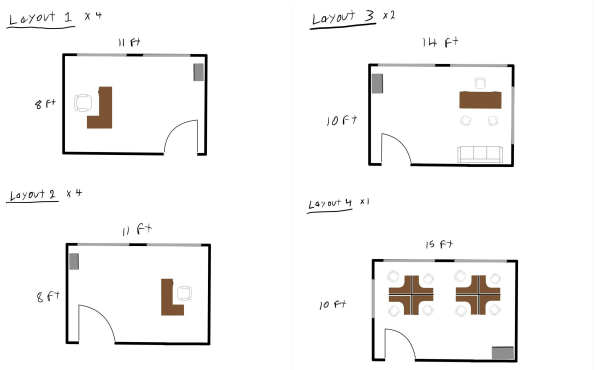
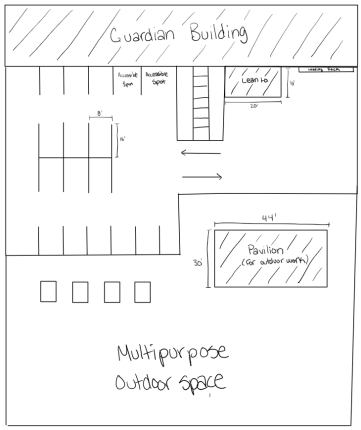
Deliverable E: Project Plan & Cost Estimate

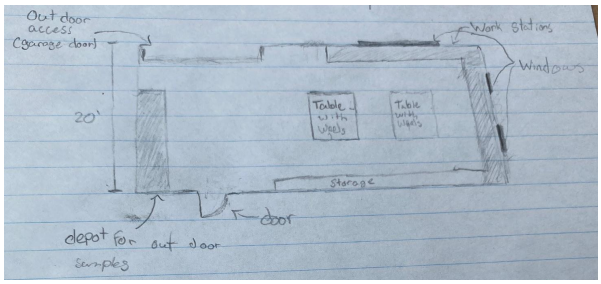
Introduction

The project plan and estimated cost are an essential step in any prototype. In this deliverable, a detailed design drawing based on the client feedback from the first client meeting is outlined. This detailed drawing is used in this deliverable to create a baseline for an initial bill of materials (BOM) for the prototypes as well as the final building. Furthermore, a list of equipment that is required for each prototype is included. Based on the coming weeks, a list of risks associated with the design and our completion of this project is included. Finally, to help evaluate and iterate the next prototype, a prototyping test plan has been outlined to test aspects such as the building capacity, the carbon and power emissions and the proposed layout in order to improve upon our design.

1. Detailed Design Drawing

1.1. Initial Conceptual Design

Office Spaces

Outdoor space


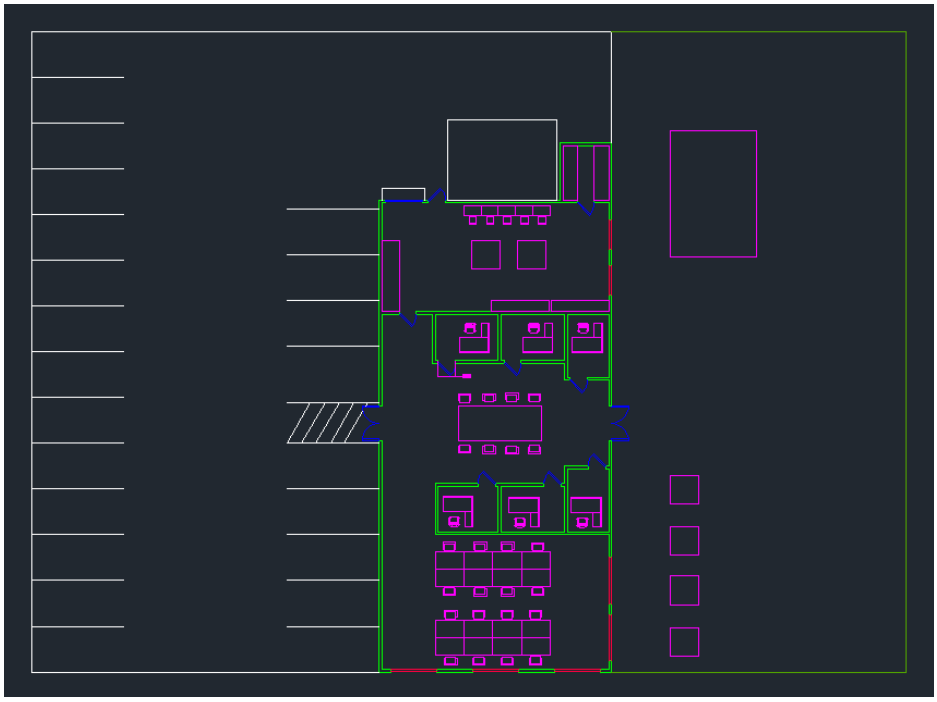
Multipurpose Work Space


1.2. Iterations Based on Client Feedback

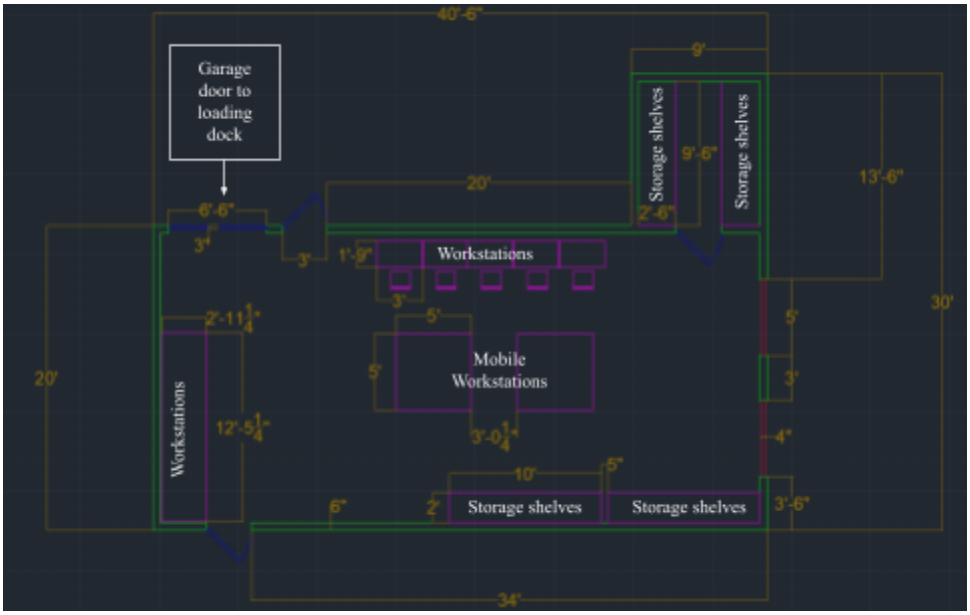
Feedback	➔ Client would prefer more, smaller offices than a few big ones (layout 1 & 2 is preferred) ➔ One larger boardroom is preferred for meetings instead of larger offices ➔ No cubicles, instead the client wants an open, general work area with many tables/desks ➔ The client wants the Lean To next and loading dock right beside the lab with double access doors ➔ The client would like a separate storage area for bigger equipment (tires/automobiles) ➔ Lab equipment storage space should be large (potential room to expand as they acquire more equipment)

1.3. Detailed Design Drawing

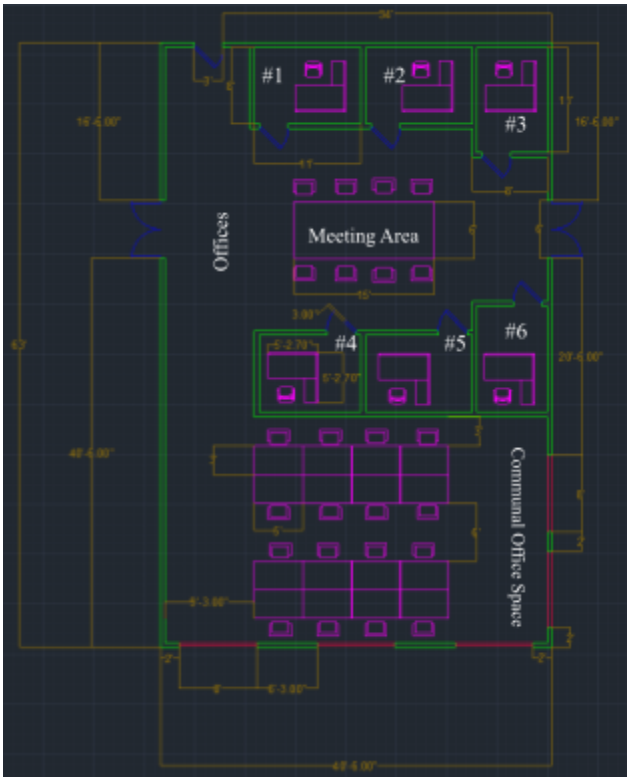
Detailed Drawing:



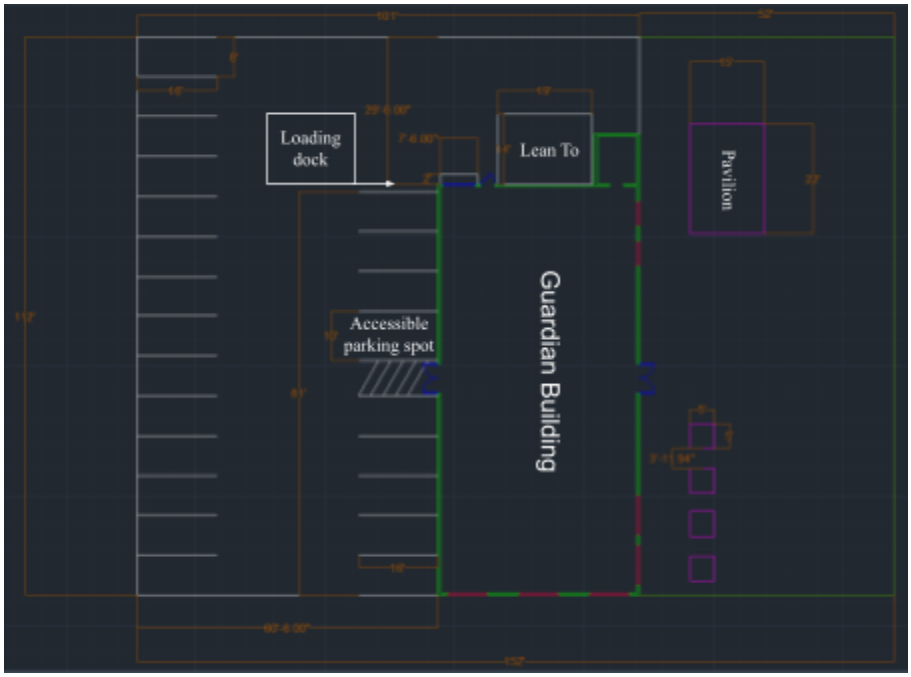
Detailed Drawing of the Multipurpose Workspace:



Detailed Drawing of the Office Spaces:



Detailed Drawing of the Outdoor space:



2. Bill Of Materials (BOM)

2.1. Bill Of Materials for the prototypes

Equipment	Description	Cost (CAD)
AutoCAD	Software used to make prototype I.	$0.00
Solidworks	Software used to make prototype II and III.	$0.00
Filament	Used to print prototype III.	$40.00
Total:		$40.00

2.2. Bill Of Materials for the final project

Item (Quantity)	Description	Cost (CAD)
Cost of Office Building/ft^2 (2551.5 ft^2)	Average cost to build office building	$798,619.50
Cost of Lab/ft^2 (900 ft^2)	Average cost to build lab	$281,700
Cost of Pavement/ft^2(8675ft^2)	Average cost to build parking lot	$29,755.25
Road Paint (3.78L)	Used for parking spaces	$132.00
Garage Door (1)	Cost of garage door	$1499.99
Pavillion (330ft^2)	Average cost to build	$103,290
Lean-to (266ft^2)	Average cost to build lean-to	$83,258
Total:	$1,304,254.74	
Link used to estimate cost of building: https://proest.com/construction/cost-estimates/commercial-costs-per-square-foot/		

3. List of Equipment Needed for the Prototypes

Equipment	Prototype (I, II or III)	Use (Purpose for creating the prototype)
AutoCAD	Prototype I	To create the floor plans in 3D for the first prototype
Solidworks	Prototype II & Prototype III	To create the floor plans in 3D for the second prototype
Ultimaker 3D Printer	Prototype III	To print the physical 3D model of the final prototype

4. Significant Project Risks and Contingency Plans

Significant Project Risks and Contingency Plans Associated with Building Design	
Project Risk	Contingency Plan
Accumulation of more hand-held lab equipment, causing insufficient storage space.	The storage space is adjacent to the exterior wall, making expansion of the space easier. The space can be extended outwards (will not take away from existing building space).
Increase in number of company employees, creating insufficient work/desk space.	The general work/desk area is designed with excess space, providing the opportunity for accommodating more employees.
Additional company vehicles purchased.	The Lean To has space available for extension to provide more parking for company vehicles.
Building code updates.	Be aware of building codes in order to stay up to date and accurate. (Building codes are updated every 3-5 years)

Natural disasters/severe weather conditions.	Building is designed with safety/support features according to common natural disasters/severe weather conditions in the region.
Fire (or another need to evacuate).	The building will have all necessary emergency exits and safety precautions in place. (According to building safety codes)

Significant Project Risks and Contingency Plans Associated with Completion of Project	
Project Risk	Contingency Plan
The team is not meeting the schedule.	Prioritize work that needs to get done. Schedule more team meetings/work periods to catch up.
Unexpected costs when creating a prototype.	Set some money aside in preparation for any unexpected but necessary costs.
Broken/dysfunctional equipment or machinery.	Aim to complete the prototype with ample time, in case of problems/setbacks. Use a different piece of equipment or machinery to complete the prototype.
Client expresses an additional need or lack of a need that was previously expressed.	Adjust project design to accommodate the clients newly expressed need or remove a property of the design that is no longer necessary.

5. Prototyping Test Plan

Test ID	Test Objective	Description of Prototype used and of Basic Test Method	Description of Results to be recorded and how these results will be used	Estimated Test duration and planned start date
1	Test building capacity	For this test we can use the 2D prototype. We should be able to comfortably fit at least 20 people at one time. We can test this by placing little dots to represent people in the 2D model. An effective way to avoid overcrowding would be to have a 3 foot radius around each dot to allow for personal space and circulation in the building.	The results for this test will be how many people we can comfortably fit in every room. Depending on these results we may have to slightly change the dimensions of some of the rooms.	Duration: 2-3 days Start date: Nov 10
2	Survey of Layout	Using one of our 3D models we would create a survey and ask people how they feel about the design of our building. They can make suggestions about the layout, furniture placement, general flow of the building, etc..	The results of this test will be feedback received from the people who took the survey. Aspects of our design will be removed/iterated for our next prototype based on feedback. If they have good suggestions to improve our design we can implement them.	Duration: 1 week Start date: Nov 15
3	Test Carbon Emissions	To test carbon emissions for our building we will use our 3D prototype. This test will estimate the building's energy consumption and carbon emissions using software such as IES virtual environment considering factors like electricity, heating, cooling, and renewable energy sources.	The carbon emissions from HVAC systems are calculated based on the type of fuel and system efficiency.	Duration: 1-2 days Start date: Nov 20
4	Duration of Completion	To test the expected duration of the construction of this building, we will research the construction duration of other buildings similar in size and function. This will give us realistic expectations regarding our design process' length and our date of completion.	The results of this test will be the research that we find, including the statistics of construction durations in the past.	Duration: 1 week Start Date: Nov 10

5	Accessibility	Ensure that the doors to the building/rooms are wide enough for accessible access (individuals with wheelchairs, walkers, etc.). Scale models will be used throughout the 3D prototype to verify the accessibility of the various regions of the building.	This test will give us more information regarding the general accessibility of our building. If our design fails the tests, the following prototypes will be iterated to widen doorways & hallways, reduce unnecessary obstacles, etc..	Duration: 3 days Start Date: Nov 15

Wrike Snapshot for the next two deliverables (Deliverable F & G):
https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=T7kNPcymAFtExvoiDz5ayvhi2l6JqCqq%7CIE2DSNZVHA2DELSTGIYA

Conclusion

Using the equipment listed above (AutoCAD, Solidworks, and Ultimaker 3D Printer) we will construct our three prototypes using our detailed design drawing as a basis and test them using our prepared prototyping test plan, improving the design each time. Our prototype and final building will include the materials listed in the bill of materials above, all while being cost effective and with the goal of maintaining the budget.