Deliverable H
Prototype 3 Final Prototype

GNG 1103

Group 20 – Cubic Designs

Abstract

This document contains the feedback from clients after the third client meeting, our own reflective feedback, the 2D floor plan and 3D model of the fourth building concept, the results for the prototyping test plans for the fourth concept, as well as the iterated design of the building. This is the final prototype before the finalization of the final building design for the Algonquins of Pikwakanagan Guardian Program Environmental Monitoring Building.

Table of Contents

1. Objective

Develop your third prototype. Get customer feedback on your prototype.

Instructions:

1. Develop a prototype which will be used to achieve the objectives your team has set out in the plan created in the last deliverable (i.e. you need to answer the "why", "what" and "when" of prototyping).
    1. Remember: a prototype is not normal work on your project, it is something that has a smaller, targeted objective with specific tests and measurable results.
2. Carefully document your prototyping test plan, analysis and your results (including detailed images of your prototype).
3. You must gather feedback and comments on your ideas and prototype from potential clients/users that you have sought out and identified on your own and/or your actual client. It is now after the third client meeting so be resourceful to find other users who can give you feedback, however it can be as easy as asking your friends and family a few questions.
4. If applicable, update your target specifications, detailed design and BOM after tests are completed and analyzed.

Since this will be your team's third prototype, your justifications and reasoning for this prototype should include a short explanation of your results from your previous prototypes and how this third prototype continues the development of your solution. This third prototype should be a fully functional version of your solution (i.e. a comprehensive prototype). Keeping in mind the total course budget of $100 or $50, get creative in order to improve your results. It does NOT need to be the version you would actually sell.

Again, it is strongly recommended that you start early. Keep in mind that this prototype should be comprehensive and will require a significant amount of time to complete.

Start thinking about the information you will need for the user manual (deliverable K). You should be able to start the documentation of your final prototype as you go through this deliverable.

2. Feedback

Same as that stated in deliverable F and G:

- Don’t need a drying room.
- Bigger bathrooms or less stalls worried not enough leg room.
- Loading bay should be attached to the Lab.
- Storage room to be closer to lab.
- If possible, add more office spaces.
- Like the design
- Like that there is a walk-in freezer
- Like the additional storage room
- Like that an estimated cost was shared

We have also looked through our earlier prototypes and given ourselves feedback for iterations in the final design.

- The roof on the two wings are evenly sloped, this could potentially cause snow to accumulate evenly throughout the roof, such that when it slides off, it has the risk of injuring people with large accumulations of snow.
- The storage room could be bigger.
- Hallways and aisles might be too narrow for wheelchair users, preventing them from turning since the longest length of a wheelchair is around 1.1 meters.

Based on our own feedback, we have added a steeper sloped portion to the top of the left and right wing, which should help with speeding up the rate of removal of snow, decreasing the maximum amount of snow expected to slide off at once. The storage has also been slightly expanded by about 6m^2. The minimum hallway width has been increased to 1.5 meters.

3. Our plans for the prototyping test

Results are like that stated in deliverable F and G. Differences are highlighted in yellow.

1. Loads withstand able by subsections of the building. Subsections will be defined by homogeneous structure, where it can be generalized more easily into a single expression.
2. Occupant capacity.
3. Wheelchair accessibility.
4. Fire emergency evacuation and controlling of fire.
5. Accessibility of building in high snow accumulation.

Tests that could be omitted:

3. Wheelchair accessibility
   Our building is one story and is planned to use wheelchair ramps on all external doors. All hallways are at least 1.5 meter wide, and bends leave extra space. Public and single washrooms have wheelchair accessible stalls. Wheelchairs are generally 1.07m L X 0.66m W.

For test 1:

Mathematical focused prototype.

WHY-

The test is to determine the expected weight at worst case scenario. The purpose of which is to estimate the weight that must be withstand able by the roof.

WHAT-

The estimated weight of frozen snow at 30 cm thick, heaviest estimate, is 3 kilograms per square meter. If there were to be people on top of the roof, maximum weight estimate can be increased to 80 kilograms per square meter. Leaving a 50% precaution, the roof must withstand 120 kg/m^2 or 24.6 pounds per square foot. If assuming the angle of the roof to be 30 degrees, the applied force experienced by the roof would be 1019.5 N/m^2.

Pressure withstand able by roof = weight of roof per m^2 X 9.81 m/s^2 X cos(30 degrees) + 1019.5 N/m^2

Pressure withstand able by roof = weight of roof per m^2 X 8.50 m/s^2 + 1019.5 N/m^2

For test 2:

Analytical comprehensive prototype

WHY-

The test is to determine the maximum capacity of each room before it would be considered crowded. The purpose is to understand the room capacities and iterate if needed.

WHAT-

Lab: ~12

Male washroom: 7

Female washroom: 6

Kitchen: ~5

Board room: ~12

Office: 12

Workspace: 4

Lobby: ~15

For test 4:

Analytical comprehensive prototype

WHY-

The test is to determine the fire escape routes and whether they are feasible. The purpose is to develop a fire escape plan.

WHAT-

Refer to image below.

For test 5:

Comprehensive analytical prototype

WHY-

The test is to determine the considerations and minimal height of components to function in highest snow accumulation. The purpose of which is to determine the feasibility of components and understand the special considerations.

WHAT-

Estimated max height of snow is 400 cm (highest record in Ontario was 464 cm in 1886).

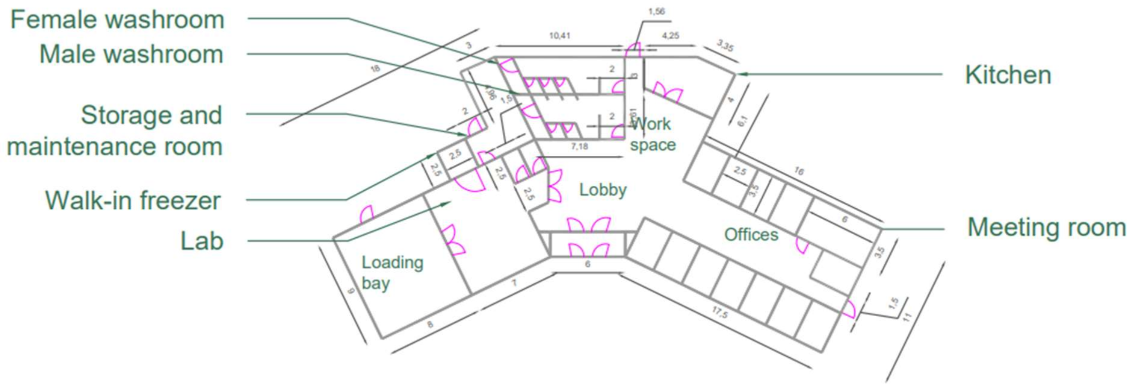
Building cannot be reached by walking or driving at such heights, so building should be accessible as normal in 0.5 meters of snow, 50 cm, functional in waist deep snow, which is 1 meter, 100 cm, and would not shut down in 4 meters of snow, 400 cm, in case of trapped individuals.

We do not have the necessary details and knowledge, i.e., location of vents, to create a detailed analysis.

Main and emergency exits should be fitted with a canopy, the size and height of which can be determined by more experienced engineers. Same with positioning of ventilation systems.

The base of the building should be elevated by 30cm from the ground to reduce the effect of snow.

4. 2D floor plan

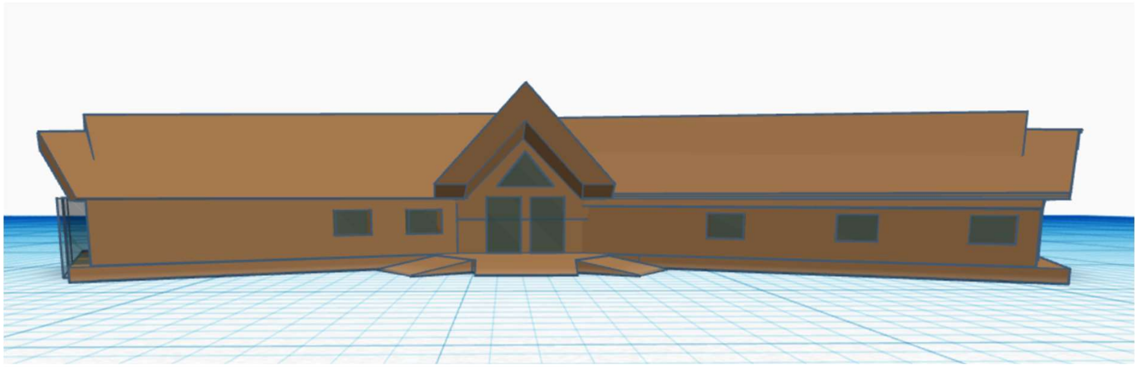


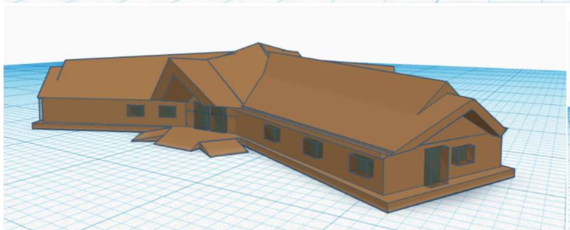
Lowest height of the building is targeted to be 2.3 – 2.5 meters. The maximum height of the building is 5.5 meters excluding the base. Assuming 1 meter for roof thickness, the maximum internal height would be 4.5 meters, average of <3.5 meters. Minimum roof slant is 27 degrees, the building tries to keep an angle of 30 degrees.

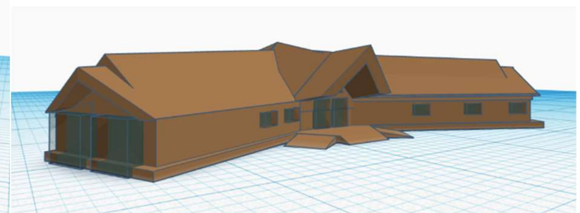
5. Emergency evacuation plan

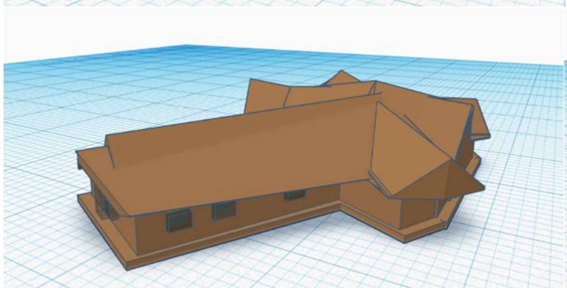
Based on the Ontario Fire Protection and Prevention Act, an indoor public space with confusing layout should have emergency egresses, effectively any pathway that allows individuals to escape and can be an easy to open window, that are at most 15 meters travel distance from any point in the space. Since our windows are likely thick and cannot be opened for insulation and structural integrity, the exits are considered egresses. All emergency exits require an aisle leading to it with a width of at least 1.1 meters, and users of the aisle must have the choice between two exits. A fire access aisle is also required extending the entire building with at width of at least 2.4 meters.

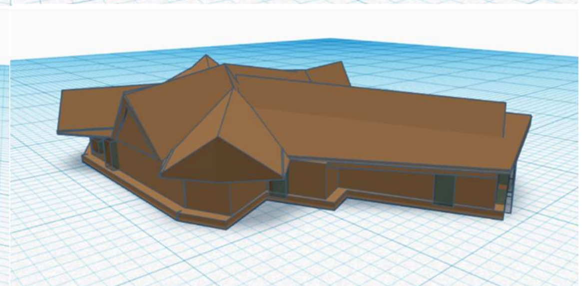
6. 3D model

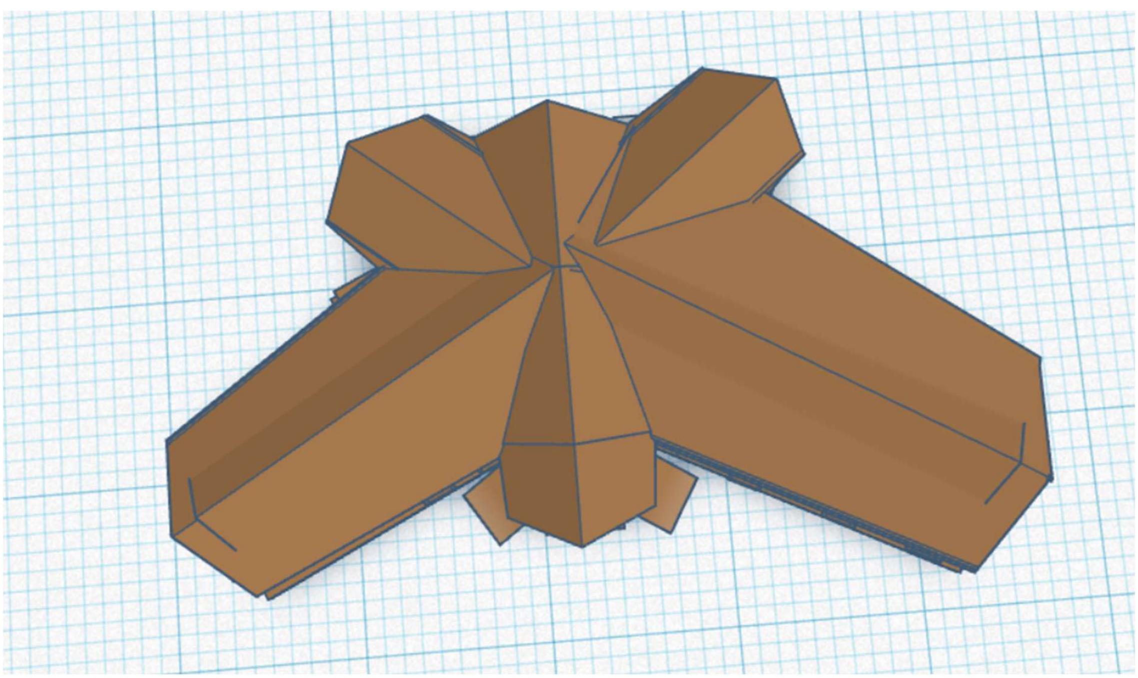












7. Changes to design

As previously mentioned, we have added a steeper sloped portion to the top of the left and right wing, which should help with speeding up the rate of removal of snow, decreasing the maximum amount of snow expected to slide off at once. The storage has also been slightly expanded by about 6m^2. The minimum hallway width has been increased to 1.5 meters.

The building material is still planned to be either version 1, concrete foundation, steel framing, internal walls being drywall/wood, or version 2, concrete walls and foundation with wood for separative framing with insulation in between, dry walls and wood on the internal layer. There is also version 3, which has concrete foundation with the bottom half of the walls made of concrete with imbedded steel extending to the roof, and the upper half of the walls would use wood framing, drywall/wood on internal layer. Version 3 is a combination of versions 1 and 2.

Floor Area: 566 square meters (6092 square feet)

Perimeter: 125.5 meters (412 feet)

Estimated cost: CAD$2 715 986.72 ($445.8 per ft^2)

Estimated cost without added precaution: CAD$1 810 657.81 ($297.2 per ft^2)

The estimated cost is with an added 50% precaution. The precise estimation of the actual cost would likely be halfway between highest and medium costs, so the more precise cost estimate would be between CAD$2 715 986.72 ($445.8 per ft^2) and CAD$1 810 657.81 ($297.2 per ft^2), at around CAD$2 300 000.

8. Link to Wrike

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=HyDPos6yImH4qU21qRJUgAhyPntYM0ke%7CIE2DSNZVHA2DELSTGIYA