Project Deliverable D: Conceptual Design

GNG 1103 – Engineering Design

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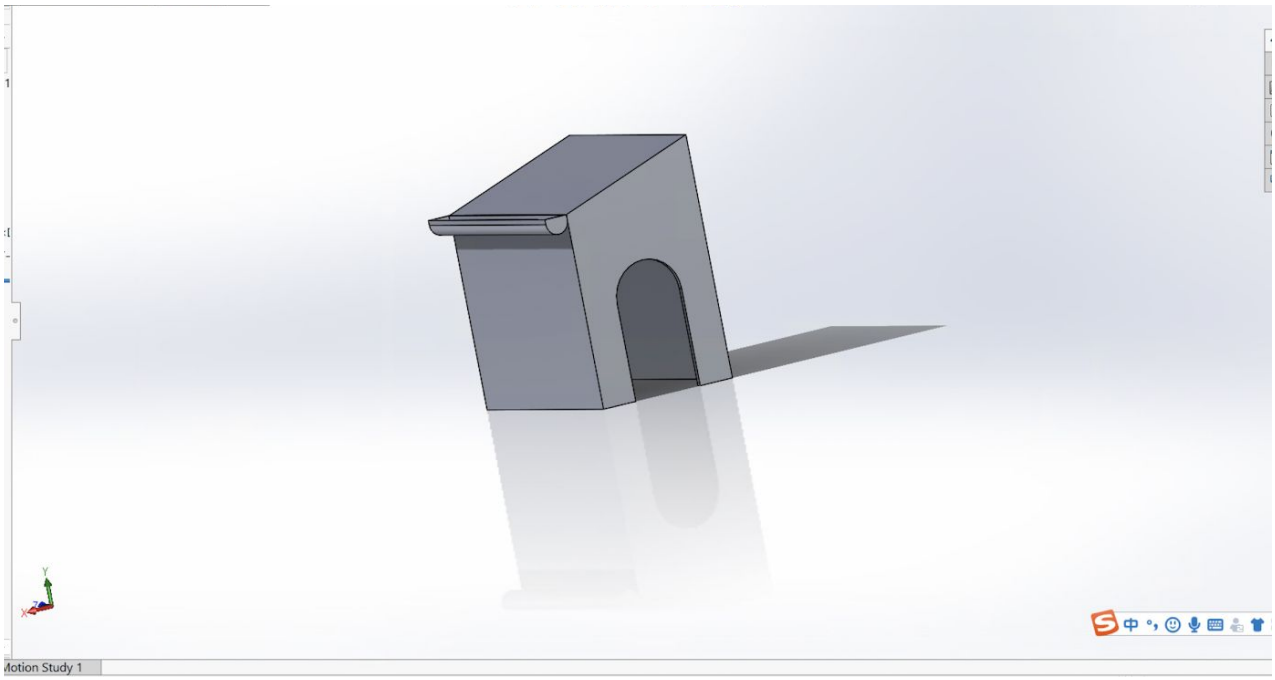
Introduction

This deliverable explains concepts based on our team's problem statement, benchmarking, and list of prioritized design criteria. After the client meeting, it was decided that the cost of materials, sustainability of the greenhouse and weather conditions of the area were top priority when deciding on the design needed to construct the greenhouse. The main goal is to reconvene as a team and discuss these concepts to focus on well-structured ideas for further enhancement of the project. There will be three concepts that cover a general sketch with a descriptive text explaining its specifications. However, each concept will then be analyzed and evaluated against our design criteria, and from this analysis and evaluation, one concept will be recognized for further development.

Concept 1 (Magd Abdelmelek and John Zhou):

Design:



The sketch above will be a rectangle figure with 8 by 6 feet dimensions. This design presents a basic structure of a greenhouse. Problems in construction regularly happen due to the difficulty of the building phase. In this case, a one-sided steep roof in a greenhouse can lessen the drawback during the construction.

Base: The base is expected to hold the entire structure as stable as possible. The size of the base is 8 by 6 ft, which is the size of the greenhouse. It has to be mentioned that some supports have to be put in order to increase the stability of the structure. The supports are going to be put in every 2 ft. In addition, the top of the base is going to be covered with plywood.

Door: The door is going to be an Archtop door with 5 by 3 ft dimension. Moreover, it will be made out of plexiglass in the internal part to provide light to pass through, and the outer part of the door will be an aluminum arch at the top and wood at the bottom.

Roof: The roof is going to be 2 by 6 ft from the section view. Furthermore, it will be a one-sided slope, which can collect the water and allow the snow to slide down, and also will be a good installation for solar panels. The frame of the roof will be made of wood and aluminum on the side. PVC Panels can be used to supply renewable energy to the greenhouse.

Walls: The walls will be square shaped 6 by 8 ft. The wooden planks will help keep all the sides of the walls and strengthen the structure of the greenhouse. This will provide a barrier between the plants and small mammals. Also, we will be connecting the walls by a half ft. plywood. The rest of the wall will be fixed by plexiglass or plywood.

Window: The frame of the window will be 3X 2 by 2 ft., which will be covered in plywood. The Interior part will be a transparent Acrylic. The location of the window will be two on the side and 1 on the back.

Problem and Subsystems of concept 1

Water filtration system

The greenhouse should have its water filtration system. The most important idea of this design is to allow the rainwater or snow to flow smoothly down to the greenhouse.

Subsystem:

- There will be a gutter, made of aluminum, at the downward side of the steep greenhouse to collect the water from the roof to the rain barrel. Furthermore, the water gathered by rain can be used for personal hydration; therefore, this will require a filtration system, which can clean the bacteria in the water.

Low budget

The cost of building a greenhouse is limited.

Subsystem:

- We plan to use some cheaper materials to help the budget keep low like composite boards, wood and polymers. Of course, we will make sure the material has enough strength to support the construction.

Easily transported

According to the client, our job was to make sure that the greenhouse will be easy to assemble and disassemble when transported.

Subsystem:

- The whole construct will be designed carefully to disassemble. We plan to use nails to connect the wood for the frames and screws to attach the frames.

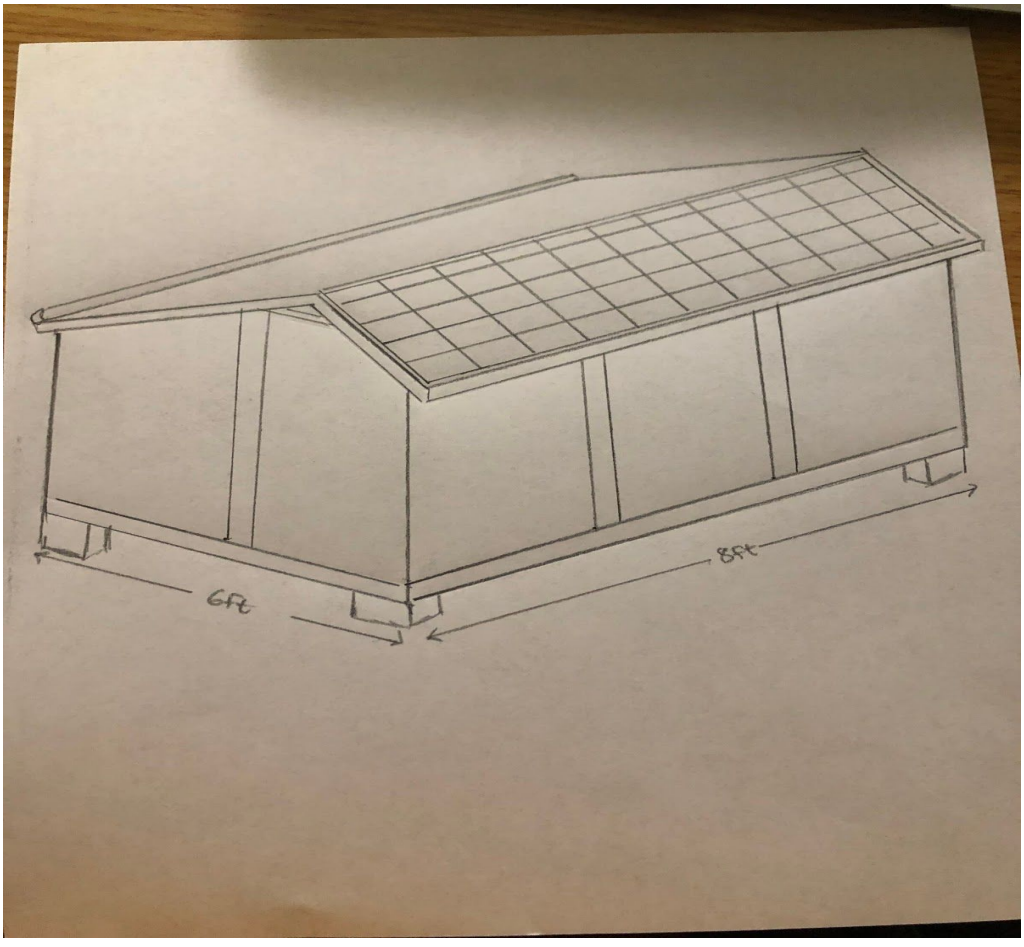
Concept 2 (Omolola Omowa and Divine Ciroma):

A saltbox shed is defined by its asymmetrical design, with its long sloping roof on the back and shorter sloped roof on the front, with gables at the end. Our shed plan adaptation is a variation of early Colonial and Cape Cod designs that originated from New England. Having different sizes and door locations on the tall wall or the end walls will allow the flexibility to situate the shed in a way that best fits our project and gives the best access to the shed.

After much thought and time taken to properly plan the project, the questions below were used as a guide when deciding on the saltbox shed construction:
What amount of storage space do we need for the plants? Does our client have any specific building requirements? Is the SaltBox Shed design the best shed style for our client's need? How much will the shed cost to build? Is the shed going to take a lot of time and energy to build?

Roofs do a lot more than just serving the most basic purpose of protection; a roof's shape plays a major role in defining the overall look and style of a house. A benefit of the smaller roof on the tall wall side of the shed is to reduce snow piling up because most of it runs off the back side of the shed. This is helpful in winter because it reduces the amount of snow that will fall from the roof in front of the access door to the shed. Finally, the slope makes it easy for water to run off, making the saltbox roof good for areas that receive heavy rain. The asymmetrical design makes it more durable than a simple gable roof.

Design:



This idea was to design a greenhouse that would maximize light absorption and be able to collect rainwater . The solar panel would be placed on the top end to achieve as much power as possible and the on the other top end would be a slope that would be able to collect rainwater. The figure of the greenhouse will be a rectangle figure with 8x6 feet dimensions. This design was decided on to keep an effective and simple design.

Problem and Subsystems of concept 2

Divergence in Temperature

Temperature within the system must be limited to ensure proper vegetation growth within a defined environment.

Subsystem:

- The greenhouse would be designed with plexiglass walls and a solar panel roof thereon. The plexiglass would be able to regulate the amount of heat energy entering the greenhouse. Also energy curtains can be used to avoid unwanted transfer of heat to the roof.

Snow Accumulation

The community normally experiences cold and snowy weather. There is always an accumulation of snow beside buildings and on the roofs of building structures. There is a need to make a system that would prevent accumulation of snow on the greenhouse.

Subsystem:

- The greenhouse would be built with a steep roof that would allow the snow to slide down off the building, it will also allow for collection of rainwater. The roof would also have heat cables installed in them, that would allow the snow to melt.

Unwanted Rodents

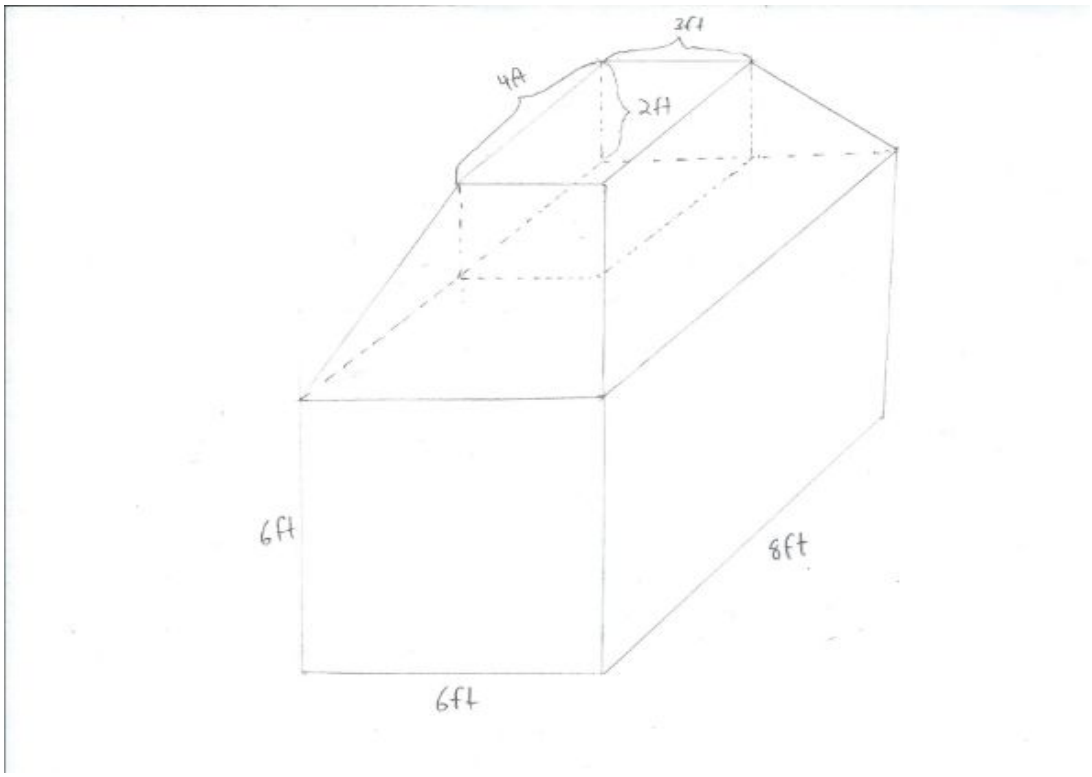
According to the client, rodents are an issue for the community. The greenhouse idea structure must be able to prevent rodents from entering the structure and eating the plants.

Subsystem:

- A rodent barrier can be built round the walls of the greenhouse in order to avoid the rodents to chew through the wood.
- The greenhouse can be elevated so that the rodents are unable to chew through the base. The greenhouse could be built about a foot off the ground on cement blocks.

Concept 3 (Brian Zhau and Saad Rana):

Design:



Summary:

This design keeps the pattern of the 6 ft by 8 ft base with a height of 6 ft. However, it includes a 4 way slanted roof with a flat 4ft by 2ft base at the top. There will be a 6 mil polyethylene film covering the sides of the green house, while stronger polycarbonate PVC panels will be used for the roof.

Roof: This style of roof allows for a great collection of water, and also diversified our options when it comes to the placement of a solar panel. This particular roof style also allows for a large

area to store water in the space between roof and the greenhouse. The Large base gives the client ample room to grow vegetation while also being able to have room to move freely in the greenhouse. The frame of the roof will be made of 2 by 4 wood, and will be covered by PVC Panels. The panels allow for a strong, opaque , and relatively cheap roof. The opaque panels will allow for good insulation while also allowing sunlight to penetrate the roof.

Walls: Wood planks will line all 4 sides of the walls. The planks will be 2 feet in height. This will increase the strength of the structure of the greenhouse, which will provide protection against strong winds. The wooden planks will also provide a barrier for the plants from rodents. The rest of the wall will be lined with a 6 mil polyethylene film. The film will provide air tight insulation allowing the heat to stay within the greenhouse, while also allowing in ample sunlight. The film will also provide protection against harmful UV rays.

Door: Will be the height of the 5 ft and it will have a width of 2 feet. The door will be made out of plexiglass to provide maximum light. The door will open outward to prevent space loss in the greenhouse.

Heat Loss: The base of the greenhouse and the roof will be insulated using spray foam insulation to prevent heat loss. Because the warm air will rise, the insulation will be focused more on the roof to ensure there is no heat loss.

Benchmarking

Evaluation for each specification on a scale of 1-3: 3-green, 2-yellow, 1-red (3 being the highest)

Specification	Concept 1	Concept 2	Concept 3
Product life Span	Five years	Five years	Five years
Rodent/insects Resistance	yes	yes	yes
Dimension	(8 x 6) ft	(8 x 6) ft	(6 x 8 x 6) ft
Easy to assemble and disassemble	yes	yes	no
Weather resistant	yes	yes	yes
Price	Cheap	affordable	expensive
Water Collection	great	great	excellent
Snow load Resistance and Capacity	yes	yes	yes
Ventilation Included	yes	yes	no
Space available	yes	Instructions would be given, but can be tricky	Instructions are given, but would definitely be tricky
Frame material	Wood planks, plexiglass or plywood	Wood planks	Wood planks and polyethylene film

Time and energy consuming	no	Takes more time to build than concept 1 but takes less time to complete than concept 3	yes
Tools needed for maintenance	Screw and nails	Nails, Bolts, Nuts	Screw, Bolts, Nuts
Doors Included	yes	yes	yes
Weight	92lbs	114lbs	260lbs
Total Score	41	35	25

Conclusion

After analyzing all three concepts using the available data above, we decided to go with the design in concept 1. This decision was due to the limited amount of time provided to complete this project. The design we finalised on, will provide additional living space for the plants, as well as make the greenhouse more resilient, energy efficient, and weather-proof.