Deliverable G - Prototype II and Customer Feedback
Group D1 - Construction
GNG1103

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1. Introduction

In order for our team to have a greater understanding of the design, functionality, and feasibility of major components of the greenhouse, a second prototype will be created and used for testing. The second prototype will focus on specific design criteria and major components of the greenhouse. Testing will be completed on the major components to see if they meet the requirements needed. We will analyse these tests to see if any changes will be required.

2. Test Objectives Description

2.1. What are the specific test objectives?:

The overall objective of testing the second prototype is to ensure that all components of the system are working properly and in unison. During this testing period we will be analyzing the following components:

- Structural Integrity: Whether or not the system can support the weight of the surrounding environment throughout the year.

- Water Collection: Whether the water collection system works efficiently and moves the water in the desired direction.

- Sunlight Accessibility: Whether there is enough sunlight entering the greenhouse.

- Animal Proofing: Whether the system can withstand any possible animals attempting to enter the structure.

2.2. What is being learned or communicated with this prototype?

This prototype will provide our group with a good idea of any adjustments we have to make to the structure that will improve the overall functionality and endurance. As a result we will be able to see each component working individually and ensure that it matches our desired outcome. With this in mind, if it does not represent our original idea properly, we will be able to make physical changes to improve the system.

2.3. What are the possible types of results?

The results from this testing process should include answers to the previously mentioned objectives. To be specific, we should be able to identify an approximate maximum weight that can be applied to both the top and sides of the structure. Additionally, we should determine the general flow of the water across our system. Next, we will get an idea of the amount of sunlight that can enter the system. Finally, the results from the animal proofing should contain a partial idea of whether any animals can enter the structure.

2.4. How will the results be used to make decisions or select concepts?

The results from the structural integrity portion will be used to determine whether we need to add any more support beams to the walls or roofing. After analyzing the water collection we will be able to check if guide rails are required on the roof and if the gutter system needs to be relocated. However an analysis of the sunlight accessibility may lead to reducing the amount of light obstructions and removing unnecessary components. Ultimately, the animal proofing will give us an idea of which parts of the structure need to be reinforced.

2.5. Criteria for success:

Structural Integrity:

The structure can withstand a reasonable weight without any flex in the wood and does not sway when horizontal pressure is applied.

Water Collection:

The majority of the water flows to the back of the structure and into the gutter system.

Sunlight Accessibility:

Sunlight is able to reach at least 90% of the inner base's area.

Animal Proofing:

There are no animal entry points in the system and the materials can withstand any possible scratching or digging.

3. What and How is it being done?

3.1. Describe the prototype type

The prototype we will be using to test for structural integrity, water collection, sunlight accessibility, and animal proofing will be components of the greenhouse which make the criteria for success possible. Thus, the prototype will be a focused prototype as we will be focusing on major components of the greenhouse. A focused prototype allows us to thoroughly design and test each system to ensure it functions at an acceptable level. Collectively, these components will be able to create a fully functional greenhouse that will perform effectively in the conditions in which the green house is in.

3.2. **Describe the prototype building and testing process**

For each component, a focused prototype will be produced. Each prototype requires a different building and testing process. Below we will highlight the building and testing process for each component of the focused prototype.

Structural Integrity:

To build a prototype which will test the structural integrity of the we should begin by building the framing of base and the walls of greenhouse. These components should be connected using nails and screws. Once connected we can test for structural by applying some force to the tops and sides of the frame to see how the wood frame bends and if the frame moves side to side.

Water Collection:

To build a prototype which will test the water collection system, we will need to construct the roof and have a gutter system at the end of this roof to collect the water that runs off of it. With the construction of the roof complete we will be able to test water collection with our greenhouse. To test this we will need to pour water along the roof and observe whether mass amounts of water falls off the sides of the roof. If this occurs we will need to create more gutters or change how we collect water. We will also observe whether or not waterfalls into the gutters at the one side of the roof.

Sunlight Accessibility:

To build a prototype which will test how much sunlight will be let into the greenhouse for the plants inside to grow, we will need to test the light occupancy of the plastic. The plastic we are using to cover the greenhouse can only let in so much light and the orientation of the greenhouse effects how much of the sunlight will be able to enter the structure. To test this we will place a light outside of the green house and observe how much light enters. If there is no light at all then we will need to change our design. Our success criteria will be if sunlight is able to reach at least 90% of the inner base's area.

Animal Proofing:

To build a prototype which will test how well the structure is protected from different animals and rodents, we will need to install the system we are planning to use on the structure. Currently we are trying to use chicken wire to go around the base of the structure. With the chicken wire, we want to see that there are no animal entry points in the system and the material can withstand any possible scratching or digging. To test this, we will analyze the structure for any possible entry points and compare strength of materials to capabilities of local animals. If we see any faults in this system we will look for an alternative method.

3.3. **What information is measured?**

With this prototype, we will be measuring the following four things:

a) The approximate maximum weight that can be applied to both the roof and walls of the structure.
b) The average amount of water that is able to successfully travel through the system.
c) The area of sunlight that can be seen on the base of the structure as well as the area of any shadows.
d) The area of any possible animal entry points.

3.4. How was the information being recorded?

From the previously mentioned information that will be recorded, these are the respective forms of recording the information:

a) The maximum weight of the system will be measured by gradually adding weight to the system and analyzing any bends in the wood. With this we will be able to generate an approximate maximum weight based on the physical struggle of the greenhouse.
b) In order to measure the average amount of water that can flow properly through the system, we will first measure two litres of water and pour it along the roof of our structure. Afterwards we will measure the amount of liquid that was collected and compare it to the initial two litres.
c) To measure the sunlight accessibility we will just bring the structure into the sun and measure the area of any shadows on the base and compare it to the area of sunlight on the base.
d) The area of any possible entry points will be recorded by compared the area of any holes to the average size of any feasible animals in the client's area that may try to enter the greenhouse.

3.5. What materials are required and what is the approximate cost?

The materials we require to build our prototype are the same materials we require to complete the greenhouse. This means that the cost of building this prototype will approximately be the cost to build the green house. If any changes are required our cost will change with the next prototype. Below is a chart that lists the material, their associated cost and the total for this prototype.

Table 1: Materials and Approximate Cost

Material	Cost

2x4x8 Wooden Planks (x6)	$3 each
2x3x8 Wooden Planks (x24)	$2.50 each
7/16 x4x8 OSB (x2)	$11.30 each
Nails	$4.95
10ft Plastic Gutters (x3)	$7.63 each
2x12 ft Plastic Roofing (x1)	$70
4x8 ft Polycarbonate Walls (x5)	$80
Overall Approximate Cost: $598.44	

3.6. **What work needs to be done?**

For this prototype to be possible we will need to construct the greenhouse itself. We will construct the greenhouse in components so that the necessary components can be tested. We will continue to construct the greenhouse in the lab until we see the greenhouse completed and ready for the final prototype.

4. When is it happening?

4.1. How long will the test take and what are the dependencies?

Testing will begin as soon as possible and they will be repeated until the desired results occur. With this in mind, the weight testing should be completed last so that we can structure any additional beams to allow for the ideal sunlight access. Similarly, a complete test of the product would take approximately a full year so that the greenhouse can be exposed to the elements 24/7 and experience all four seasons, which can range from very hot to very cold with lots of snow in the region the greenhouse will be delivered to. For this test to happen, the product needs to be completed, delivered and assembled at the final destination. Regular check-ups can be performed and information on the integrity of the structure can be recorded.

4.2. When are the results required?

The results are due at least a week before design day so that we have time to make any minor adjustments to the structure. In general, the testing should be completed as early as possible to compensate for additional problems within the system.

5. Conclusion

This prototype will give us a greater understanding of each individual system in the greenhouse. This focused approach will also allow us to identify any possible issues in our system and resolve them. Additionally, the results of this prototype will provide us with an accurate depiction of our final product.

Appendix:

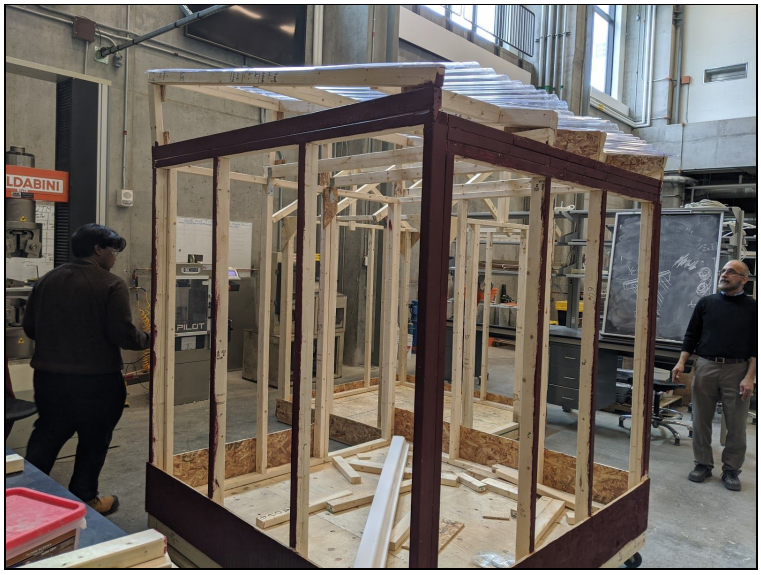

Figure 1 - Structure

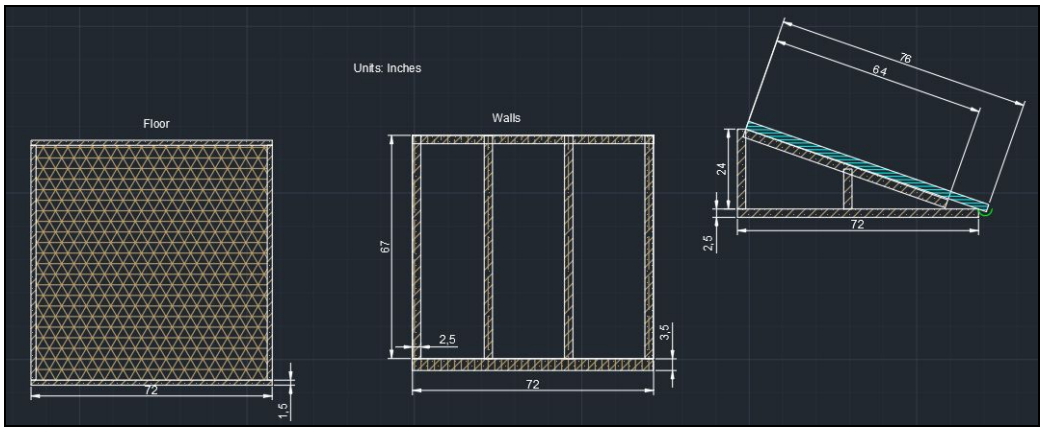

Figure 2 - Computer generated basic design