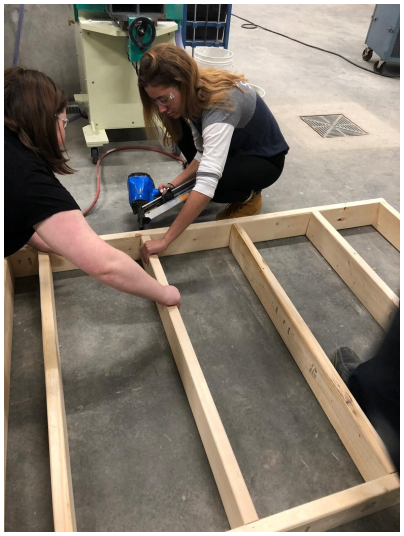


Figure 6. Building the base

Materials: Two 6”x2”x6’
Five 6”x2”x4’
6’x4’ OSB

Instructions: To construct the base, make a frame that is six feet by four feet using two 6”x2”x6’ pieces and two 6”x2”x4’ pieces fixed together with nails at each joint to produce a rectangular frame. To reinforce the frame add the remaining 6”x2”x4’ pieces parallel with the four foot length of the frame, each sixteen inches apart starting sixteen inches to the right of the left edge of the frame. The final reinforcement should be only eight inches from the right edge of the frame. Once the frame is completed, nail the OSB to the top face to finish the base.

Walls

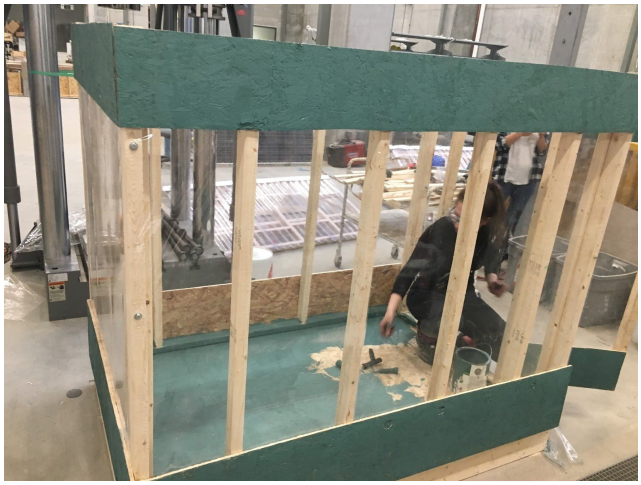


Figure 7. Walls

Materials: **Long Sides**
Four 3”x2”x6’
Ten 3”x2”x5’
Two 1’x6’ OSB
Two 8”x6’ OSB
5’x6’ Polyethylene Plastic Sheet

Short Side
Four 3”x2”x5’
Two 3”x2”x4’
One 1x4’ OSB
One 8”x4’ OSB
5’x4’ Polyethylene Plastic Sheet

Door Side

Four 3”x2”x5’
Two 3”x2”x4’
Two 12”x5’ Polyethylene Plastic Sheets

Instructions:

Long Sides (x2): To construct the longer walls, make a frame that is six feet by five feet using two 3”x2”x6’ pieces and two 3”x2”x5’ pieces fixed together with nails at each joint to produce a rectangular frame. Find and mark the centers of the six foot long sides of the frame, then make a mark sixteen inches away from the center mark on either side. Nail a 3”x2”x5’ piece parallel to the shorter side of the frame at each of the markings (three in total). Cover the entire surface area of the frame (on one side) with the 5’x6’ polyethylene sheet, then use staples to fasten the sheet to the frame. Be sure to pull the polyethylene taunt against the frame before stapling it to avoid wrinkles and air bubbles. Once the polyethylene has been secured to the frame, position the 8”x6’ OSB at what will become the top of the wall (lengthwise, even with the top edge of the frame) and screw it to the frame on top of the polyethylene. Position the 1’x6’ OSB at what will become the bottom of the wall (lengthwise, even with the bottom edge of the frame) and screw it to the frame on top of the polyethylene. Repeat this process to make the second of the long side walls.

Short Side: To construct the shorter wall, make a frame that is four feet by five feet using two 3”x2”x4’ pieces and two 3”x2”x5’ pieces fixed together with nails at each joint to produce a rectangular frame.Make a mark 16” from each side of the four foot long side of the frame . Nail a 3”x2”x5’ piece parallel to the five foot side of the frame at each of the markings (two in total). Cover the entire surface area of the frame (on one side) with the 5’x4’ polyethylene sheet, then use staples to fasten the sheet to the frame. Be sure to pull the polyethylene taunt against the frame before stapling it to avoid wrinkles and air bubbles. Once the polyethylene has been secured to the frame, position the 8”x4’ OSB at what will become the top of the wall (along the four foot side of the frame, even with the top edge of the frame) and screw it to the frame on top of the polyethylene. Position the 1’x4’ OSB at what will become the bottom of the wall (along the four foot side of the frame, even with the bottom edge of the frame) and screw it to the frame on top of the polyethylene.

Door Side: To construct the door wall, make a frame that is four feet by five feet using two 3”x2”x4’ pieces and two 3”x2”x5’ pieces fixed together with nails at each joint to produce a rectangular frame. Make a mark 12” from each side of the four foot long side of the frame . Nail a 3”x2”x5’ piece parallel to the five foot side of the frame at each of the markings (two in total). Cover the portions of the frame within twelve inches of either side of the five foot side of the frame with the 12”x5’ polyethylene sheets, then use staples to fasten the sheet to the frame. Be

sure to pull the polyethylene taunt against the frame before stapling it to avoid wrinkles and air bubbles.

Door

Figure 8. Door

Materials: Two 3”x2”x5’
Two 3”x2”x2’
Two 8”x2’ OSB

Instructions: To construct the door, first create a frame using the two 3”x2”x5’ pieces and the two 3”x2”x2’ pieces fixed together with nails at each joint, producing a rectangular frame. Cover the entire surface area of the frame (on one side) with the 5’x2’ polyethylene sheet, then use staples to fasten the sheet to the frame. Be sure to pull the polyethylene taunt against the frame before stapling it to avoid wrinkles and air bubbles. Once the polyethylene has been secured to the frame, position the 8”x2’ OSB at both the top and bottom of the door (along the two foot sides of the frame, even with the top edge of the frame) and screw them to the frame on top of the polyethylene.

Roof

Figure 10. Roof

Materials: Five 2”x4”x2’
Ten 2”x4”x13”
Ten 2”x4”x21”
Twenty 2”x4”x18”
Fifty Aluminum Gusset Plates
Two 13”x6’ Corrugated Plastic
Two 21”x6’ Corrugated Plastic
Two Polyethylene Plastic sheets cut to size

Instructions:

Frame: To construct the frame of the roof first create five identical quadrilaterals using two 2”x4”x13 planks, two 2”x4”x21” and one 2”x4”x2’ . Use aluminum gusset plates on both sides of all joints to properly secure them (use a hammer to attach the gusset plates to the wood).

Once the five quadrilateral frames are complete, fasten them equal distance apart along two 2”x4”x6’ planks set four feet apart (One at each corner of the quadrilateral, see figure 10). To properly secure the structure and keep the distance between the quadrilateral frames consistent, attach 2”x4”x18” planks between them using screws. There should be eight support pieces attached to each quadrilateral (except the two end pieces which should have only four). To increase structural stability, offset the attachment sites of the support planks.

Finally, nail the corrugated plastic to the wooden frame, matching the pieces to the rectangles of the frame with corresponding dimensions. At the point of the roof, screw in the bent sheet metal to help waterproof the structure. Take the polyethylene sheets and staple one to each of the end quadrilaterals, being sure to pull it taunt against the wooden frame to ensure a proper seal. Cut the polyethylene sheets to size once they are stapled to ensure an accurate measurement.

Putting it all Together:

Figure 11. Final Product

Materials: 32 Nuts and Bolts
Screws
Two 6' Gutters
Door Handle
Hinges
Aluminum Brackets

Instructions:

Walls: To fasten the walls to the base of the structure, use approximately four screws per wall straight through at the very edge of the base. The screw should go through the OSB of the base and enter into the outer frame of the base. To attach the walls to each other at the corners, use four bolts approximately equal distance apart (vertically).

Door: To fasten the door in its place, use hinges and short screws to secure it within the two foot space on the "door wall". At this point any type of door handle can be added (we went with a makeshift door handle consisting of a piece of wood nailed to the frame of the door).

Roof: To fasten the roof to the body of the greenhouse, use approximately five bolts for the long sides and around four bolts for the shorter sides. Aluminum brackets may also be added in the corners for additional structural integrity.

Gutters: At this point, 6' gutters can be screwed into the long sides of the structure and downspouts can be run to the interior of the greenhouse depending on the hydroponics system being run within the greenhouse and whether it relies on rainfall as a water source.

4.0 Conclusion

There were a number of lessons learned that came out of the design process. While many of them are things we knew previously, or even learned through the course materials, having lived these lessons makes them all the more meaningful and likely to remain with us. Our analysis is on more on the most important lessons, learned and how to improve on each of them and they include communication teamwork and conflict management, Researches and information gathering and the last but not the least common goal.

Communication: It is well known, that the importance of communication cannot be underestimated. The manner of communication in the group, how freely and frequently team members communicated between each other, determined how effective the team is. team members were more comfortable at sharing their insights and ideas to the group which lead to effective productivity. Therefore, we can say there was good and solid communication, but nevertheless, we still need to improve our communication skill in the near future.

Teamwork and conflict management: at the beginning, the team discussed and established some team rules together, which prevented the development of inappropriate rules. But even as were these rules discussed early on, we each sometimes came up with one or more reasons that lead to us not abiding by the rules. Nevertheless, this wasn't completely taken account of because we each came to an understanding that we each accept responsibility as individuals and as a team. We did blame one another for team mistakes and failures. We each knew that people are diverse in many ways and we each learned to understand and cooperate with each other. The conflict level was very minimal and if there was ever a conflict, it was healthy or constructive which helped promote our success and innovation. Although our teamwork was good we still ignored our rules and we each forgot that our rules set the expectation for how we would work together and archive our set out goal.

Researches and information gathering: as a team tasked with finding a solution to a problem, we research to help us identify, evaluate and collate all the engineering information that we could find. We used the information researched or gotten from our client or other experienced personnel, break down concepts into main ideas and then we applied strategies and techniques create a workable solution. We need to improve our research and information gathering because we realized that we were lacking in information.

Common goal: As a team, setting a common goal was a top priority in order to for us to achieve effective productivity. In order for us to achieve the common goal, each member had to place the common goal above their individual interests.