

Deliverable E

Group-A03-11

November 3, 2023

Abstract

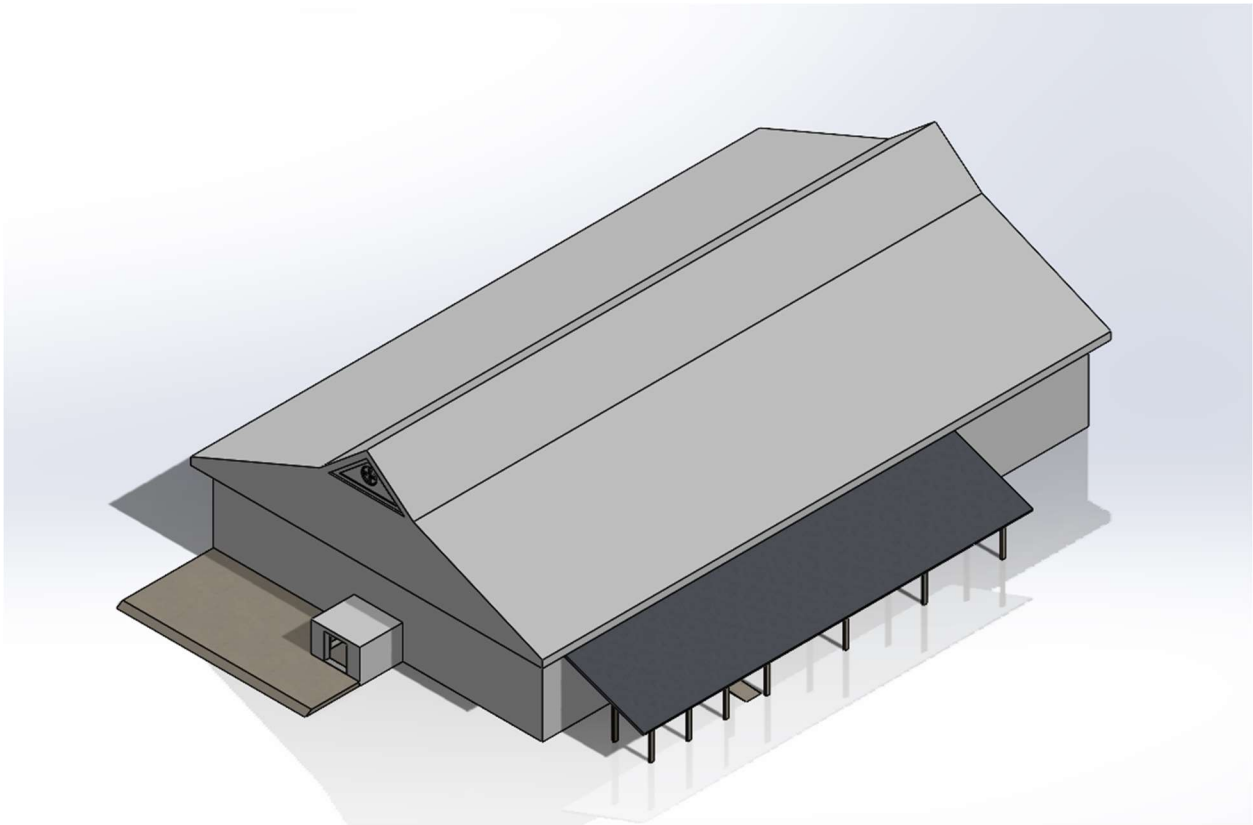
This document covers the plan produced by group 11 that helps ensure the completion of the three prototypes until the end of the semester. It includes sample designs of the interior and exterior of the building, risk assessment, a detailed CAD model, and a complete breakdown of the budget.

1. Introduction

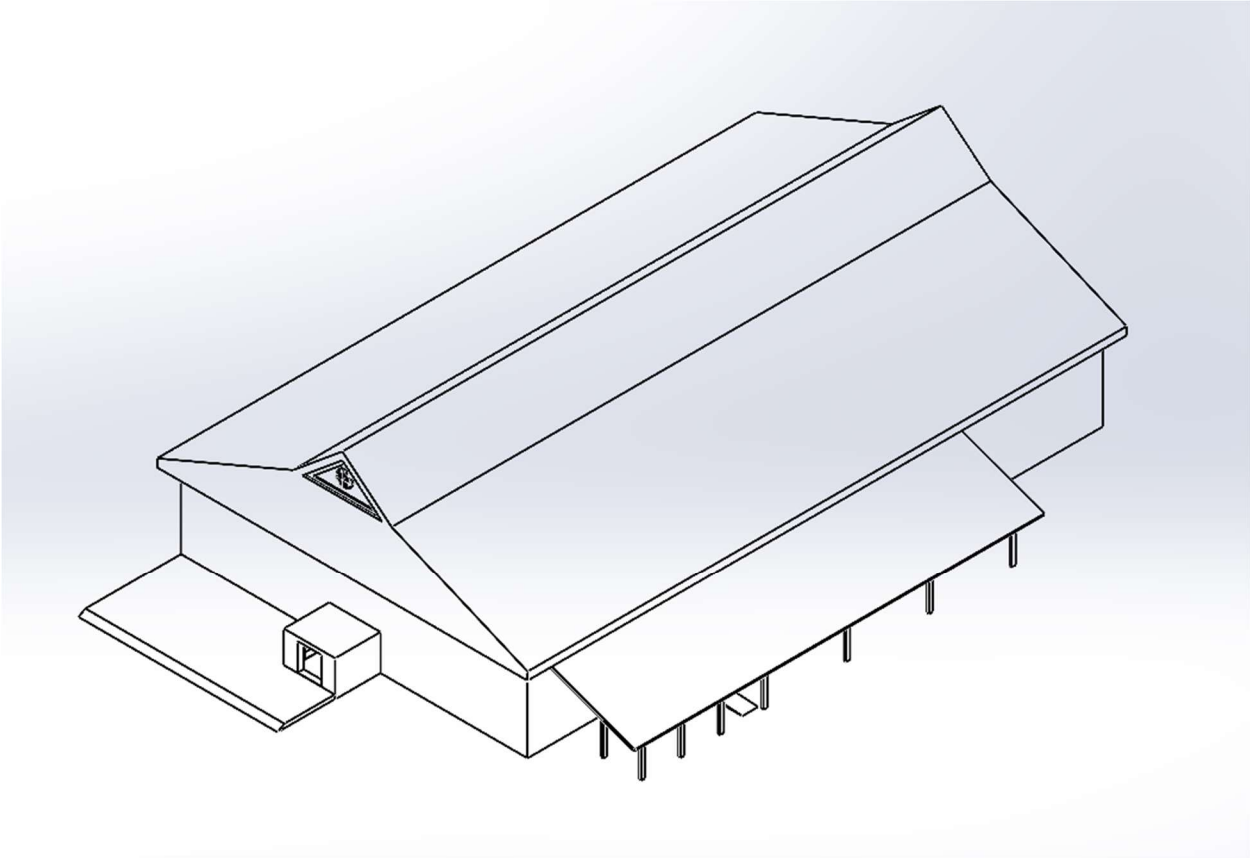
In this document, we go over our risk assessment of the building, which lists the potential risks related to the project and how the risks can be mitigated; detailed CAD models of the interior and the exterior of the building; a thorough budget breakdown of the project; and Bill of Materials, List of Equipment, and Prototyping Test plan for the materials we will need to successfully complete our project.

2. Final Design Drawing

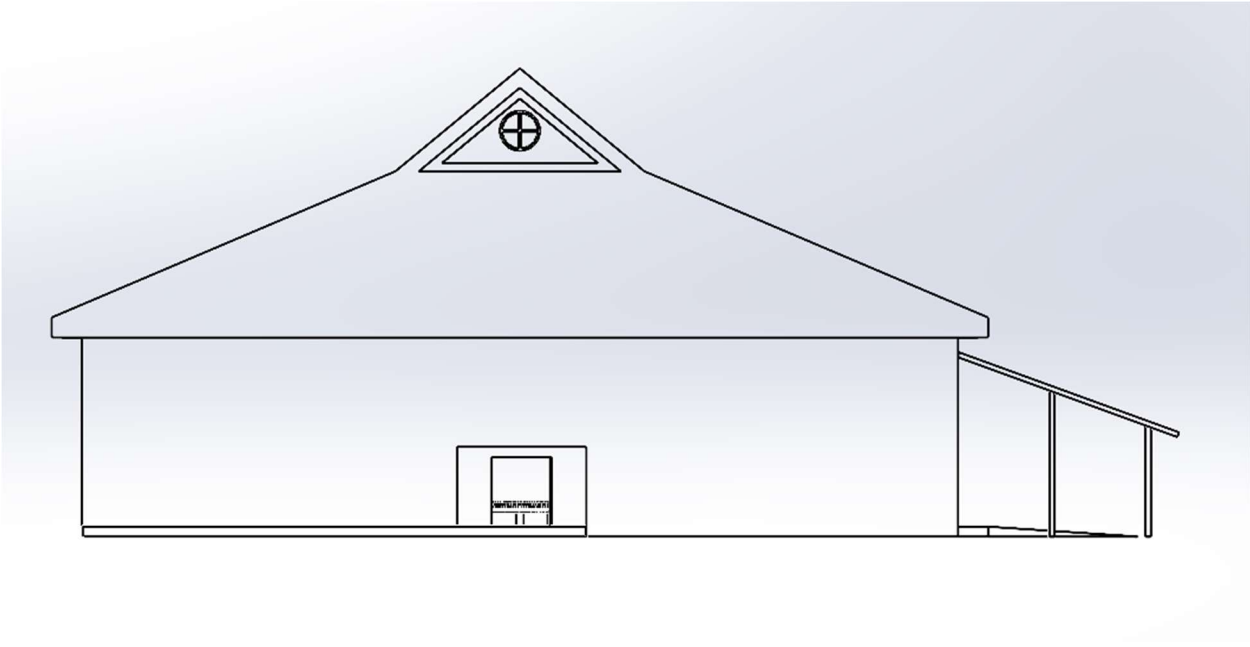
Overall Isometric View



Outlined Isometric View

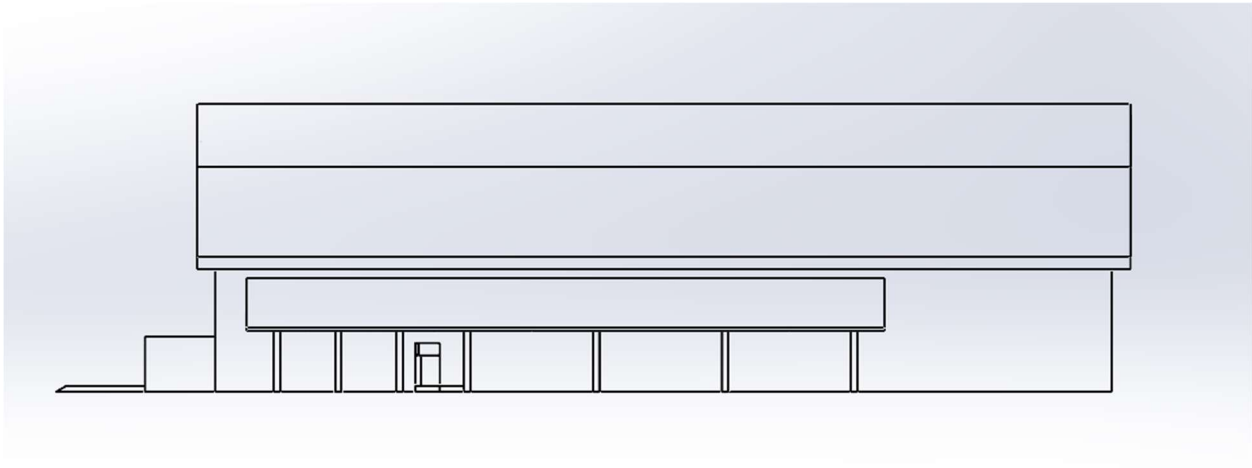


Outlined Front View



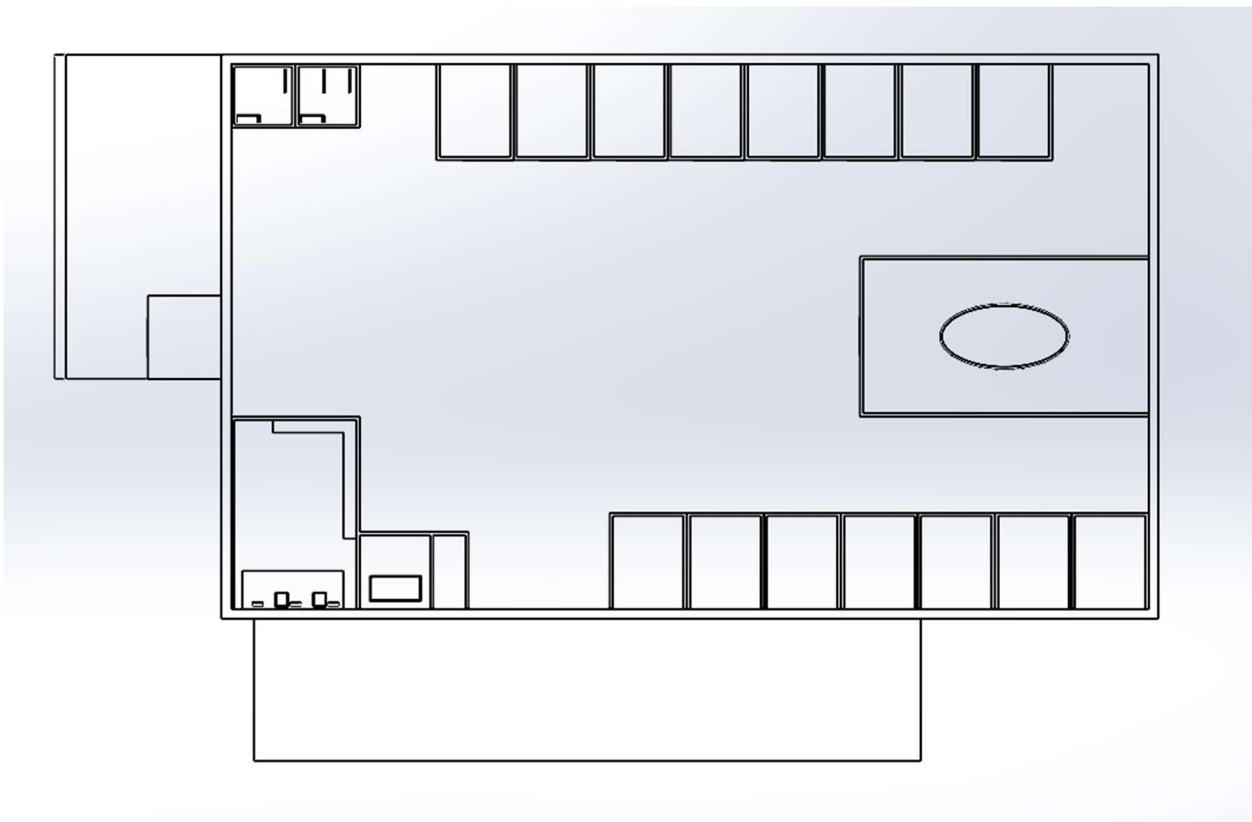
Outlined Side View

Covered parking space shown.

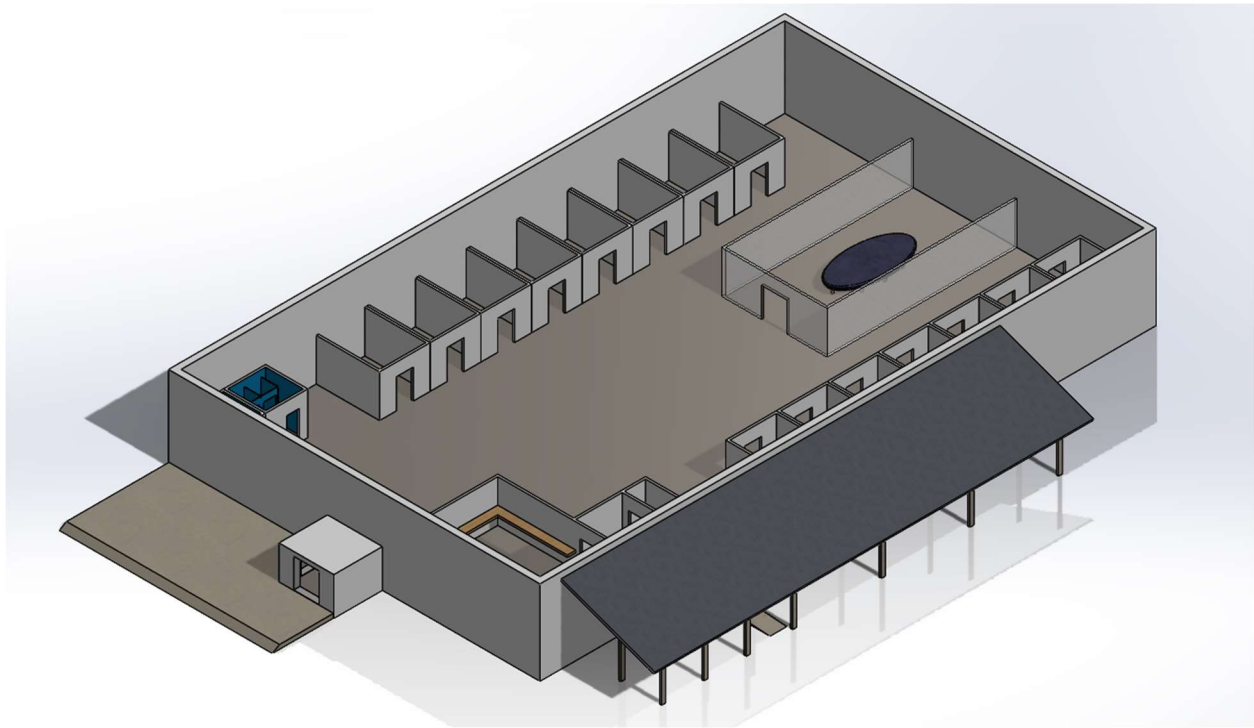


Outlined Top View (Roof removed)

Kitchen space available on top right sections if desired, fire exits possible in any of the 4 non-obstructed sections of the interior walls. Meeting room center-right, plant processing lab bottom left, offices lining the top and bottom. Accessible parking available outside on far top left.

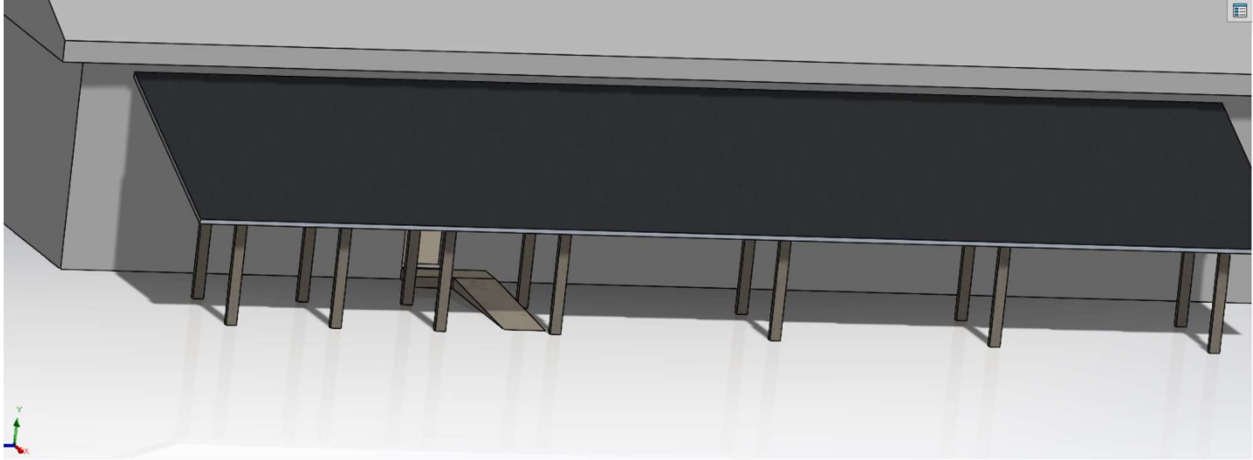


Overall Isometric Interior View.



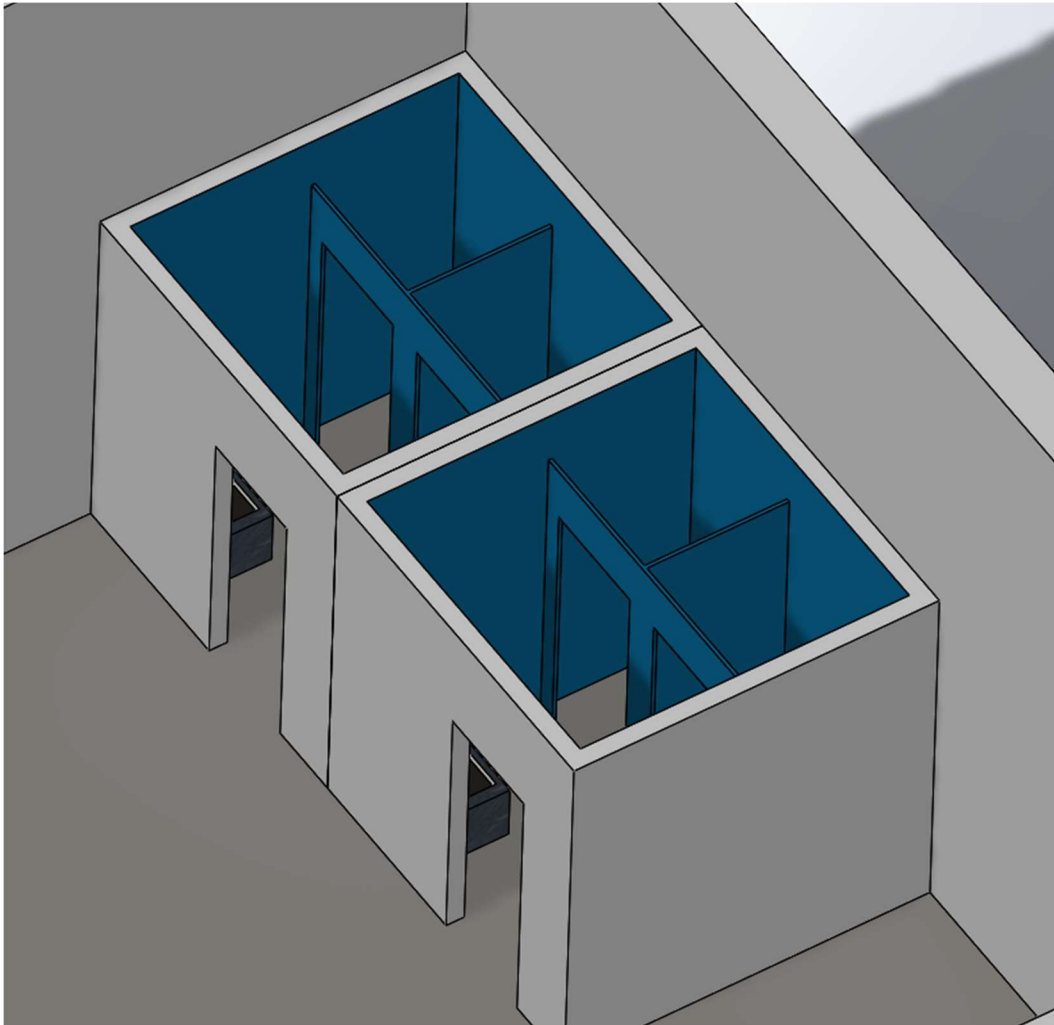
Covered Parking and Loading Dock View

Covered parking for two ½ ton trucks (more than adequate space), plus loading dock that leads into antechamber connecting to the storage room. Additional covered parking area for up to 6 employee vehicles adjacent.



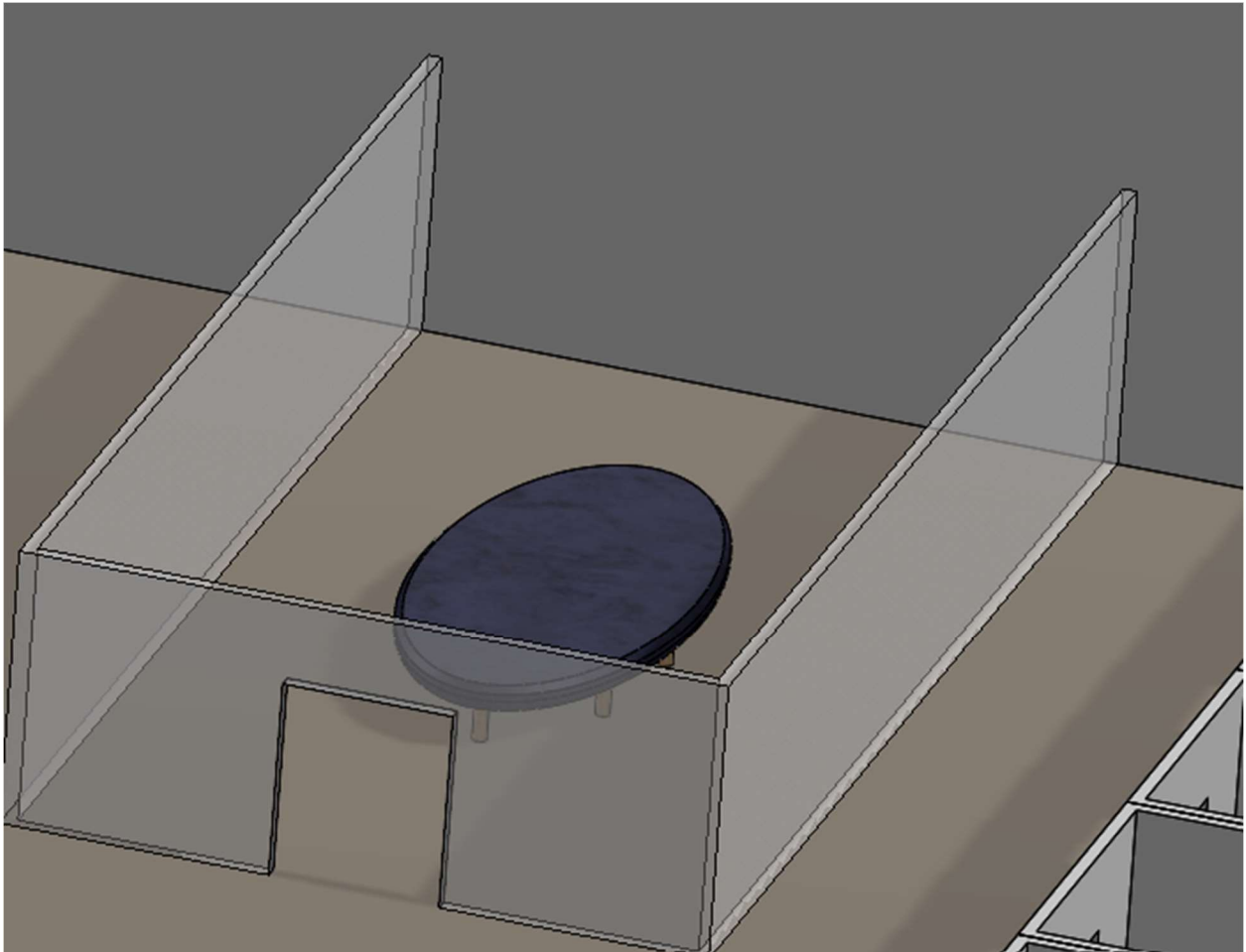
Bathroom View

Two bathrooms (M/F), two stalls each as per client request, plus a sink each.



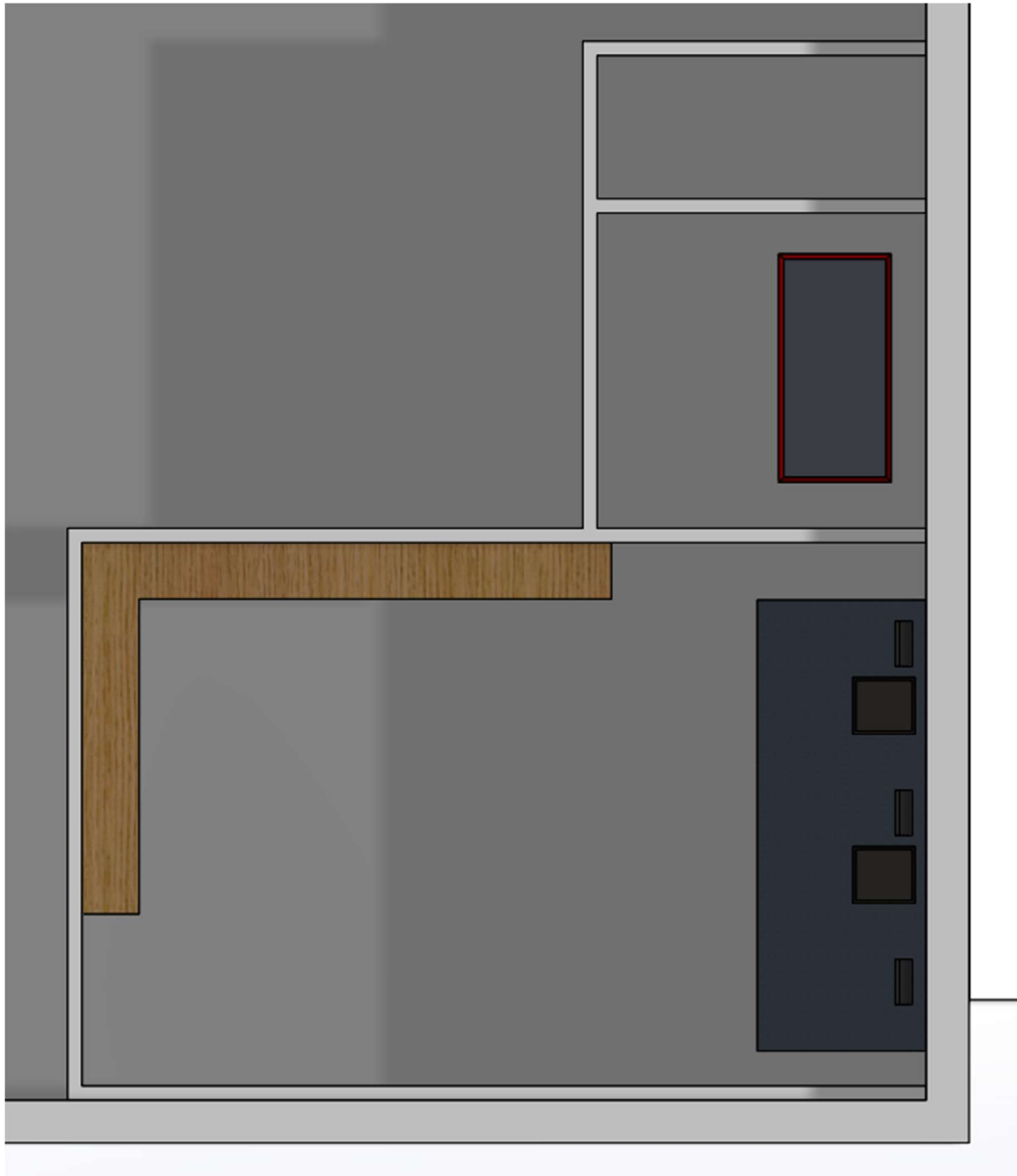
Meeting Room View

Glass walls, oval/round table design, adequate space on interior wall to mount monitors/screens, plenty of room for whiteboards, chairs, other office paraphernalia.

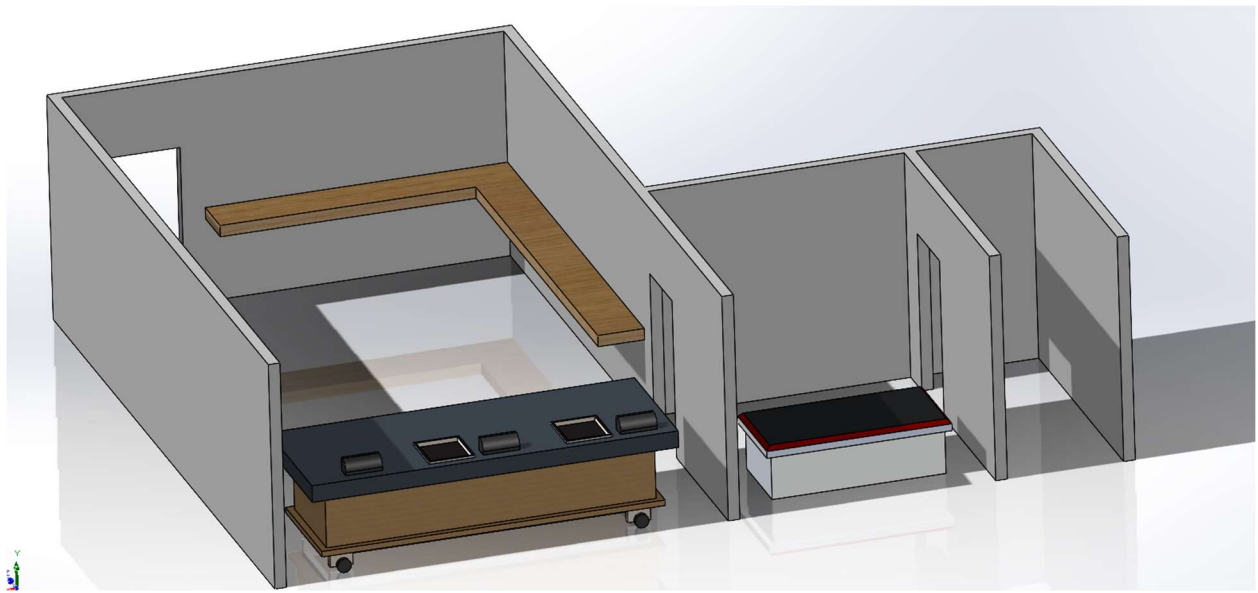


Plant Processing Lab Top view

The lower section represents the active lab space: Workspaces mounted to wall, movable workstation tucked away to the right. The square section above this represents the storage room, with a red-outlined freezer easily enough to store 1-2 deer carcasses. Above that still is the 'antechamber', leading to the outside loading dock, intended to minimize heat/air loss when opening doors in winter months.



Plant Processing Lab side view



3. Risk Assessment

3.1 Parking Lot Risk Assessment

While using wood chips in a parking lot might be an environmentally friendly and visually beautiful decision, there are some hazards and things to keep in mind. The following are important things to think about while evaluating the risk of utilising wood chips in a parking lot:

- 1. Slip and Trip Hazards:** When wet, wood chips may become slick and produce uneven surfaces. Evaluate the possibility of slip and trip risks for cars and pedestrians in the parking lot, particularly in the event of rain or icy weather.
- 2. Fire Hazard:** Due to their flammability, wood chips can be dangerous around open flames or sparks, especially in arid conditions. Determine the level of fire risk and implement the necessary fire safety and response protocols.
- 3. Insect Infestations:** Termites, ants, and beetles are among the creatures that wood chips can draw and may cause harm to neighbouring structures. Consider the possibility of bug infestations and take precautions against them, including using insect-resistant wood chips or conducting routine inspections.
- 4. Decomposition and Maintenance:** Over time, wood chips deteriorate and may need to be replenished or replaced, which may need routine maintenance. Examine the expenses and continuing upkeep needed for utilising wood chips in the parking lot.
- 5. Accessibility:** Analyse the danger to people with disabilities' accessibility. Ascertain that wood chips do not impede accessibility for individuals with limited mobility and adhere to pertinent accessibility standards and guidelines.
- 6. Parking Lot Design:** Make sure the wood chip parking lot is thoughtfully designed to prevent difficulties with drainage, ponding, erosion, and other factors that could pose a risk to public safety.

3.1.1 Parking Lot Risk Management Assessment

1. **Slip and Trip Hazards:** Maintain and examine the wood chip surface frequently to make sure it stays level and risk-free. Put in place non-slip mats or surfaces at important entry points for cars and pedestrians. Post warning signs when it's ice or rainy outside.
2. **Fire Hazard:** Select wood chips that are resistant to fire or apply fire retardant chemicals to wood chips. Place firebreaks around the wood chip locations, such as non-flammable obstacles or gravel. Provide a clear fire safety procedure that specifies where the emergency contacts and extinguishers are located.
3. **Insect Infestations:** Employ insect-resistant wood chip materials or apply the proper insect repellent on the wood chips. To find and treat early indications of infestations, conduct routine inspections. If necessary, put pest control measures into action.
4. **Decomposition and Maintenance:** Establish a routine maintenance programme to replace or add more wood chips as they break down. Make sure to dispose of decomposed wood chips in an eco-friendly way. Allocate funds for continuous upkeep expenses.
5. **Accessibility:** Make sure wood chip surfaces are made to fit people in wheelchairs and those who have trouble moving about.
6. **Parking Lot Design:** To stop erosion and ponding, make sure that the grading and drainage are correct.

3.2 Roof Risk Assessment

A building's structural integrity may be seriously jeopardised by snow load, particularly in areas where heavy snowfall is common. It can cause damage or the roof to collapse.

1. **The roof structure's ability to support weight:** This situation carries a risk of possible structural failure or roof damage from an excessive weight or load. This may lead to possible injury, property damage, and roof collapse.
2. **The roof's slope or pitch:** The risk associated with the pitch or slope of the roof relates to any problems that could occur because of its unique design. This could involve issues with snow accumulation, water drainage, and upkeep challenges.

3. **Patterns of snowfall in the region:** This situation carries danger because of how different snowfall patterns may affect public safety, business operations, building integrity, and transportation.

3.2.1 Roof Risk Management Assessment

1. **Roof Maintenance:** Make sure the roof is properly maintained, which includes clearing the gutters and drainage systems to let snowmelt run off the roof.
2. **Structural Assessment:** Check the roof's structural soundness on a regular basis, particularly in areas that see a lot of snowfall. To determine the roof's ability to support weight and to provide the required advice, think about speaking with a structural engineer.
3. **Construction codes and roof design:** Make sure that any renovations or new construction complies with the building requirements in your area and consider the roof's pitch while designing to reduce the risk of snow loads.

3.3 Ground Composition Risk Assessment

The possibility of ground settling, or instability poses a danger because it might result in structural damage, safety issues, and monetary losses.

1. **Soil type and composition:** The risk is associated with the possible difficulties or problems that may emerge because of the type and composition of the soil. This could involve problems like low fertility, erosive soil, pollution, or restrictions on farming.
2. **Groundwater levels:** The risk is associated with possible problems or difficulties that could emerge because of groundwater level fluctuations, depth, or quality. This could involve problems including contaminated water sources, flooding, and unstable soil.
3. **Geological conditions, including seismic activity:** The risk is associated with possible geological hazards that could affect infrastructure, public safety, and the environment, including as landslides, earthquakes, and ground subsidence.
4. **Historical data on subsidence or ground movement in the area:** Based on past data, the risk is associated with possible problems with earth movement or subsidence that could affect environmental stability, safety, and infrastructure.

3.3.1 Ground Composition Risk Management Assessment

1. **Geotechnical Investigation:** To ascertain the geological characteristics and soil parameters of the site, conduct a thorough geotechnical examination. This covers groundwater monitoring, borehole analysis, and soil testing.
2. **Foundation Design:** Based on the geotechnical results and regional construction codes, design the footing, supports, and foundation. Make sure the foundation is suitable for the soil and ground circumstances
3. **Groundwater Management:** Control drainage and groundwater levels to avoid too much soil saturation. To keep water away from the foundation, install the appropriate drainage systems

4 Budget Breakdown

Provided, is a thorough breakdown of the budget. It includes the budget for the materials needed for the Substructure of the building, the Shell (structural skeleton, foundation, and exterior walls), interior, services (water, electricity, plumbing, etc.), and equipment and furnishings.

| Cost Estimate report | |
|-----------------------|--|
| Author | T. Powell |
| Building Type: | Office, 1 Story with Stone Veneer / Wood Frame |
| Location: | Golden Lake Ontario |
| Story Count: | 1 |
| Story Height (L.F.): | 18 |
| Floor Area (S.F.): | 12584.00 |
| Labour Type: | STD |
| Basement Included: | No |
| Data Release: | 2018 |
| Cost per Square Foot: | \$ 159.21 |
| Building Cost: | \$ 2,003,498.64 |

| | | Quantity | % of Total | Cost per S.F. | Cost |
|-------|---|----------|------------|---------------|---------------|
| A | SubStructure | | 8.65% | \$ 13.77 | \$ 173,281.68 |
| A1010 | Standard Foundations | | | \$ 6.99 | \$ 88,088.00 |
| | Foundation wall, CIP, 4' wall height, direct chute, .148 CY/LF, 7.2 PLF, 12" thick | 462 | | \$ 3.60 | \$ 45,302.40 |
| | Strip footing, concrete, reinforced, load 11.1 KLF, soil bearing capacity 6KSF, 12" deep x 24" wide | 462 | | \$ 1.74 | \$ 21,896.16 |
| | Spread footings, 3000 PSI concrete, load 100K, soil bearing capacity 6 KSF, 4' - 6" square x 15" deep | 44 | | \$ 1.66 | \$ 20,889.44 |
| A1030 | Slab on Grade | | | \$ 6.44 | \$ 81,040.96 |
| | Slab on grade, 4" thick, non industrial, reinforced | 12584 | | \$ 6.44 | \$ 81,040.96 |
| A2010 | Basement Excavation | | | \$ 0.33 | \$ 4,152.72 |

| | | | | |
|----------|---|---------------|-----------------|----------------------|
| | Excavate and fill, 10000 SF, 4' deep, sand, gravel, or common earth, on site storage | 12584 | \$ 0.33 | \$ 4,152.72 |
| B | Shell | 31% | \$ 49.38 | \$ 621,397.92 |
| B1010 | Floor Construction | | \$ 2.58 | \$ 32,466.72 |
| | Wood column , 8" x 8", 20' x 20' bay, 10' unsupported height, 133 BF/MSF, 160 PSF total allowable load | 12584 | \$ 0.53 | \$ 6,669.52 |
| | Fireproofing, gypsum board, fire rated, 2 layer, 1" thick, 14" steel column | 615 | \$ 2.05 | \$ 25,797.20 |
| B1020 | Roof Construction | | \$ 9.74 | \$ 122,568.16 |
| | Wood roof truss, 2' OC, 60' span, 4:12 pitch, 1' overhang, 5/8" sheathing, 1 x 8 fascia, R30 insulation | 12584 | \$ 9.74 | \$ 122,568.16 |
| B2010 | Exterior Walls | | \$ 25.33 | \$ 318,752.72 |
| | Stone wall, ashlar veneer, 4" thick, 8' high, 2 x 4 @16" stud back-up, low priced stone | 6653 | \$ 23.57 | \$ 296,604.88 |
| | Insulation, Fiberglass batts, 6" thick, R19 | 12584 | \$ 1.76 | \$ 22,147.84 |
| B2020 | Exterior Windows | | \$ 5.24 | \$ 65,940.16 |
| | Windows, aluminum, awning, insulated glass, 4'-5" x 5'-3" | 74 | \$ 5.24 | \$ 65,940.16 |
| B2030 | Exterior Doors | | \$ 3.82 | \$ 48,070.88 |
| | Door, aluminum & glass, with transom, narrow stile, double door, hardware, 6'-0" x10'-0" opening | 2 | \$ 2.48 | \$ 31,208.32 |
| | Door, steel flush 20ga, 7'-0" x 3'-0" wide | 2 | \$ 1.34 | \$ 16,862.56 |
| B3010 | Roof Coverings | | \$ 2.67 | \$ 33,599.28 |
| | Asphalt roofing, strip shingles, inorganic, Class A, 4" slope, 210-235 lbs/SQ | 12584 | \$ 2.42 | \$ 30,453.28 |
| | Gutters, box, aluminum, .032" thick, 5" enameled finish | 231 | \$ 0.20 | \$ 2,516.80 |
| | Downspout, aluminum, rectangular, 2" x 3", enameled, 0.24"thick | 93 | \$ 0.05 | \$ 629.20 |
| C | Interiors | 14.63% | \$ 23.29 | \$ 293,081.36 |

| | | | | | |
|-------|---|--------|---------|----|-----------|
| C1010 | Partitions | | \$ 7.34 | \$ | 92,366.56 |
| | Wood partition, 5/8" fire rated gypsum board face, non base, 2 x 4, @ 16" OC framing, same opposite face, 0 insul | 4405 | \$ 1.67 | \$ | 21,015.28 |
| | Wood partition, 5/8" fire rated gypsum board face, 1/4" sound deadening gypsum board, 2 x 4 @ 16" OC framing, same opposite face, sound attenuation insul | 1888 | \$ 1.24 | \$ | 15,604.16 |
| | Gypsum board, 1 face only, exterior sheathing, fire resistant, 5/8" | 14580 | \$ 0.57 | \$ | 7,172.88 |
| | Add for the following: taping and finishing | 14580 | \$ 0.57 | \$ | 7,172.88 |
| | Glass panel, wall | 2070 | \$ 3.29 | \$ | 41,401.36 |
| C1020 | Interior Doors | | \$ 4.90 | \$ | 61,661.60 |
| | Door, single leaf, oak finish, wood frame, commercial quality, flush, 3'-0" x 7'-0" x 1-3/8" | 15 | \$ 1.68 | \$ | 21,141.12 |
| | Stainless steel door, prehung double door, foam core, 6'-0" x 7'-0", 14gauge | 3 | \$ 1.35 | \$ | 16,988.40 |
| | Door, double door, aluminium and glass, narrow stile, 6'-0" x 10'-0" opening | 2 | \$ 1.87 | \$ | 23,532.08 |
| C1030 | Fittings | | \$ 0.38 | \$ | 4,781.92 |
| | Toilet partitions, cubicles, ceiling hung, plastic laminate | 5.39 | \$ 0.38 | \$ | 4,781.92 |
| C3010 | Wall Finishes | | \$ 1.27 | \$ | 15,981.68 |
| | Painting, interior on plaster and drywall, walls and ceilings, roller work, primer, and 2 coats | 12584 | \$ 0.83 | \$ | 10,444.72 |
| | Painting, interior on plaster and drywall, walls and ceilings, roller work, primer and 2 coats | 6652.8 | \$ 0.44 | \$ | 5,536.96 |
| C3020 | Floor finishes | | \$ 3.21 | \$ | 40,394.64 |
| | Vinyl, composition tile, maximum | 12854 | \$ 3.21 | \$ | 40,394.64 |
| C3030 | Ceiling Finishes | | \$ 6.19 | \$ | 77,894.96 |
| | Acoustic ceilings, 3/4" fiberglass board, 24" x 48" tile, tee grid, suspended support | 12584 | \$ 6.19 | \$ | 77,894.96 |

| D | Services | 45.42% | \$ 72.31 | \$ 909,949.04 |
|-------|--|--------|----------|---------------|
| D2010 | Plumbing Fixtures | | \$ 3.15 | \$ 39,639.60 |
| | Water closet, vitreous china, bowl only, with flush valve, wall hung | 5.39 | \$ 1.48 | \$ 18,624.32 |
| | Urinal, vitreous china, wall hung | 1.79 | \$ 0.20 | \$ 2,516.80 |
| | Lavatory w/trim, vanity top, PE on CI, 20" x 18" | 5.39 | \$ 0.58 | \$ 7,298.72 |
| | Service sink w/trim, PE on CI, wall hung w/rim guard, 24" x 20" | 1.79 | \$ 0.56 | \$ 7,047.04 |
| | Water cooler, electric, floor mounted, dual height, 14.3 GPH | 1.79 | \$ 0.33 | \$ 4,152.72 |
| D2020 | Domestic Water Distribution | | \$ 1.75 | \$ 22,022.00 |
| | Gas fired water heater, commercial, 100< F rise, 100 MBH input, 19 GPH | 1.79 | \$ 1.75 | \$ 22,022.00 |
| D3050 | Terminal and Package Units | | \$ 22.75 | \$ 286,286.00 |
| | Rooftop, multizone, air conditioner, offices 10,000 SF, 31.66 ton | 12584 | \$ 22.75 | \$ 286,286.00 |
| D4010 | Sprinklers | | \$ 3.70 | \$ 46,560.80 |
| | Wet pipe sprinkler systems, steel, light hazard, 1 floor, 10,000 SF | 12584 | \$ 3.70 | \$ 46,560.80 |
| D4020 | Standpipes | | \$ 1.63 | \$ 20,511.92 |
| | Wet standpipe risers, class 3, steel, black, sch 40 4" diam pipe, 1 floor | 2.15 | \$ 1.63 | \$ 20,511.92 |
| D5010 | Electrical Service/Distribution | | \$ 2.93 | \$ 36,871.12 |
| | Overhead service installation, included breakers, metering, 20' conduit and wire, 3 phase, 4 wire, 120/208 V, 400A | 1.25 | \$ 0.61 | \$ 7,676.24 |
| | Feeder installation 600 V, including RGS conduit and XHHW 400 A | 100 | \$ 0.79 | \$ 9,941.36 |
| | Switchgear installation, incl switchboard, panels and circuit breaker, 120/208 V, 3 phase, 600 A | 1.2 | \$ 1.53 | \$ 19,253.52 |
| D5020 | Lighting and Branch Wiring | | \$ 28.66 | \$ 360,657.44 |
| | Receptacles incl plate, box, conduit, wire, 16.5 per 1000SF, 2.0 W per SF, with transformer | 12584 | \$ 5.15 | \$ 64,807.60 |
| | Miscellaneous power, 1.2 Watts | 12584 | \$ 0.36 | \$ 4,530.24 |

| | | | | | |
|-------|---|---------|----|----|-----------|
| | Central air conditioning power, 4 Watts | 12584 | \$ | \$ | 8,179.60 |
| | Motor installation, three phase, 460 V, 15 HP motor size | 2 | \$ | \$ | 5,411.12 |
| | Flourescent fixtures recess mounted in ceiling, 1.6 watt per S.F., 40 FC, 10 fixtures @ 32 watt per 1000 SF | 14471.3 | \$ | \$ | 82,928.56 |
| D5030 | Communications and Security | | \$ | \$ | 97,400.16 |
| | Telephone wiring for offices and laboratories, 8 jacks/MSF | 9438 | \$ | \$ | 22,022.00 |
| | Communication and alarm systems, fire detection, addressable, 25 detectors, includes outlets, boxes, conduit and wire | 1.79 | \$ | \$ | 39,891.28 |
| | Fire alarm command center, addressable without voice, excl. wire and conduit | 1.79 | \$ | \$ | 11,954.80 |
| | Internet wiring, 8 data/voice outlets per 1000 SF | 9.43 | \$ | \$ | 23,532.08 |
| E | Equipment and Furnishings | 0.29% | \$ | \$ | 5,788.64 |
| E1090 | Other Equipment | | \$ | \$ | 5,788.64 |
| | 5.00-Closed circuit television system (CCTV), surveillance, for additional camera stations, add | 5 | \$ | \$ | 4,026.88 |
| | 1.00-Closed circuit television system (CCTV), surveillance, one station (camera and monitor) | 1 | \$ | \$ | 1,761.76 |

4. Bill of Materials, List of Equipment, and Prototyping Test plan

4.1 Bill of Materials

| Item Name | Description | Unit of measure | Quantity | Unit cost | Extended Cost | Link |
|---|---|-----------------|----------|-----------|------------------------|---|
| VR Headset | Oculus Quest 2 (Bought by a student before the project) | Unit | 1 | 419.99\$ | 0\$ | https://www.bestbuy.ca/en-ca/product/meta-quest-2-128gb-vr-headset-with-touch-controllers/15490835 |
| VR Cable | USB 3.0 male to male type A to C (Bought by a student before the project) | Unit | 1 | 29.99\$ | 0\$ | https://www.amazon.ca/CableCreation-Compatible-Virtual-Reality-Headsets/dp/B08RMLWVL6?pd_rd_w=nsQ7H&content-id=amzn1.sym.0820519d-1cf1-4010-bbcc-b190182bd419&pf_rd_p=0820519d-1cf1-4010-bbcc-b190182bd419&pf_rd_r=92W1RXD12MBB4WHE NNAT&pd_rd_wg=SIVOG&pd_rd_r=5be9ec6d-f5ea-4ffa-a6a7-b0d5ab559518&psc=1&ref_=pd_bap_d_grid_rp_0_5_t |
| Monitor | MSI Optix G24C6P (Bought by a student before the project) | Unit | 1 | 159.88\$ | 0\$ | https://www.canadacomputers.com/product_info.php?cPath=22_700_1103&item_id=195444 |
| 3D Printing | For physical prototypes and design day | Grams | 314 | 0.25\$ | 47.19\$ | https://makerepo.com/job_orders/253/steps?step=2 |
| Laser Cutting | For design day | Unit | 3 | 3\$ | 9\$ | https://makerstore.ca/shop/ols/products/mdf/v/M003-1-8-18-NCH |
| Trifold Display | For displaying our project on design day | Unit | 1 | 11.98\$ | 11.98\$ | https://www.walmart.ca/en/ip/artskills-large-tri-fold-display-board/10263542 |
| CAD Software | Auto Desk SolidWorks Onshape | Unit | 1 | 0\$ | 0\$ | https://www.autodesk.com/ca-en https://www.solidworks.com/ https://www.onshape.com/en/ |
| Total product cost (without taxes or shipping) | | | | | 68.17\$ | |
| Total product cost (including taxes and shipping) | | | | | 77.03\$ + 0\$ shipping | |

4.2 List of Equipment

| Item Name | Description | Type | Prototype # | Source |
|-----------|-------------|------|-------------|--------|
|-----------|-------------|------|-------------|--------|

| | | | | |
|-------------|------------------------------------|-----------|---------|---|
| Solid Works | To run simulations on the building | Software | 1, 2, 3 | https://www.solidworks.com/ |
| Auto Desk | To run simulations on the building | Software | 1, 2, 3 | https://www.autodesk.com/ca-en |
| 3D printer | To print out prototype | Equipment | 3 | MakerLab |

4.3 Prototyping Test Plan

| Test ID | Test Objective (Why) | Description of Prototype used and of Basic Test Method (What) | Description of Results to be Recorded and how these results will be used (How) | Estimated Test duration and planned start date (When) |
|---------|--|--|--|--|
| 1 | To ensure all key zones and points of interest are covered and clearly visible within camera view. | The prototype will be a CAD model with camera view setup in predetermined spots. | Results will be recorded in a heat map to show overlap and missing area, so that we can move cameras to more useful areas. | Test duration: 2 hours Date: Saturday, November 4, 2023 |

5. Wrike Snapshot

This is the link to the Wrike snapshot for this week:

<https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=hMsEbdYJp1h7NiM8XMfZ9JEO1py1GoS%7CIE2DSNZVHA2DELSTGIYA>