University of Toronto
Faculty of Applied Science and Engineering
APS111
Conceptual Design Specifications (CDS)

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Project Title	Conceptual Design Specifications
Client	Sustainability Office
Tutorial Section	115
Teaching Assistant	Bojing Gui
Communication Instructor	Rhonda Bowen
Prepared By (Names and Student #s of Team Members)	Xuankai Zhang (1011011815) Adalric Tai (1010961924) Maya Rak (1010955753) Chloe Yeung (1011013010) Jalilya Zhaxybayeva (1011042373) Salma Elmalky (1010855371)

State your document word count: 3286 words (word count excludes Cover Page, Executive Summary, Reference List and Appendices)

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✔ CDS submitted as a PDF to Quercus with the following components:

✔ Cover Page
✔ Executive Summary
✔ Introduction
✔ Problem Statement
✔ Service Environment
✔ Stakeholders
✔ Detailed Requirements (FOCs)
✔ Generation, Selection and Description
✔ Alternative Designs Selection Process
✔ Alternative Design Descriptions
✔ Introduction
✔ Proposed Conceptual Design Specification
✔ Conclusion
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Executive Summary

The University of Toronto St. George Campus Sustainability Office requests a redesign of the first floor of the Bahen Centre for Information Technology and its adjacent courtyard due to the closure of its former food site, Cube Cafe.

This redesign aims to address the gap in accessible food options for the students and staff working in the Bahen Centre by introducing an area that provides food while also promoting the Bahen Courtyard as a welcoming gathering space. The scope of the design is the Bahen Centre's first floor, including the Cube Cafe's old facilities, the courtyard area outside of the southern exit, and the walkway to College Street. The scope is bounded by the Fields Institute (to the south), the Koffler Student Centre (to the east), the UTSU Student Commons, and 215 Huron St. (to the west).

The service environment encompasses indoor and outdoor areas, including existing electrical, water, and HVAC outlets, mainly in the unused Cube area. Consideration will be given to living organisms, light, and sound levels. The project will reduce privacy and affect accessibility for users of the multi-faith prayer space and nearby buildings. Other stakeholders, such as the University's Waste Management Team and Ontario regulators, will have their concerns integrated into the project's objectives and constraints.

The primary functions are to facilitate a gathering space and provide food, with numerous supporting secondary functions acting as the foundations for the project's objectives. The objectives of this project revolve around the 17 UN sustainability goals and include physical success, namely weather-resistant outdoor equipment and accessibility accommodations. Additionally, the gathering space should support group gatherings while addressing allergies, facilitating mobility challenges, and representing Indigenous culture. Sufficient lighting and efficient food service interactions are crucial. The Ontario Food Premises Code has specifications for food service areas, while the Ontario Building Code dictates accessibility needs, and the fire safety code mentions fire hazard separation requirements and extinguisher placements. The client requires vegan, vegetarian, halal and keto options.

Through structured brainstorming and idea selection, three alternate designs are proposed.

The Cook-it-box design combines a 24/7 self-serve vending machine equipped with instant meals as a subscription service to provide users with convenient, ready-to-eat options. Instant meals are stored in vending machines, only requiring reheating with microwaves or ramen cookers provided on-site. Moveable tables and seating are provided in the courtyard, with tactile tiles by elevation changes to improve accessibility.

The Pan Harvest option is a student-staffed food station offering customizable pan-cooked meals made from locally sourced produce through partnerships with local farmers. A greenhouse along the south of the courtyard supports meal preparation, while an LED-lit solarium attached to the side of Bahen functions as a year-round gathering and dining space. Additional illuminated signage will be introduced to the courtyard to mark walkways. Pan Harvest is the proposed conceptual design, which best fulfils the main objectives.

The Commons Patio solution proposes a Smart Chicken franchise, building on its popularity and ability to meet dietary needs demonstrated by its track record in MSB and Sid's Cafe. The Cube will be redesigned to house an industrial kitchen. The remaining area will feature a kiosk with indoor and outdoor service windows, complemented by an outdoor dining area with group seating covered by large, lit umbrellas.

With fully defined alternate solutions, the next steps would be implementing the chosen design and affirming associated costs.

1.0 Introduction

The St. George Campus Sustainability Office at UofT promotes sustainability and aims to transform UofT into a net-zero institute [1]. The office identified the lack of accessible food services in the Bahen Centre (Figure 2) after Cube Cafe closed [2], leaving space underutilised (Figure 1).

This document outlines the project's stakeholders, objectives, functions, and constraints, acting as criteria for generating and selecting solutions, presenting three thorough designs and recommending the best-suited one.

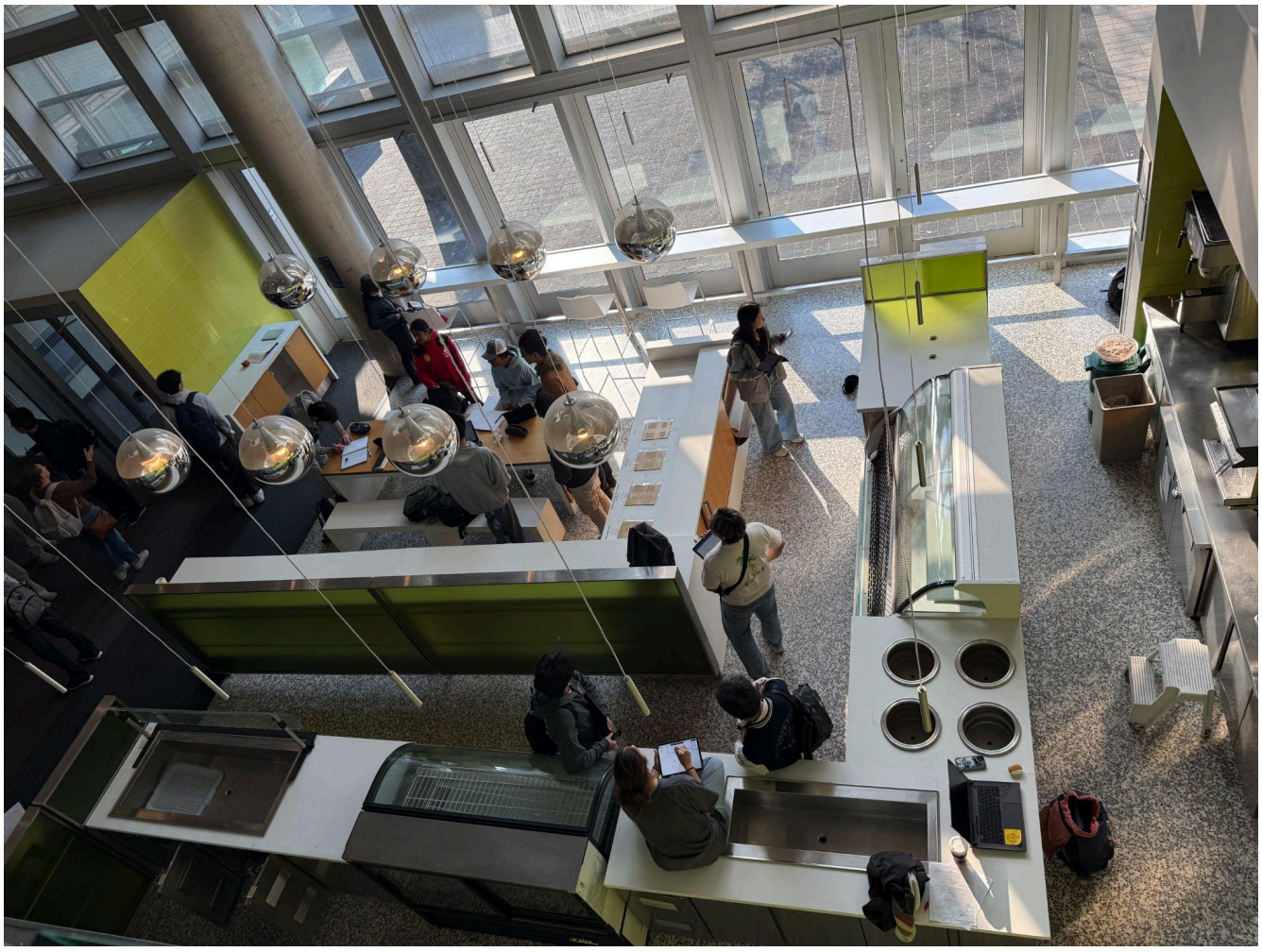

Figure 1. Former site of the Cube. [4]

Figure 2. Bahen courtyard

2.0 Problem Statement

The Sustainability Office highlighted the lack of accessible food options in the Bahen Centre, an engineering and computer science building with hundreds of users. There are no food services available in the Bahen Centre (Figure 3), the nearest being the food trucks on St. George or the restaurants on College Street.

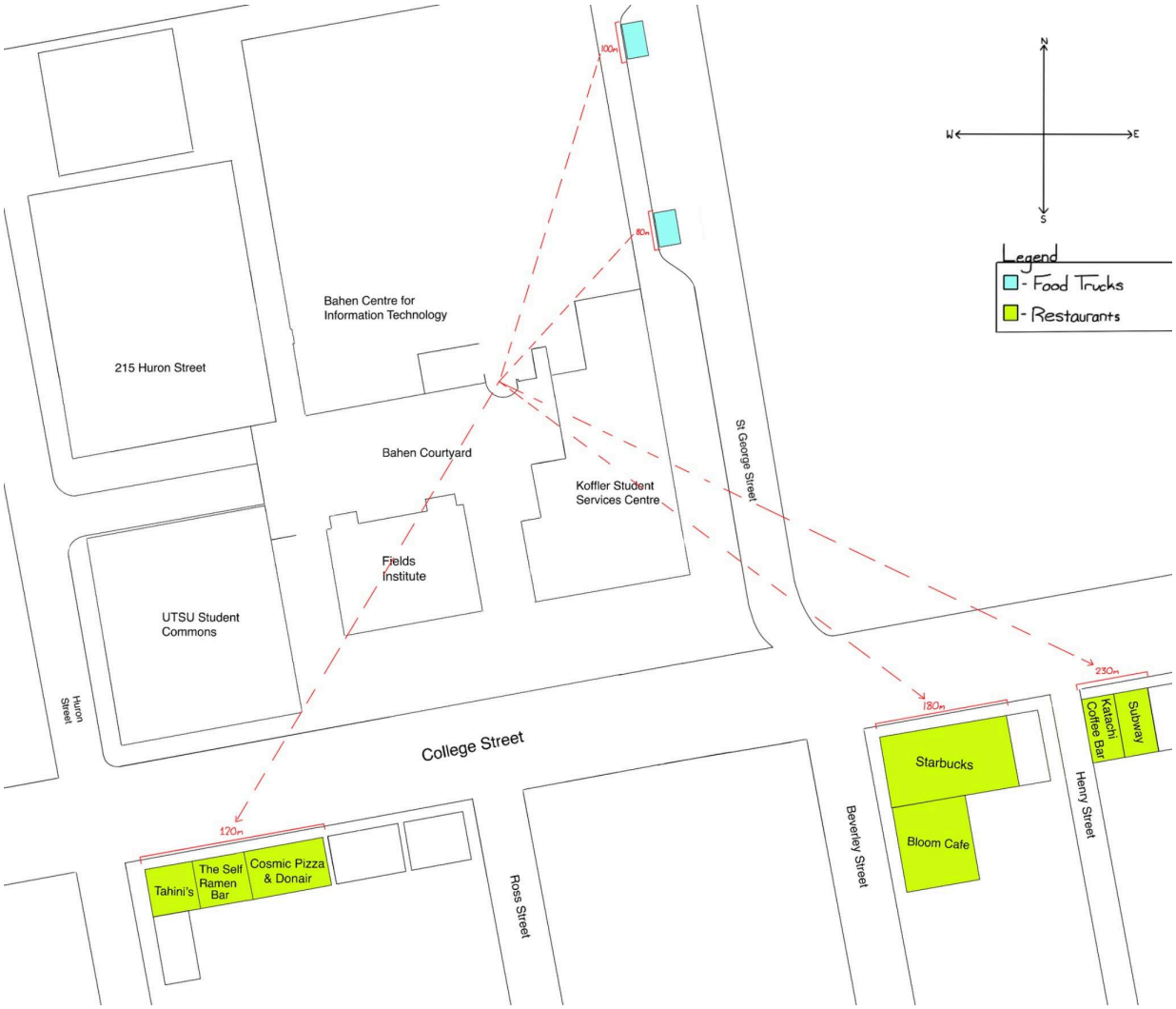

Figure 3. Distances between the entrance to Cube and nearby food services are illustrated.

The Bahen courtyard is an underutilised gathering space due to limited seating and greenery, with only two benches and 23.9% green space by area (Appendix A.1, Figure A.1.1), compared to 70-100% at King's College Circle. Currently, it serves as a walkway between College Street and Bahen Centre. The redesign aims to introduce food service and foster a community space.

The design scope is limited to the former Cube site, the courtyard, and the walkway to College Street [2]. Four buildings surround the courtyard (Figure 4).

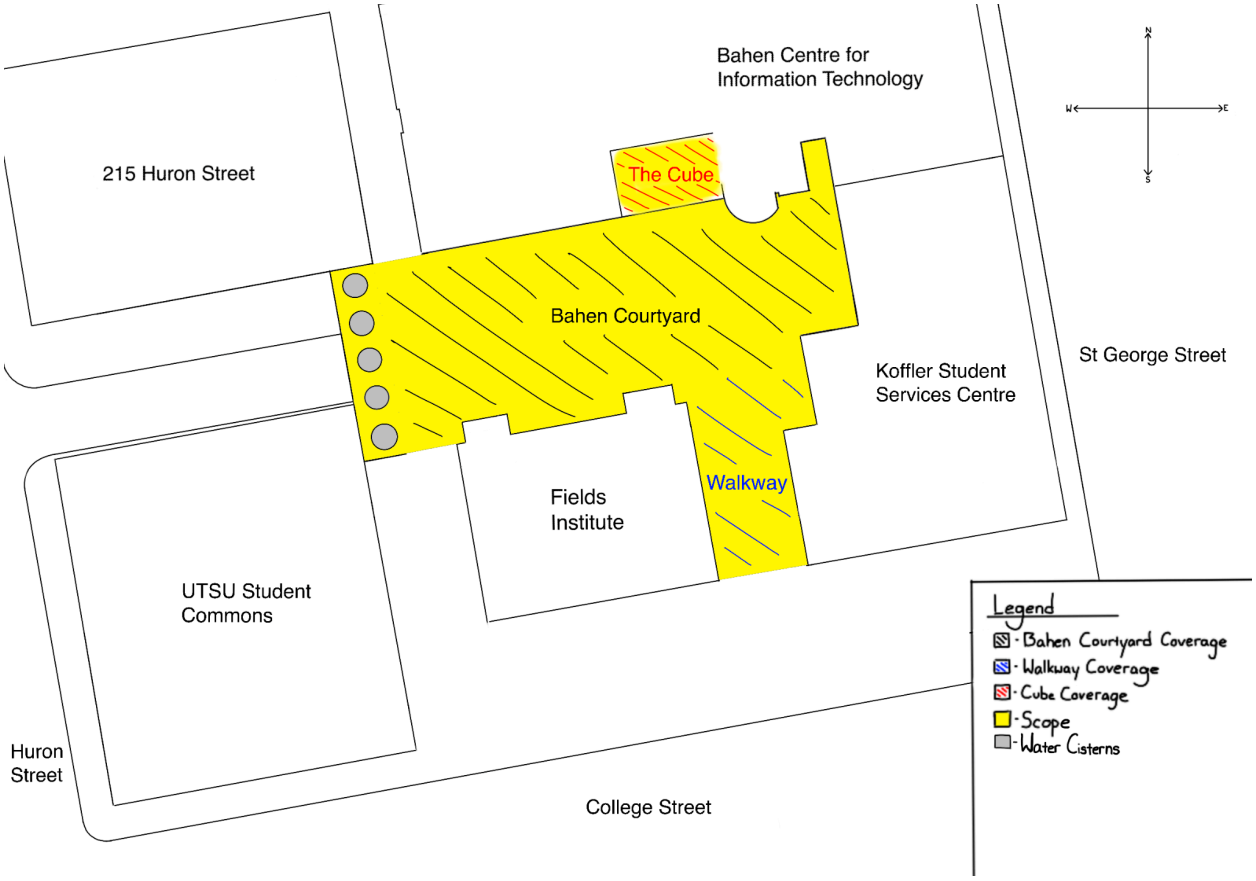

Figure 4. Top view of Bahen Courtyard. [3] (Appendix A, Figure A.2.1)

Water cisterns cannot be altered [2]. Sustainable design is desired by preserving greenery, managing waste, maintaining year-round functionality, and integrating existing utilities.

3.0 Service Environment

This section includes site observations relevant to the redesign.

3.1 Physical Environment

The design scope includes indoor and outdoor aspects. Data from existing infrastructure (Tables 3.0.1 and Table 3.0.2), Cube site measurements (Figure 5), site observations (Table 3.0.3), and Toronto weather (Table 3.0.2) were analysed to assess the physical service environment. Based on observations from the site visit (Appendix B):

Table 3.0.1 Existing infrastructure within the Cube. For kitchen and food preparation considerations.

Available	**Description**
Utilities	• PPG Solarban 60 Solar Control Low E • UofT Automated Control System [5] • Faucet • Geoexchange. [6]

Appliances	● Fridge ● Sink ● Three TVs ● Two food display cases
Accommodation	● Four barstools ● Two benches ● Counter space (Figure 5)

Table 3.0.2 Existing infrastructure within the Cube. For food preparation considerations. See Appendix B for observations.

Available	**Description**
Utilities	● Faucet under fountain table and on wall outside the Cube ● Lowered fountain area: ○ Plumbing utilities ○ Six drains
Accommodation	● Two benches ● Plot of grass ● Three recycling bins.
Accessibility	● 24 Bike racks ● Two ramps ● Three staircases.

Table 3.0.3 Annual weather analysis in Toronto [7], [8] (12 words)

	Temperature (℃)	**Days of rain**	**Rainfall (mm)**	**Snowfall (mm)**	**Sunshine (Hrs)**
Seasonal lows	-6.7	4.4	14	25	85
Seasonal highs	26	8.7	52	88	280

Table 3.0.3 Light measured during a site visit see Appendix B.

	Cube	**Courtyard**
Light (kLux)	78	107

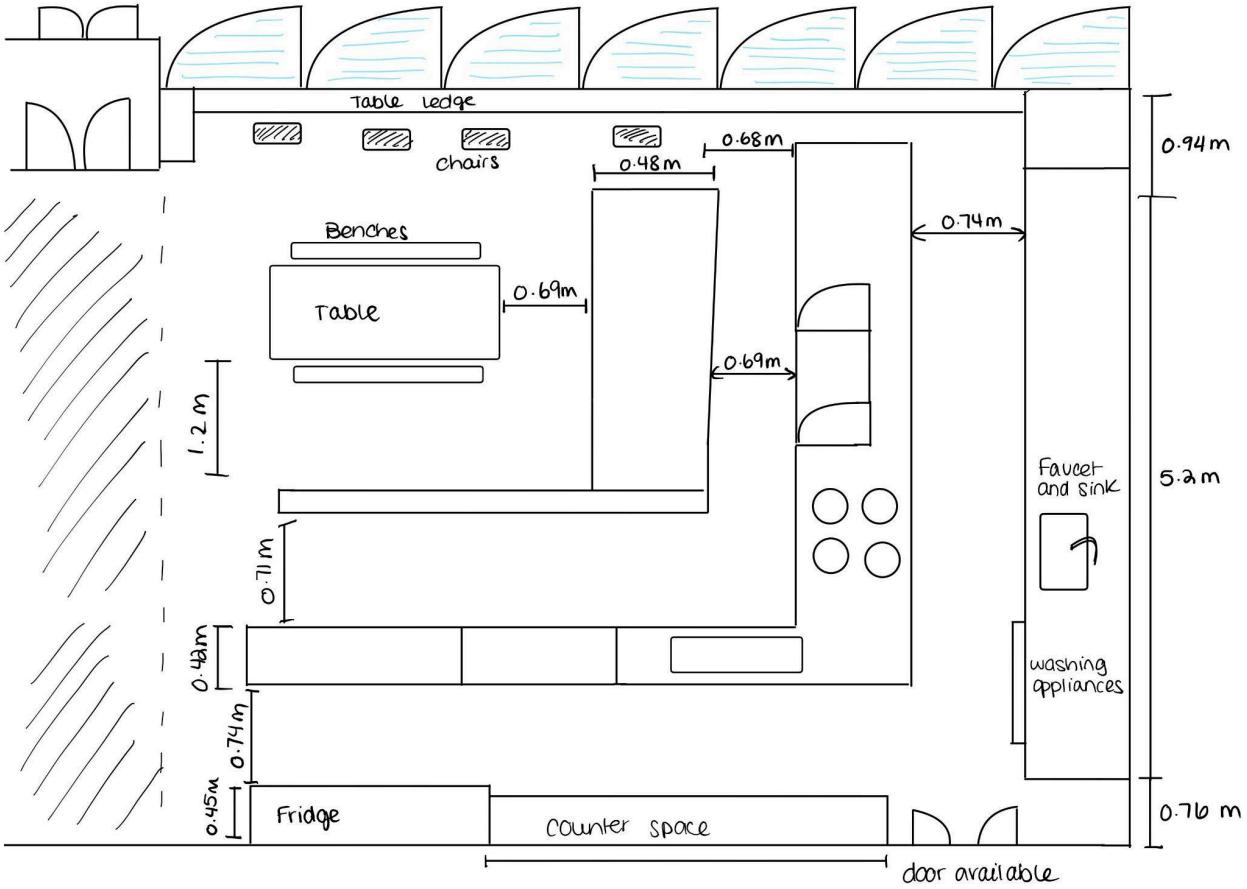

Figure 5. Dimensions for indoor “Cube” scope.

The physical environment includes uneven courtyard levels. Measurements are shown in Figures 6 and 7, with drainage blockages observed in Figure 8.

Figure 6. Depression between levels in Bahen Courtyard.

Figure 7. Elevated lawn drawn in Figure 8.

Figure 8. Blocked drain.

3.2 Living Things

The living things observed are shown in Table 3.0.3, and Appendix B. Figure 9 shows a layout of the courtyard's greenery.

Table 3.0.3 Observations of living things seen in the courtyard

Type observed	**Description**
Biodiversity	• 13 trees • Native grass south of the courtyard. • Elevated grass plot in Figure 7.
Animals	• Birds • Squirrels • Raccoons.

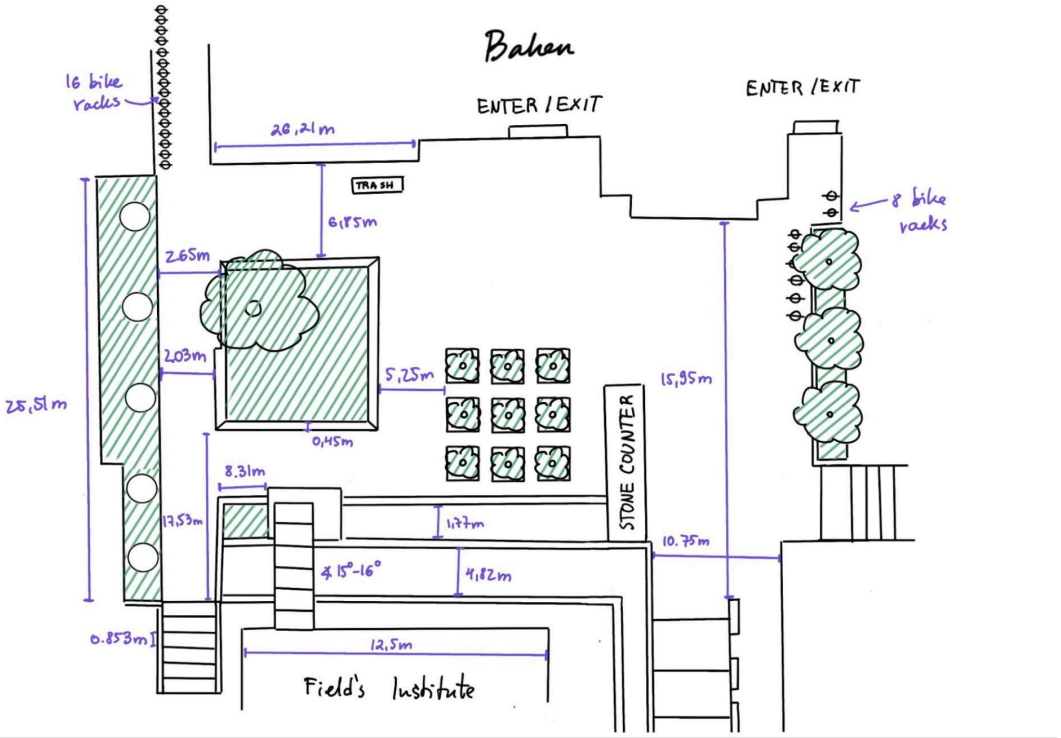

Figure 9 Bahen courtyard layout.

3.3 Virtual Environment

Within the virtual environment scope, the following existing services could support a gathering space:

- UofT campus wifi
- 4-bar cellular service
- UofT Mobile order app.

4.0 Identification of Stakeholders

This section outlines those impacted by the project, their influence on the design, and the project's responses to stakeholders. Table 4.0.1 lists the influential stakeholders.

Table 4.0.1. Stakeholders ordered highest to lowest impact and influence (Appendix C).

Stakeholder	**Impact and Influence**
City of Toronto / Province of Ontario ● Waste management ● Health/Food regulations	● Localised congestion ● Economic and social benefits. Constraint: Compliance with regulations (see 5.3)

Multi-faith prayer space users	• Increased noise level and traffic flow • Reduced privacy [5] • Enhanced user experience from accessible food. Objective: Maintain privacy and accessible pathways. [10]
UofT student organisations	• Increased event hosting and visibility • Social gathering spaces. Objective: Flexible gathering area.
UofT Waste Management Team	• Efficient waste disposal [11] Objective: Efficient waste management.
Nearby buildings' users and residents: • Bahen Centre underground parking • Koffler Student Services • Fields Institute • UofT Bookstore • Residents near Bahen Centre [12]	• Increased foot traffic and noise • Busier accessways [5]. • Potential pest issues [13]. Objective: Ensure cleanliness, accessible pathway.

5.0 Detailed Requirements

The design must provide food and space to users, withstand weather, and prioritise accessibility and sustainability. The following subsections consider the functions, objectives and constraints.

5.1 Functions

This section outlines the design requirements and connects the nine secondary functions with the three primary functions in Table 5.1.1.

The functions were identified through Functional Basis Analysis of the Client Statement [1] and the HOW-WHY TREE in Appendix D. Each secondary function supports a related primary function.

Table 5.1.1 Primary and secondary functions with corresponding sustainability goals.

Primary Functions The design…	**Secondary Functions** The design…
Provides food	1. Processes food waste 2. Stores perishable food 3. Provides cooking/food preparation space.
Facilitates a gathering space	4. Removes snow/rainwater 5. Temperature controlled 6. Provides lighting 7. Facilitate navigational info signage 8. Equipped with seating

5.2 Objectives

Of the 17 Sustainability Goals [14], those referenced in the client statement are listed and referenced in brackets by their numbers (SG #) in the objectives indicating relevance.

3 - Good health and well-being
10 - Reduces inequality
11 - Sustainable cities and communities
12 - Responsible consumption and production

The courtyard's physical success is shown in Table 5.2.1.

Table 5.2.1. Physical Success Objectives. Labelled by letter for reference in 6.3.

Objective	**Metric**	**Goal**
Durable seating, bike racks, cooking utilities (D)	● # of years before repairs are needed for: ○ Paint ○ Structural integrity ○ Appliances ○ Electrical/plumbing.	● > five years. [15]
Accessible year-round	● Width of walkway clear of: ○ Snow/ice ○ Leaves ○ Water	● ≥ 36 inches clear. [16]

Environmental objectives are present[15]. Shown in Table 5.2.3.

Table 5.2.3. Environmental Success Objectives. Labelled by letter for reference in 6.3.

Objective	**Metric**	**Goal**

Maximise energy-efficiency(SG 11,12) (F)	• Percentage of total energy consumption for:
	  ○ Lighting
	  ○ Refrigeration
	  ○ Cooking.
		• 4-7% for lighting [17]
		• 40-44% for refrigeration [17]
		• 12-14% for cooking. [17]

Minimise waste produced(SG 11,12) (B)	• Percentage of purchased food supply (by mass) that becomes waste.	• ≤ 4% waste. [18]
Support native plants/grasses and wildlife health(SG 11) (H)	• Percentage of all native plants in outdoor green spaces.	• 70-80% of plants.[19]

Social success will be measured by diverse space usage (Table 5.2.4.)

Table 5.2.4. Social Success Objectives. Labelled by letter for reference in 6.3.

Objective	**Metric**	**Goal**
Indigenous culture represented	• Percentage of events held in gathering space that reflect indigenous culture.	• 10% of events. [20]
Supports group gatherings (C)	• Group size of one table	• 4-8 people [21]

Addresses dietary restrictions relating to allergies(SG 3,10) (G)	• Percentage of total food that satisfies each of the following diets:
	  ○ Gluten-free
	  ○ Nut-free
	  ○ Seafood-free
	  ○ Lactose-free.
		• 10% of total food. [22]

Facilitates mobility challenges (SG 10) (E)	• Percentage of accessible seats.	• 15% of seats are accessible [16]

Performance will be measured by convenience and space comfort (Table 5.2.5.)

Table 5.2.5. Performance Success Objectives. Labelled by letter for reference in 6.3.

Objective	**Metric**	**Goal**
Effective ventilation(SG 3)	• # of air changes per hour.	• 0.35 air changes. [23]
Sufficient lighting	• Lumens in indoor space.	• 450-850 lumens. [24]
Time-efficient interaction with	• Average food station	• ≤ 10 minutes. [25]

food service (A)	interaction time.	

5.3 Constraints

Most constraints come from legal regulations, with certain client inputs.

Table 5.3 The relevant highlights of each code, though all referenced documents must be followed.

Constraint	**Highlights**
Must obey Ontario Food Premises Regulations	Food Premises shall have: ● Smooth and non-absorbent floors [26] ● Hot/cold running water, refrigerated space, staff handwashing stations. [9]
Must obey the Ontario Building Code	Accessibility: ● Pathways must measure at least 1100mm wide [27] ● Areas with ≤20 fixed seats must have 2 wheelchair spaces and 1 adaptable seat [28] ● Objects must be between 460mm-1100mm above the floor. [29] Fire Safety: ● Cabinets shall be ≥ 750mm above cooktops (Appendix F.1) [30] ● Indoor/outdoor space separations (Appendix F.1) [31] [32]
Must obey the Ontario Fire Code	Class K portable extinguishers (Appendix F.2) shall be provided. [34]
Shall accommodate dietary restrictions	Client requirement (Appendix F.3); vegan, vegetarian, halal, and keto options. [35]

6.0 Generation, Selection, Description of Alternative Designs

6.1 Idea Generation Process

The idea generation process used tools in Table 6.1.2 for a table of 50 unique solutions (Appendix G.1, Table G.1.1).

Table 6.1.1. Common approaches to meeting the gap. Appendix G.1, Table G.1.2 presents the sorted 50 ideas.

Theme/Approach	**Description** **The solution…**	**Idea Example**
Sector-Based (Partnerships)	● Food sourced from local farms, catering, organisations.	46. CSA Boxes Partnership with Local Farmers
Educational-Based	● Educates users about nutrition, cooking, sustainability while providing food.	29. Lessons & Cycles of Food
Technology-Based	● Autonomous food distribution ● Mobile/online ordering system.	4. Conveyor Belt Service
Community-Based	● Provides a community space for gathering and sharing food.	5. Daily Picnic

Table 6.1.2. Tools and processes used to generate ideas.

Process	**Description**
Technical Analogy	Review existing solutions around campus: ● Sid's Cafe ● MSB Food Court.
Morph Chart	A need-means table Appendix G.1, Table G.1.3
Free Brainstorming	Chart of 50 brief ideas Appendix G.1, Table G.1.1
AI-Assisted Idea Generation	Microsoft Copilot

Ideas were tracked in a Google document for easy consolidation.

Microsoft Copilot was used, with conversations shared with team.

Table 6.1.3. Types of solutions generated.

Category	**Subdivisions**

Service locations	• Indoor (Cube) • Outdoor (Bahen Courtyard).
Staffing	• Students • Automated • Faculty
Sourcing	• External companies • UofT Food Services • Local farmers • Student-run organisations.
Portion and Target Mealtimes	• Breakfast/lunch/dinner • Snacks • 24/7 Services.

6.2 Alternative Design Selection Process

The design selection process follows a structured approach; evaluating, selecting, and refining ideas based on their feasibility and alignment with the key objectives (Figure 10).

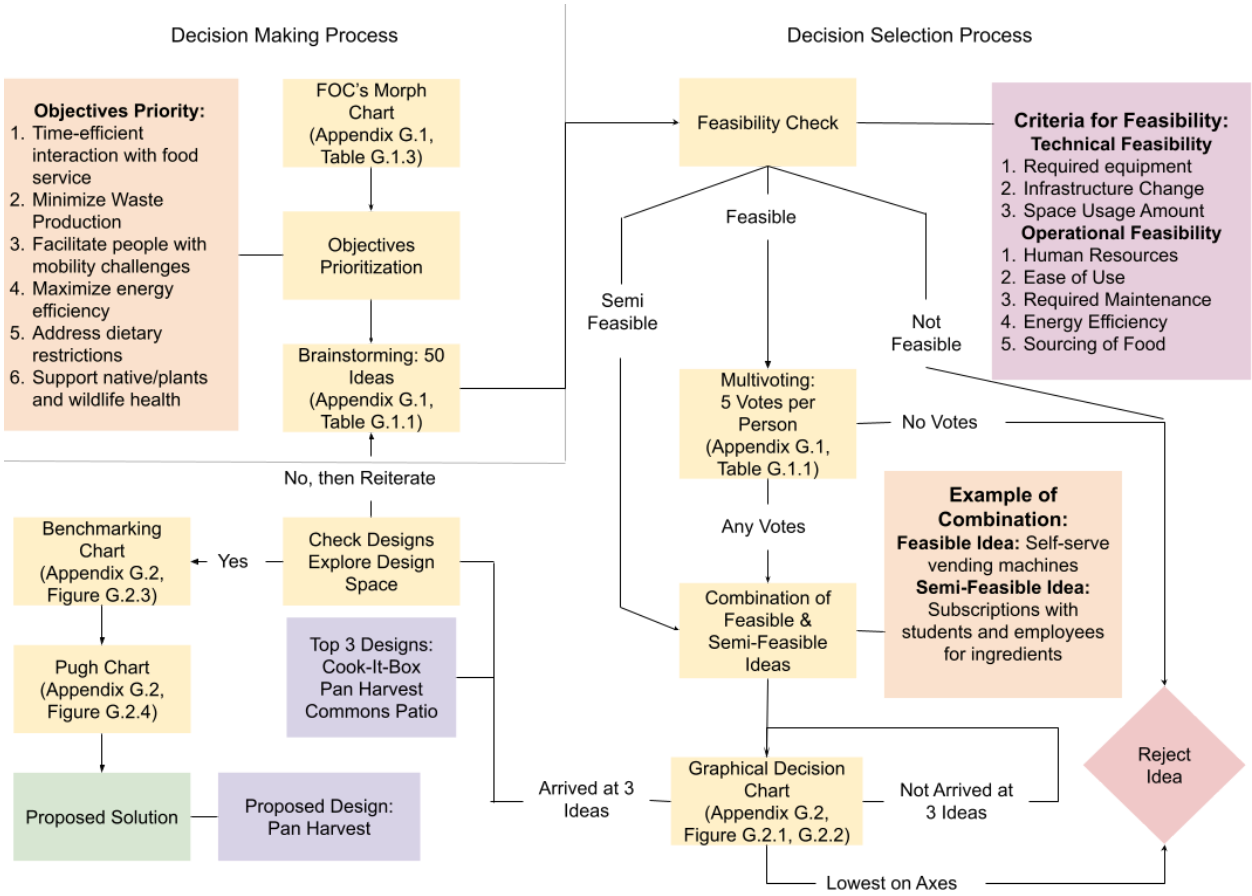

Figure 10. Illustration of design process. (107 words)

We included a “Reiterate” path because the initial designs didn’t fully explore the design space defined by FOCs.

This process broadened solutions and produced three quality designs.

6.3 Alternative Design Descriptions

Objectives and functions by letter and number referenced in their sections.

Idea #1

The Cook-it box is a self-serve vending machine offering instant meals by subscription. Meals require reheating using on-site microwaves or ramen cookers. The user-design interaction is demonstrated in Figure 11, and layout is shown in Figures 12 and 13. Key features include:

- 24/7
- Regularly restocked vending machines
- Meal options for various dietary restrictions
- Recycling/garbage bins on-site
- Tactile pavement (College Street to Bahen Centre)
- Vegetation on wall

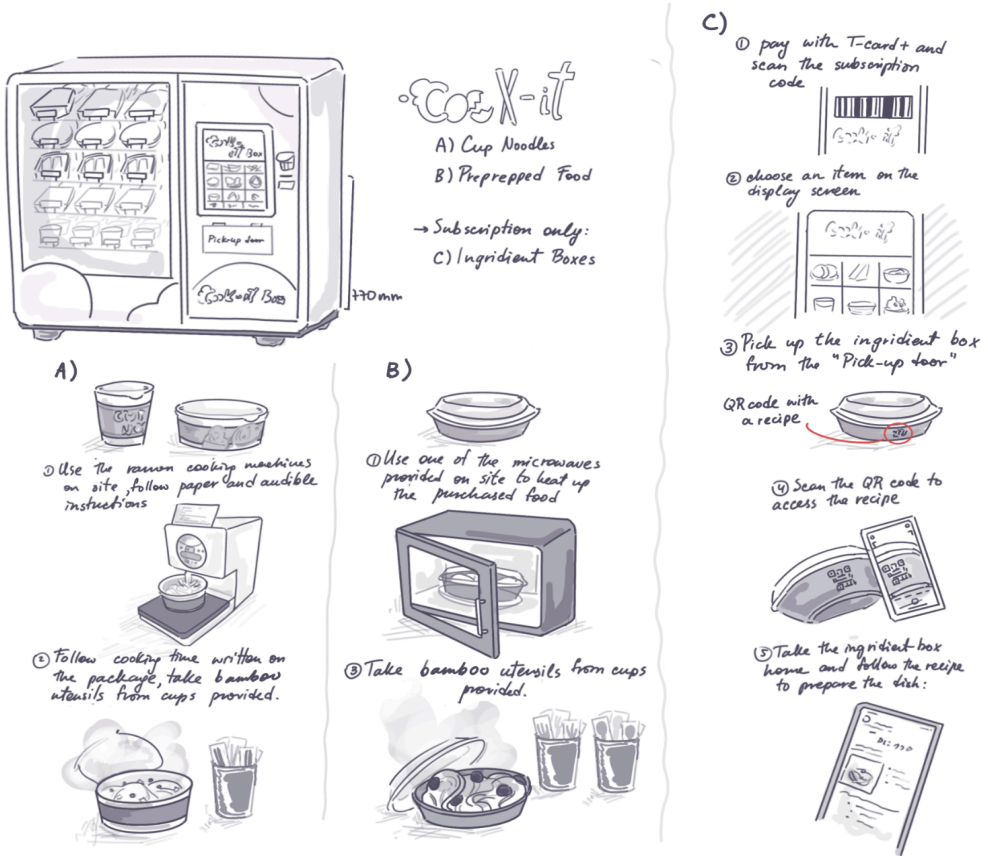

Figure 11. Illustration of Cook-it-Box-user interaction with three possible cases

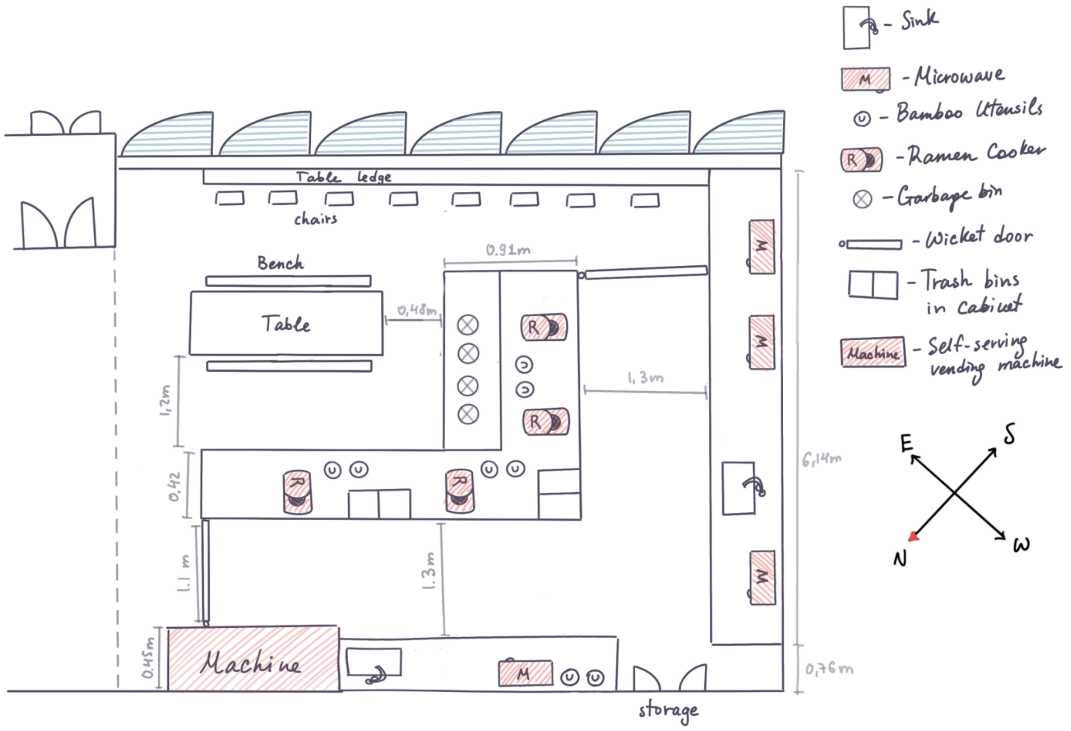

Figure 12. Redesign of the indoor Bahen space. (25 words)

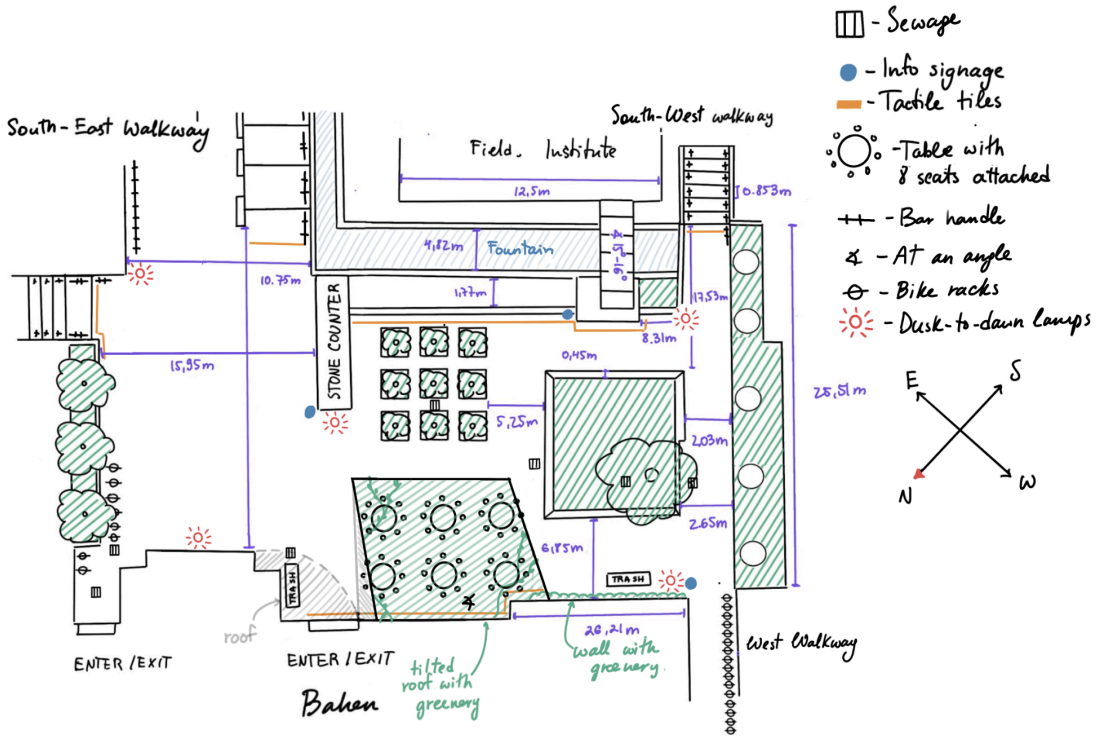

Figure 13. Layout of the redesigned Bahen Courtyard (34 words)

Tables 6.3.2 and 6.3.3 outline how Cook-it Box meets key functions and objectives, respectively.

Table 6.3.2 Key functions satisfaction by Cook-it Box

Functions	**The solution includes…**
(1)	● Waste separation bins ● Recyclable containers/utensils.
(2)	● Refrigerated vending machine
(3)	● Three microwaves ● Two water taps ● Four IH5600 EZ COOK Ramen Cookers. [36]
(4)	● Staff snow removal ● Pre-existing drainage system. ● Vegetation on walls to absorb rainwater. [37]
(5)	● Pre-existing heating system.
(6)	● Dusk-to-dawn lamps ● Pre-existing lighting within the Cube.
(7)	● Tactile pavement (Guidance/Hazard) ● Distinct coloured text & picture signs.
(8)	● Pre-existing Cube seating ● Movable furniture outdoors.

Table 6.3.3 Cook-it Box's alignment with objectives

Objectives	**Design Strategies**
(A)	● Offers frozen food heated < 5 minutes via microwave and EZ COOK Ramen Cookers ● 24/7 Availability
(B)	● Lunch boxes are the only waste ● Recyclable.
(C)	● Outdoor seating ● Existing Cube seating.
(D)	● Microwave and hot water dispenser customer-use-only.
(E)	● Braille buttons ● Wheelchair-accessible vending control

	height 770 mm [29].
(F)	● Convection microwaves ● Refrigeration only in vending machines.
(G)	● Options for dietary restrictions.
(H)	● Replace shrubs with native greenery [38] ● Green roofs and walls [38]: ○ Swamp milkweed ○ Early meadow Rue.

Idea #2

The Pan Harvest is a student-run food station offering customizable pan-cooked meals made with locally sourced produce from an on-site greenhouse and local farms. A solarium attached to Bahen provides a year-round gathering space. Figures 14, 15, and 16 show the user-design interaction and layout. Key features include:

- Hours: 12:00-20:00
- Student staffed
- Enclosed solarium
- Produce grown in greenhouse garden and local farms
- Indigenous artwork in the courtyard

Figure 14. Illustration of Pan Harvest-user interaction. (18 words)

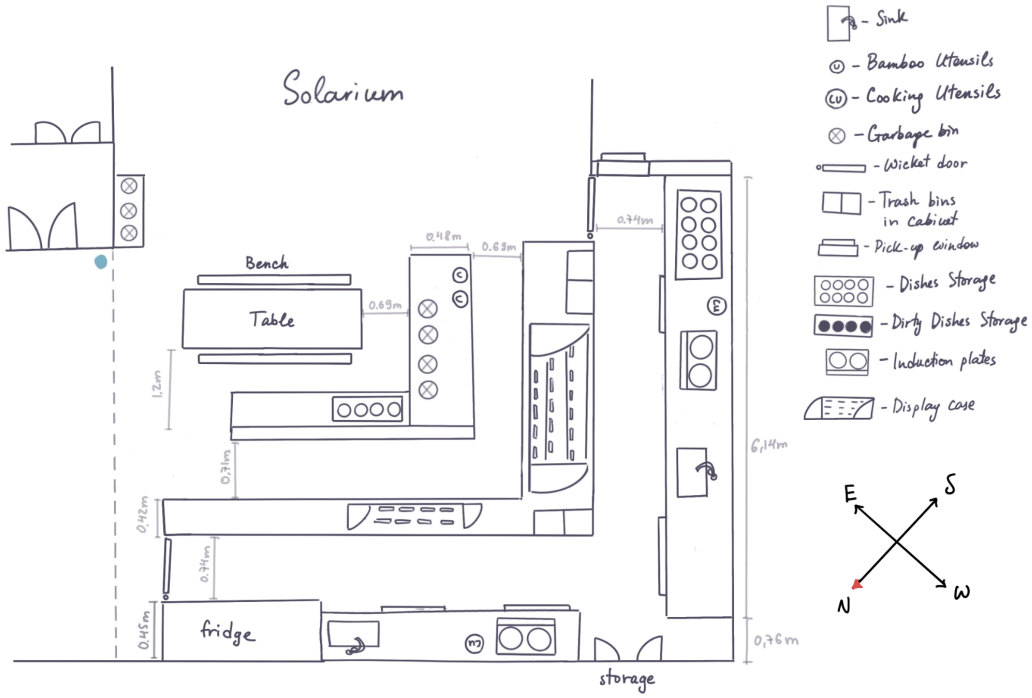

Figure 15. Redesign of the indoor Bahen space

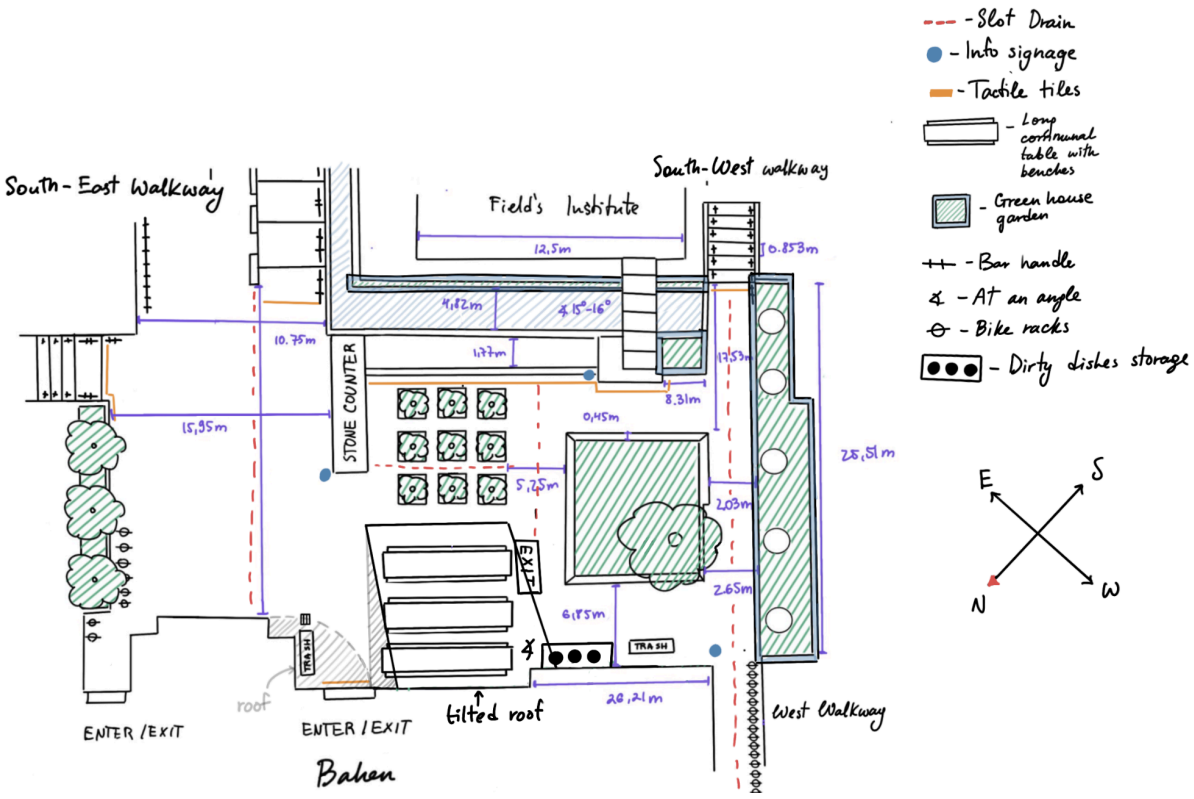

Figure 16. Layout of the redesigned Bahen Courtyard

Tables 6.3.4 and 6.3.5 outline how Pan Harvest meets key functions and objectives, respectively.

Table 6.3.4 Key functions satisfaction by Pan Harvest

Functions	**The solution includes…**
(1)	● Raccoon-proof trash cans ● Composting food waste.
(2)	● Cold food display cases.
(3)	● Existing Cube appliances for food preparation ● Three additional induction stoves.
(4)	● Graded tiles ● Slot drainage system [39].
(5)	● Heaters within solarium
(6)	● Tube LED lighting ● Pre-existing Cube light fixtures
(7)	● Illuminated signage at exits/solarium ● Tactile tiles around elevation changes.
(8)	● Ergonomic, non-slip communal tables

Table 6.3.5 Pan Harvest's alignment with objectives

Objectives	**Design Strategies**
(A)	● Pan stations offer prepped ingredients, meals in < 5 minutes.
(B)	● Dishes cleaned at Medical Sciences Building's cafeteria ● Different bins for reusable dishes/recycling.
(C)	● Communal seating in courtyard ● Indigenous artwork displayed
(D)	● Trained students operate restaurant ● Induction cooktops reduce fire risk.
(E)	● Wide west walkway in courtyard 1100mm with ramp [27].
(F)	● Energy Star-certified appliances ● Locally grown produce
(G)	● Pan stations clearly label allergens and

	dietary restrictions.
(H)	• Greenery in solarium enhances biodiversity • Courtyard garden grows native plants and herbs.

Idea #3

The Commons Patio is a new franchise location of UofT's existing food partner, Smart Chicken, chosen for its popularity and dietary-inclusive menu. The Cube will be redesigned to include an industrial kitchen, occupying ¾ of the current indoor square footage, with a service window and an outdoor group dining area. User-design interaction is demonstrated in Figure 17, layouts are shown in Figures 18 and 19. Key features include:

- Kitchen hours: 12:00 - 21:00
- Mobile orders through UofT order app
- Vertical live gardens for better air quality.
- Retractable umbrellas over tables
- Geo-exchange [6] heated courtyard tiles
- Unused food discounted
- Recyclable containers and utensils

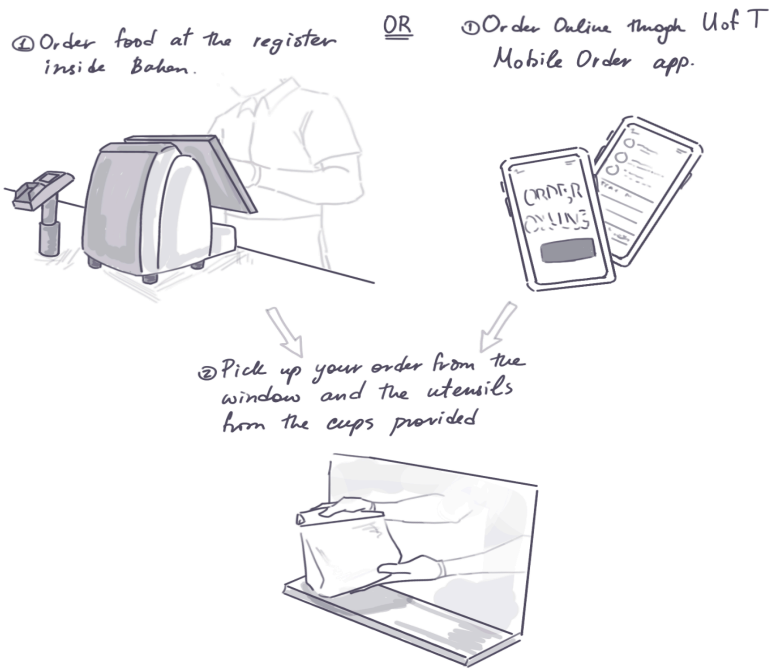

Figure 17. Illustration of Common Patios user interactions.

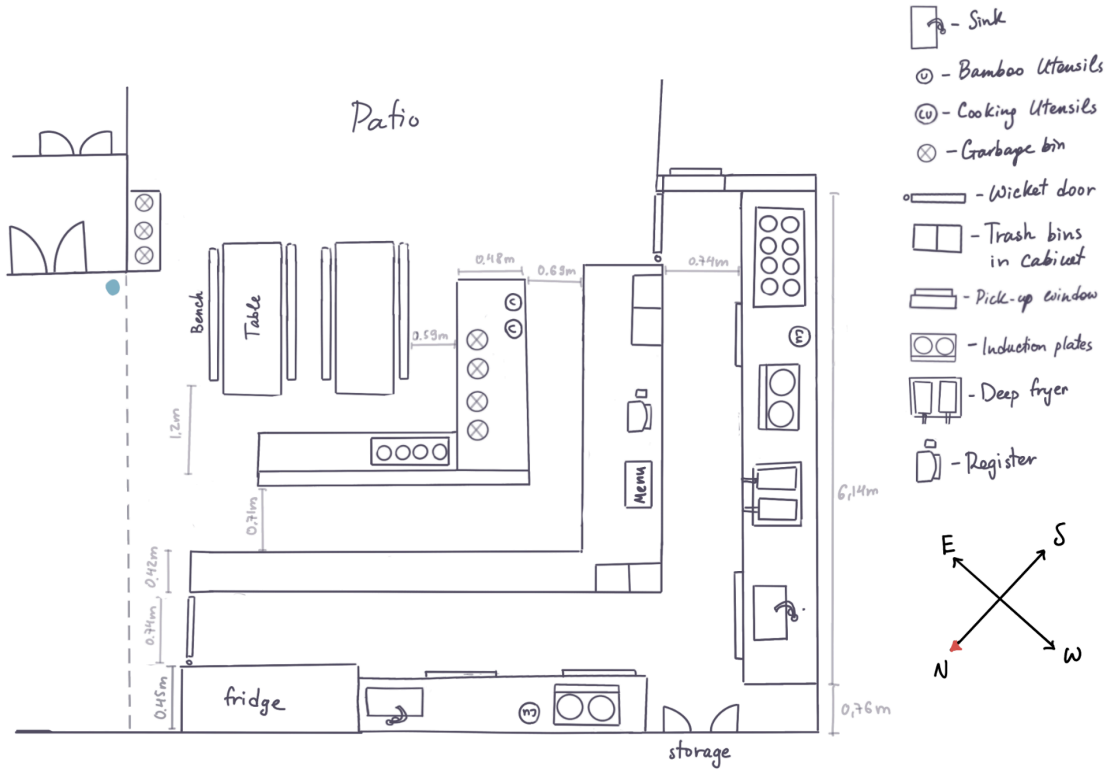

Figure 18. Redesign of the indoor Bahen space

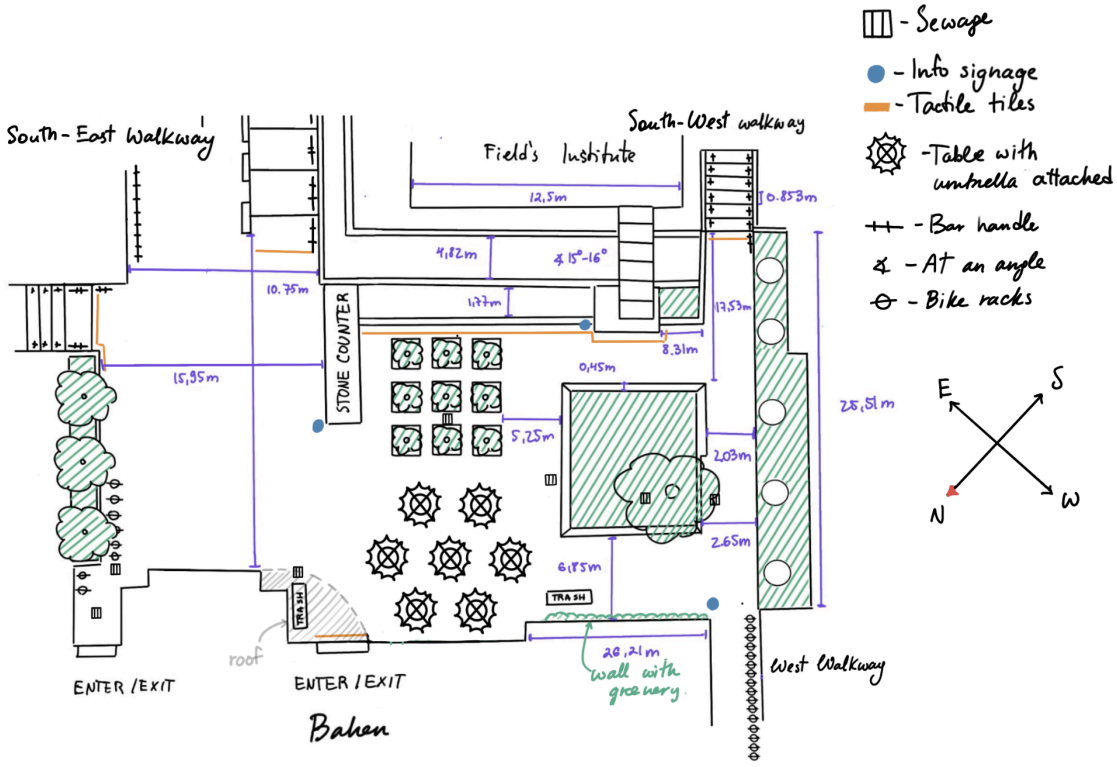

Figure 19. Layout of the redesigned Bahen Courtyard.

Tables 6.3.4 and 6.3.5 outline how Cook-it Box meets key functions and objectives, respectively.

Table 6.3.6 Key functions satisfaction by Commons Patio

Function	**The solution includes…**
(1)	● End-of-day sale at 20:00 reducing food waste
(2)	● Variable-speed compressor freezers [40] ● Modular refrigeration systems [41]
(3)	● Reconfiguring Cube area based on Smart Chicken
(4)	● Geothermally heated courtyard tiles to melt snow
(5)	● Portable heaters for courtyard
(6)	● Motion-detected lighting throughout courtyard ○ JSOT solar step lights [42] ○ Stair light ● Umbrellas internal light [43]
(7)	● Stair lights ● Signage for food outlet, seating areas, exits
(8)	● Wooden picnic tables outdoors

Table 6.3.7 Pan Harvest's alignment with objectives

Objectives	**Design Strategies**
(A)	● Online order pickup window.
(B)	● Recycled material containers and utensils.
(C)	● Communal tables in the Courtyard encourages group dining
(D)	● Regulatory standards and training from franchise.
(E)	● 1100mm Walkway with ramp [27] ● Multilingual digital platform.

(F)	● Native plants for improved indoor air quality [44]: ○ Sweetgrass. ○ Maidenhair Fern
(G)	● Smart Chicken offers two options for each dietary restriction. [45]
(H)	● Indoor vertical plant walls [38]: ○ Eastern Red Columbine ○ Bittercress.

6.4 Proposed Conceptual Design Specification

Pan Harvest excelled in most design metrics and was selected as the best design.

Benchmarking against Sid's Cafe and food trucks along St George., Pan Harvest matched Cook-it Box but outperformed Commons Patio (Appendix G.2, G.4.3). A Pugh Chart confirmed Pan Harvest as the best choice (Appendix G.2, Figure G.2.4). Key benefits include:

- Local and fresh ingredients
    - Sourced from greenhouses and local farms
    - Promotes sustainability and health
- Community-centred design
    - Indigenous artwork
    - Inclusive space
- Sustainability
    - Composting food waste
    - Native plants garden
- Accessibility
    - Tactile tiles, ergonomic furniture

Trade-offs compared to Cook-it Box and Commons Patio include:

- Operational complexity
    - Requires staff training and management
    - Season-dependant produce has supply risks
- Energy consumption
    - Greenhouse and solarium require more energy than systems like Cook-it Box
- Meal preparation
    - Slower meal assembly compared to Cook-it Box and Commons Patio

In summary, Pan Harvest best aligns with the project's gap and needs while complying with constraints. While Cook-it Box offers convenience and Commons Patio leverages a well-known restaurant chain, Pan Harvest fosters more meaningful community engagement, overall best meeting the objectives.

7.0 Conclusion

This project bridges the gap in publicly available food access for Bahen Centre users by redesigning the courtyard and indoor area with accessible food service. The scope includes the Bahen Centre's first floor, southern courtyard, and walkway to College St.

Three feasible alternative designs are proposed, each carefully considering the project requirements and FOCs.

Cook-it Box offers fast access to pre-made food boxes and online subscription to healthy meal-prep kits. It includes a vending machine with microwaves and hot water dispensers in the current Cube area.

Pan Harvest was chosen as the final design due to its locally sourced food, customizable food options, use of existing facilities, and solarium for gathering and dining, thus meeting all project criteria.

The Commons Patio proposes a student-staffed Smart Chicken franchise. This option will install a service counter, service windows, and eight-seat tables with illuminated umbrellas in the courtyard.

With fully defined alternate solutions, the next steps would be to affirm associated costs and implement the chosen design.

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Appendix A: Problem Statement

Appendix A.1

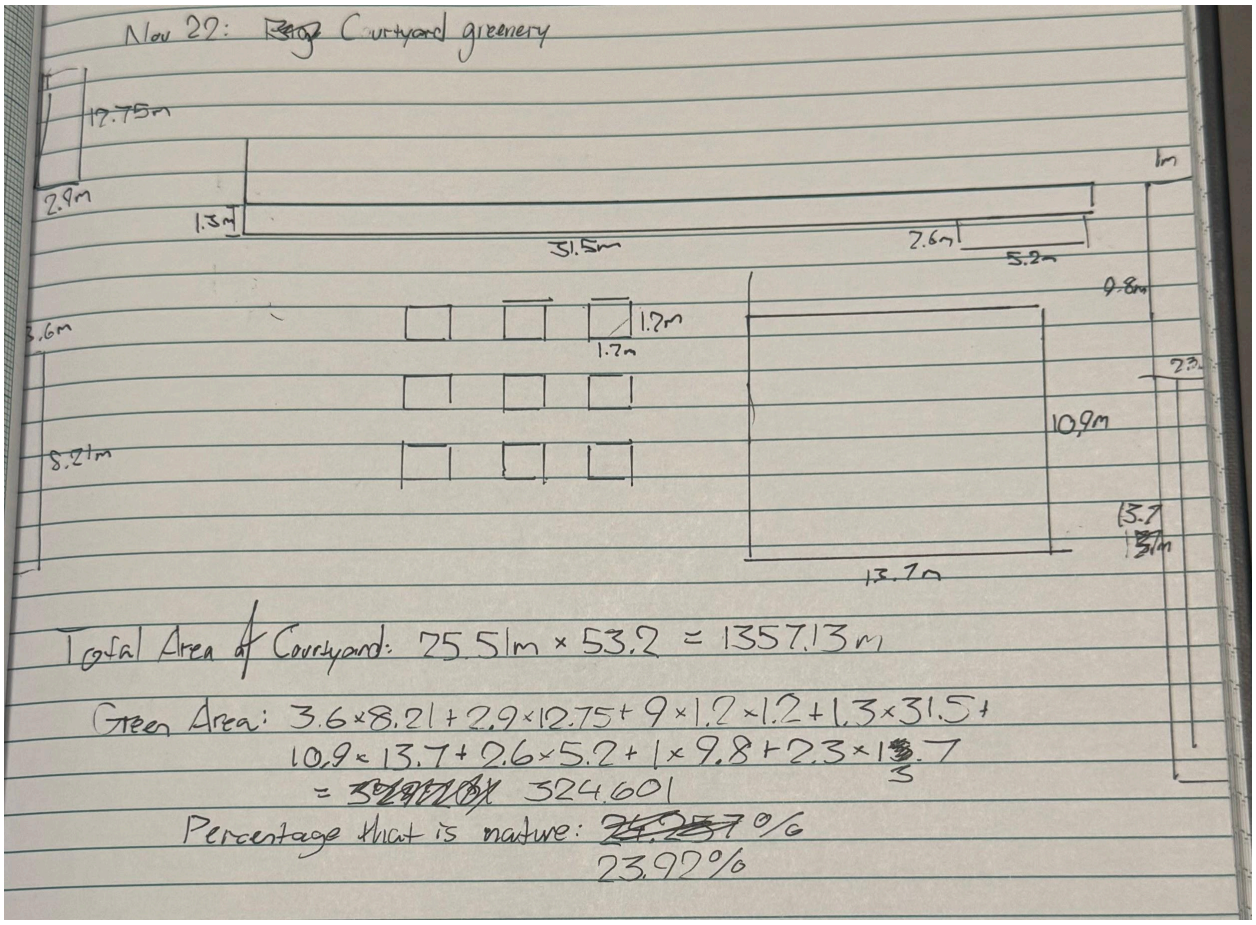

Figure A.1.1. Observations taken in engineering notebook on Friday, November 22 for measurements on greenery and calculations to determine the percentage of greenery in Bahen Courtyard.

Appendix A.2

Physical boundaries listed by the client statement and observed in person, shown in Figure A1:

- South end of Bahen's first floor
    - *Major changes to infrastructure are out of scope*
- Bahen courtyard + walkway
    - Surrounded by Bahen Centre, Fields Institute, Student Commons and Koffler Student Services Centre
- Avoid modifying water cisterns
    - Can cover it

Other boundaries, not just limited to physical, through observation and analysis of the site

- Bound by:
    - *Sustainability: Sustainability must be maintained*
        - *Cutting down trees are out of scope*

        - *Waste Management: Users' must have access to disposal methods*
        - *Distribution of Food: Sourceable/Less Waste*
    - Utilities: Major expansions to utilities are out of scope (electricity, water, gas)
        - Must integrate existing utilities using minimal expansions
    - Labour Considerations: Workers' jobs must be feasible
        - Food Workers: Handling of Food, Production of Food
        - Maintenance Workers: Maintaining grass, Cleaning area
    - Accessibility
        - Pedestrians: Walkable, Consideration for the less fortunate
        - Bicycles
        - Non-discriminatory
    - Nature
        - Weather: Design must be functional in downtown Toronto weather year-round
            - Wind
            - Temperature
            - Rain/Snow: *Ties to v.2. Maintenance*
        - Fauna: Animal-Friendly
            - *Death to insects*
        - Flora: Bound by effects of nature
            - See Trees…
            - Ties to v.2. Maintenance
            - Natural degradation (ie. find materials that degrade less)
                - Corrodibility
                - Oxidization (Rust)

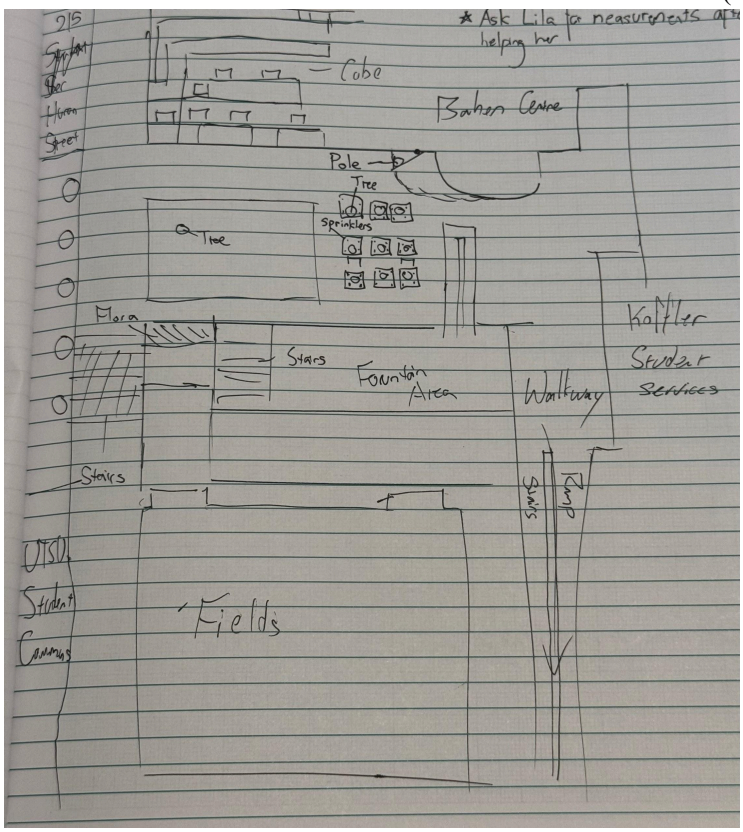

Figure A.2.1. Observations taken in engineering notebook on Friday, October 11, during site visit.

Appendix B: Service Environment evidence and photos on site

The information gathered during two separate site visits with photos taken at the locations. Along with measurements taken in the engineering notebook (Figures B1, B2 and B3) considering the exact numbers for materials to be looked after such as safety considerations as well as living creatures, shown in Figure B4 and Figure B5 and virtual considerations. Pre-existing machines, such as the weatherproof outlet (Figure B6), regular outlets inside the Cube (Figure B7) and infrastructure (Figure B8) are also documented and photographed to help identify which materials may be reused.

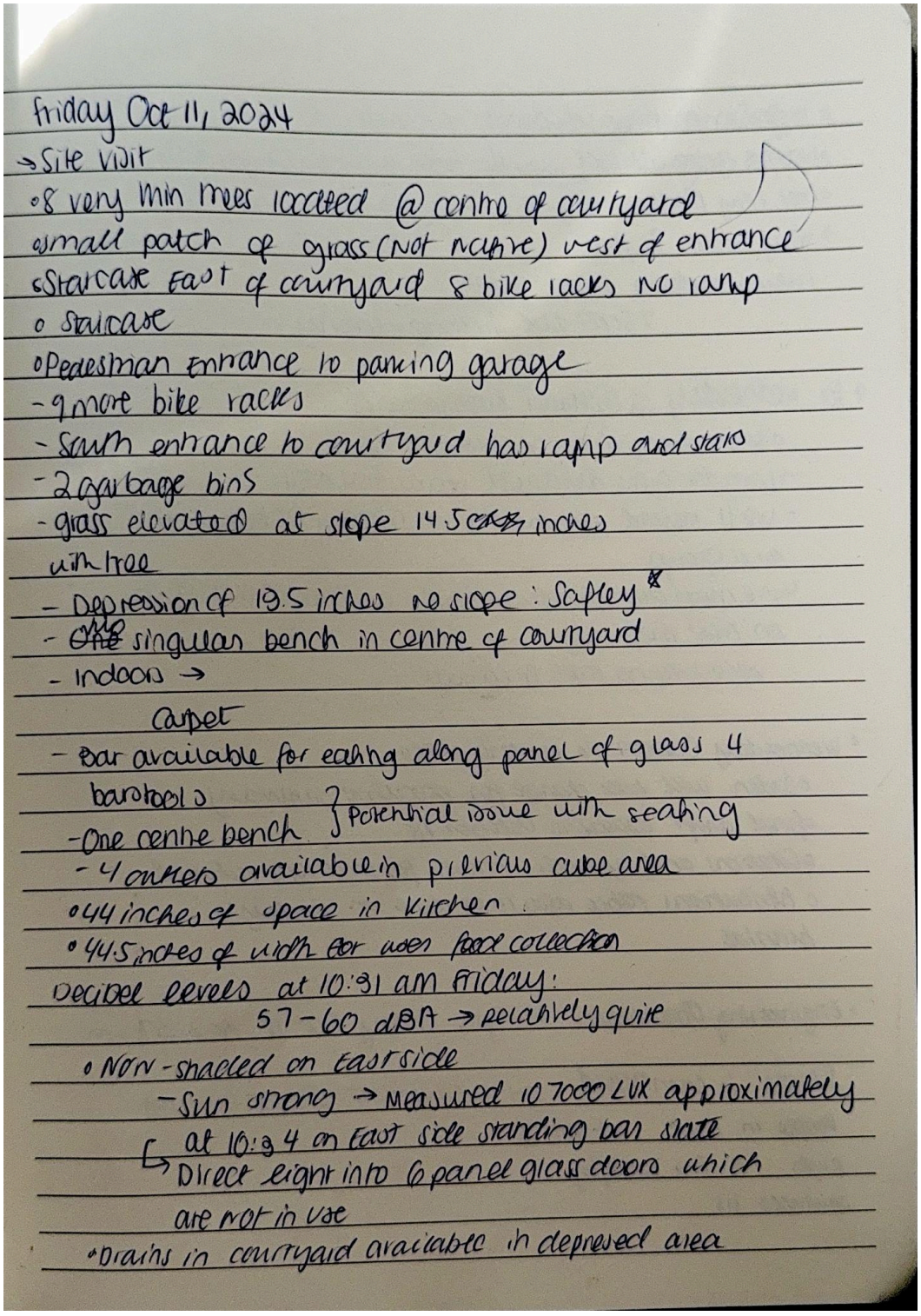
Friday Oct 11, 2024
→ Site visit
• 8 very thin trees located @ centre of courtyard
small patch of grass (Not native) west of entrance
• Staircase East of courtyard & bike racks NO ramp
• staircase
• Pedestrian entrance to parking garage
- 9 more bike racks
- South entrance to courtyard has ramp and stairs
- 2 garbage bins
- grass elevated at slope 14.5 ~~cm~~ inches
with tree
- Depression of 19.5 inches no slope : Safety
- ~~One~~ singular bench in centre of courtyard
- Indoors →
carpet
- Bar available for seating along panel of glass 4 barstools
- One centre bench } Potential issue with seating
- 4 outlets available in previous cube area
• 44 inches of space in kitchen
• 44.5 inches of width for user food collection
Decibel levels at 10:31 am Friday:
57 - 60 dBA → relatively quite
• NON-shaded on East side
- Sun strong → Measured 10 7000 LUX approximately at 10:34 on East side standing bar state
↳ Direct light into 6 panel glass doors which are not in use
• Drains in courtyard available in depressed area

Figure B1. Observations taken in engineering notebook on Friday October 11, during site visit at 10:31 pm

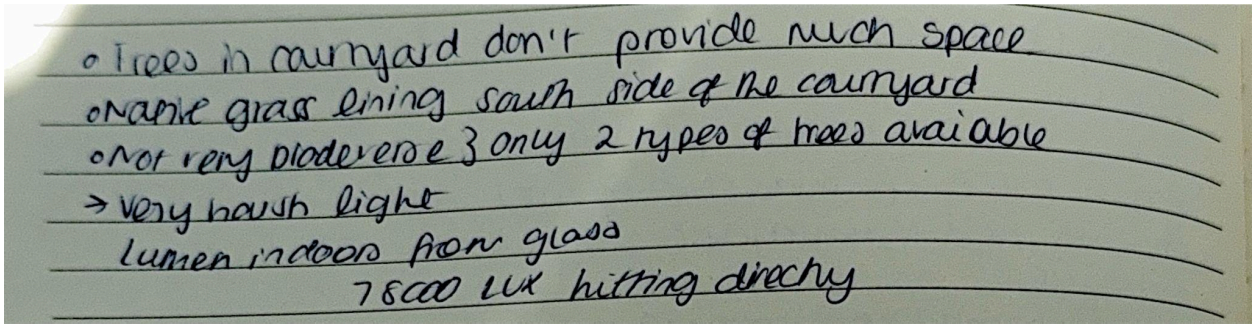

Figure B2. More Observations taken in engineering notebook on Friday October 18, 2024 at 10:31 am

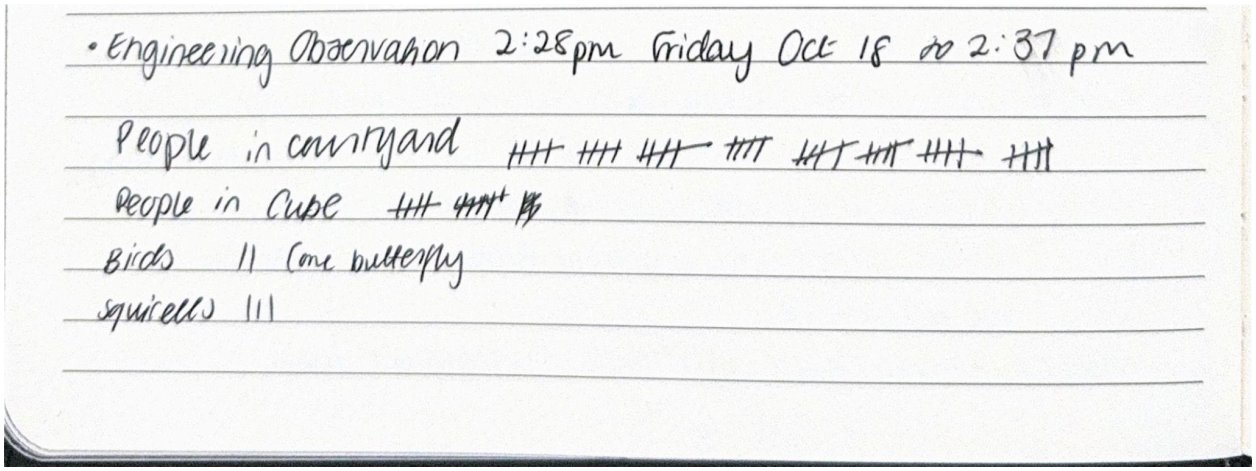

Figure B3. Observations taken in engineering notebook on Friday October 18, 2024 from 2:28 pm to 2:37 pm

Figure B4. Squirrels observed in Bahen Courtyard during site observation Oct 18, 2024.

Figure B5. Pigeons observed in Bahen Courtyard Oct 18, 2024.

Figure B6. Electrical receptacle (GFCI outlet) with weatherproof cover for outdoor Courtyard.

Figure B7. Outlets seen in the “Cube” during site visit Friday Oct. 11, 10:31 am.

Appendix C: For Stakeholders

This Appendix provides additional information about the research process and drafting of potential stakeholders alongside their impact and influence.

Potential stakeholders and their impact and influence:

1) Food vendors and service provider near Bahen Centre
    - Increased competitions
    - Possible partnership with the food outlet
    - Could be beneficial as there are more foot traffic

2) Users of the multi faith prayer space
    - Increase in noise and foot traffic
    - Reduced privacy
    - Busy entrance and exit points

3) UofT Clubs and Student Organizations

4) Waste Management Services (Outside/UofT)

5) Users of the Underground Parking in Bahen Centre
    - 215 Huron St, Toronto, ON M5S 1A2
    - Total 370 spots available all-day from monday to sunday
    - Change in traffic flow

6) Office users near Bahen Centre
    - Disturbance when the site is under/after construction

7) Security and Safety Teams of UofT
    - Provide additional security patrol for that area
    - Day + Night

8) Passersby:

a) Cars
b) Bikers
c) Pedestrian

9) Road users on Huron Street/ St. George Street/ College Street
    a) Increased traffic flow
        i) Longer waiting time for right turn due to increased foot traffic (crossing of St. george Street and Huron Street)
        ii) Increased number of on-street parking?
            (1) Vision block/narrow roads
            (2) Potential safety hazards due to higher foot traffic

    b) Residence nearby
        i) Noise pollution
        ii) Light pollution
        iii) Rodents

10) Koffler Student Services and Fields Institute
    a) Increased foot traffic, noise

11) Engineering Science Office (locate in the Bahen Centre)

12) Financial Department of UofT
    a) Oversee budgeting and resource allocation

13) The indigenous community

14) Accessibility Office

15) Facilities and Service Department of UofT

16) UofT Book Store

Appendix D: Function Identification Methods

The techniques used for discovering and developing primary and secondary functions are the techniques adapted from the lectures and reading. Figure D1 shows the results of brainstorming using the Functional Basis technique and merging/narrowing down the ideas to 2 distinct primary functions.

Functional Basis Teachnique

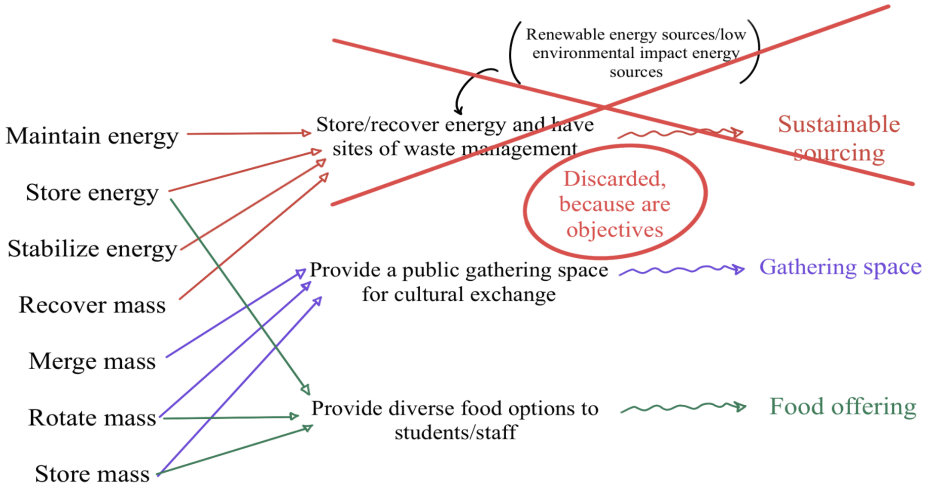

Figure D1. Three primary functions identified using Functional Basis technique including points discarded during revision.

Figure D2 illustrates the HOW-WHY TREE that was built in the process of identifying supplemental (secondary) functions and is particularly useful in showing the important relation/connection between the primary and secondary functions of the project requirements including ideas discarded during revision and newly added ideas in yellow.

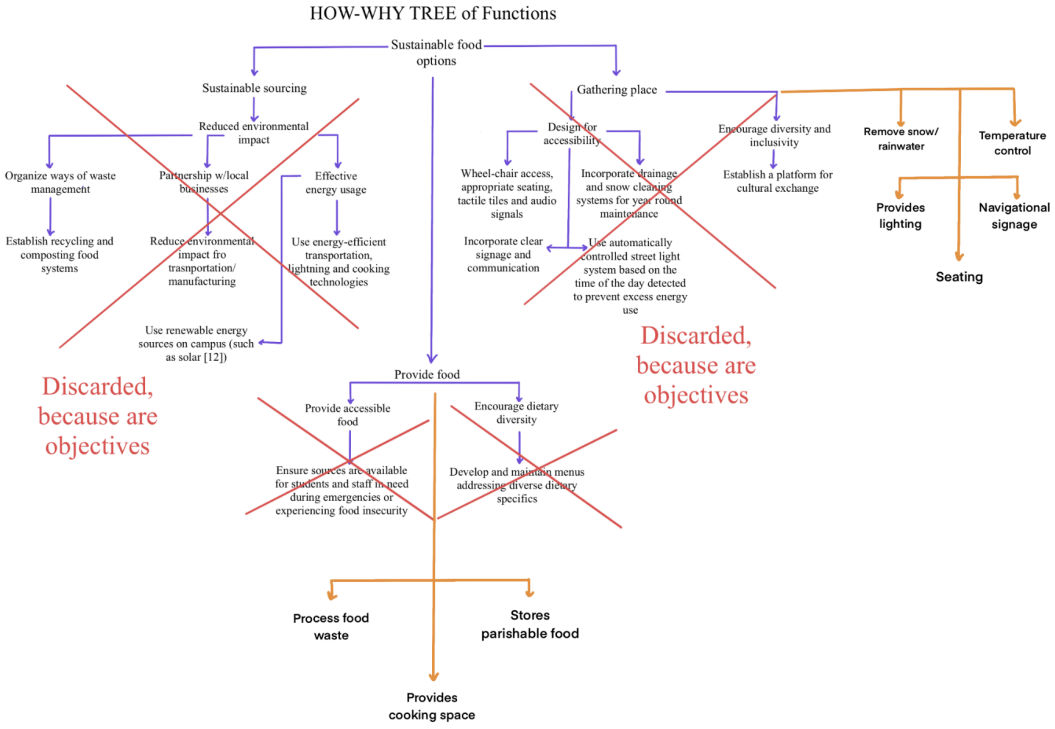

Figure D2. The secondary functions identified using HOW-WHY TREE showing clear connection to particular primary functions including the discarded and newly added branches in yellow.

Appendix E: The Sustainable Development Goals list

The list of goals out of the 17 Sustainable Development Goals [14] mentioned during the Client Interview to be prioritised by the client. This list was used to help evaluate the relevance of objectives identified previously. The numbers each correspond to a specific Sustainable Development Goal[14].

The prioritised sustainability goals stated by the client during the Client Interview:
3 - Good health and well-being
10 - Reduces inequality
11 - Sustainable cities and communities
12 - Responsible consumption and production

Appendix F: Constraints

Appendix F.1

Combustible framing within 450mm of cooktops shall have separation with fire-resistance (Appendix F.1) not less than 9.5mm gypsum board [19]

Indoor/outdoor separations shall have *fire-resistance* of $\geq$2 hours and 1.5 hours , respectively.

Fire resistance rating, as defined by the Ontario Building Code (O Reg 332/12), is the time in hours that a an assembly will withstand the passage of flame and the transmission of heat when exposed to fire under specified conditions of test and performance criteria [21]

Appendix F.2

Class K extinguishers are extinguishers that are able to suppress Class K fires. These fires, as defined by the Ontario Fire Code (O Reg), involve combustible cooking media such as vegetable and/or animal oils and fats. [27]

Appendix F.3

The notes taken from the client Q&A to the question concerning budget are shown in figure F.1. Note the mention of catering to dietary restrictions

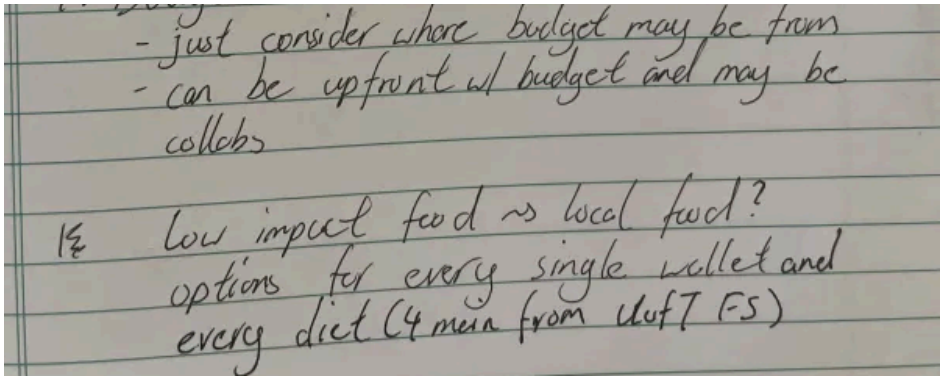

Figure F.1 Brief notes of the client's answer to a question addressing budget concerns. Note that towards the end of their answer, it was mentioned that the four dietary restrictions described by U of T food services should all have options.

Appendix F.4

Shown below is the rough brainstorming work that was consolidated into the Constraints subsection

* The University is known as "The Governing Council of the University of Toronto (Ontario Corporation No. 100478)" as it is a corporation continued by an Act of the Legislative Assembly of Ontario https://legal.utoronto.ca/faq/

- Codes and standards
    - Must adhere to O. Reg. 493/17: FOOD PREMISES
        - Ontario Food Premises , enforced by Ontario gov, about safety inspections, hygiene requirements, etc
        - Source: https://www.ontario.ca/laws/regulation/170493
    - Excluded from bylaw 841 since 1. Bahen's first floor is big 2. UT has their own services
    - Not necessarily excluded from bylaw 68-2024 (the single use one), but that deals with more of service behaviour of the place rather than building codes

- Building code https://www.ontario.ca/laws/regulation/120332
    - 3.7.6.1 - 3.7.6.7 Food Premises
        - "floors and floor coverings shall be *tight*, *smooth* and *non-absorbent* in rooms" where consumption, processing, washing, toilet

    - 3.8.1 - 3.8.2 Barrier free path of travel
        - 3.8.1.3
            - "every barrier-free path of travel shall provide an unobstructed width of at least 1 100 mm for the passage of wheelchairs" with minor exceptions
        - Table 3.8.2.1 shows the accessibility requirements for seating areas

Item	Column 1 Number of Fixed Seats in Seating Area	Column 2 Minimum Number of Spaces Designated for Wheelchairs	Column 3 Minimum Number of Fixed Seats Designated for *Adaptable Seating*
1.	Up to 20	2	1
2.	21 to 40	2	2
3.	41 to 60	2	3
4.	61 to 80	2	4
5.	81 to 100	3	5
6.	Over 100	3% of the seating capacity	The greater of 5 seats or 5% of the aisle seating capacity

        - Et al. mainly if we decide to consider designs with elevation or washrooms

    - 9.10 Fire Protection
        - 9.10.22 Cooktops
            - Cabinets above cooktops >= 750 mm above
                - 600 if non combustible or protected by metal hood with 125mm projection
            - Combustible wall framing within 450mm (sphere) of cooktop location shall be protected by something with fire resistance >= that of a 9.5mm gypsum board

        - (within buildings) 9.10.9.11
            - live/work units shall be separated from other major occupations by a fire separation having a fire-resistance rating of not less than **2 h**.

        - 9.10.9.16
            - a *storage garage* shall be separated from other *occupancies* by a *fire separation* having not less than a **1.5 h** *fire-resistance rating*

        - 9.10.9.6 a *very* long list of fire separations, with stuff like electronics, tubing, chimneys, outlet boxes

- UT administration codes
    - **Must** include food options for all dietary restrictions (mentioned during 10/09 Q&A)
        - https://foodservices.utoronto.ca/

        - Vegan
          In sum, no animal products/derivatives. Align with VegeCert
          https://foodservices.utoronto.ca/vegan/

        - Vegetarian
          In sum, no animal meat. UofT wants ovo-vegetarianism: yes eggs but no dairy products, such as milk and cheese and other animal products resulting from slaughter

https://foodservices.utoronto.ca/vegetarian/

- Kosher
  Prepared in a *kosher kitchen* (?) only meat allowed are from animals that have split hooves who chew their cud
  https://foodservices.utoronto.ca/kosher/

- Halal
  Contain only ingredients that are completely permissible for ingestion by Islamic faith and have not come into contact with non-halal food.
  https://foodservices.utoronto.ca/halal/

Appendix G: Alternative Designs Generation and Selection

Appendix G.1

Table G.1.1 50 ideas of free brainstorming. Highlighted yellow are the main aspects of each design

Number	Idea	Description	Multivoting (First letter of your name)
1	Solar powered induction hotpot	• Place hotpot in the cube to serve food • Meets primary function of serving food, meets secondary function as it's solar powered using solar panels • Enclosed serving area in the cube • Meets a secondary function of dietary diversity by dividing the pots and cutlery • Provides a gathering space facilitating socialization addressing the primary function	L
2	Self-serve vending stations	• Vending machine with non-perishable food items • Takes minimal spaces leaving for area for multiuse by clubs or for hosting events • Minimises waste that gets created while serving the food • Eliminates the problem of staff hiring and therefore is budget	M J A C S

		friendly ● Motion sensor light ● Amenities for cooking the food are available ○ Hot water dispenser ○ Microwave ● Edible utensils	
3	Reopen the Cube with old menu	● Reopen the cube facilities ● Student-run food services ○ Serving/cooking food	
4	Conveyor Belt Service	● Conveyor belt service from inside Cube kitchen, with food available to be ordered online through an app ● Food is freshly prepared inside the Cube by order ● Reduced staff - only cooking staff	
5	Daily organized picnic	● Community gathering event ● Everyday, depending on weekday/weekend/holiday, 1-3 community picnic times are organized where students eat together ● Food is provided by staff organizer of program	
6	Daily Pan Station	● Flexible station that cycles through different meals daily - promotes cultural diversity ● Benchmarked from Chestnut cafeteria ● Outsourcing washing ● Induction heating elements	M A J C
7	Combination of pan station and self serve	● Self serve open 24/7 ● Pan station allows unique options and hot food ● Self serve minimises waste and offers flexibility to support clubs ● Pan station sources food from a nearby cafeteria (40) → acts as a secondary	M L A S
8	Self-Serve Baked Goods	● Premade variety of bakery items with gluten-free… ○ Satisfies varies dietary	

		restrictions ● Maybe also offer coffee ● No worker required	
9	Portable tapas stations	● Small plates of different food are served ○ Can cater to different dietary needs ○ Can be cooked using solar powered stoves	
10	Partnership with Popular Food Chain + food court style seating	● Survey Bahen users about their favorite place to eat ● Partner with most popular food chain ● Convert cube space to facilitate the station ● Perhaps another starbucks	J A S C
11	Partnership with food trucks	● Sector-based collaboration to decrease distance to food trucks and increase service speed ● Involves getting food from further food trucks and serving at peak times to reduce overall wait time vs without this option ● Would be manned and served in Cube indoor area	
12	Convenience Store	● Stocked convenience store to provide food plus some essentials for students (e.g. stationary) ● Pre packaged food, similar to that provided at Hardhat Cafe	
13	Pre-packed food fridge	● Self-serve fridge with pre-made food ○ Salads, sandwiches, sushi, etc ● Workers at cashier station ● Do NOT require reheating	
14	Drone powered delivery	● Drones to deliver food, ordered on a mobile app ● Requires also installation of landing pad/landing area ● Would not increase foot traffic	
15	Food court	● Combination of indoor and	M

		outdoor food stations ● Includes mainly local vendors ● Includes self serve. Microwaves and sufficient seating	L
16	Smoothie bar	● Customizable healthy smoothie making station ● Possibly self service ● Indoor facility to utilise pre existing cube facilities	
17	End-of-day sales (discounts)	● Utilises perishable items ● Addresses the emergency food offering listed in secondary functions ● Solves the food waste issue while maintaining sustainability ● Student discounts and loyalty programs (Ai generated)	S L THIS IS AN IDEA TO BE ADDED ON ALL IDEAS
18	Club sponsored food	● Completely student-run area that allows clubs to get some more funding ● Station would have essential equipment, such as fridges and basic heating methods available for clubs to use ● Station would be available to be booked online	
19	Single truck delivery	● Users can order food on an online app from restaurants close by ● On specified times (eg. 1PM, 6PM), the truck will have picked up all the food from local restaurants and deliver in bulk to Bahen Centre ● A few workers required, to collect some food on foot, drive and organize distribution	
20	Late-Night Hot Chocolate bar	● Late night hot chocolate available in a self-serve fashion	
21	Self-serve instant ramen bar	● Variety of instant ramen offered ● Microwaves and water provided	
22	Fully autonomous cooking area	● Meals are prepared by robotic arms	

		● Provide customizable meals	
23	Vegan Food/Salad Bar Stations	● Plant-based food options in self-serve stations and pan station ● Self-serve vegetables similar to ones in buffets	
24	Library cafe	● Provides a number of entertainment/books ● With a small cafe operated indoor	
25	Courtyard Co-op	● Restaurant operated by co-op students	
26	Flexible cooking area	● Flexible food production easily utilized by clubs and organizations to easily used ● Need some way to minimize food waste → perhaps review of food production before set up	M
27	Hot dog stand	● Barbeque hot dogs ● Condiment table ● Similar to hot dog stand outside of Syd smith	
28	Fold-out prep station	● Pop-up cooking counters that expand for larger events and fold back for everyday use in the Bahen courtyard	
29	Lessons & Cycles of Food	● Biweekly lessons for basic recipes and how to cook them ● Throughout the week, ingredients in groups would be for purchase, with accompanying cooking equipment ● Competition with small prize for biweekly	
30	Mobile order food service	● Has app that allows people to order through devices & notifies when done ● Delivers via apps ● Gets food from close-by UT cafeterias	

31	Street food	• Recreate a street market in Bahen courtyard that provides street food from different culture	
32	Meal subscription	• Users can subscribe to a monthly meal plan that includes discounts or meal credits	
33	Edible packaging	• Food served with edible wrappers/ containers	
34	Courtyard picnic zone	• Increase green area in the courtyard • Small stalls selling simple sandwiches/wrap/taco (picnic kit)	
35	Left-over meal	• Utilize left-overs from nearby campus cafeteria to create meal/lunch boxes	
36	Grain and legume bowls	• Base meals on non-perishable staples like rice, quinoa, or lentils, paired with fresh toppings	
37	Finger food platters	• Offer sliders, pizza bites, or stuffed veggies designed for utensil-free dining	
38	Dedicated dietary station	• Separate zones for different dietary restrictions	
39	Local Food drive	• Non-perishable foods donated by and received by local students. • Includes heating/basic cooking area • E.g. instant ramen, snacks, etc	
40	lunch boxes from the nearest campus cafeteria	• Lunch boxes are made by the nearest campus caf and transport to bahen centre	C
41	Garden in the courtyard to provide fresh fruits and vegetables	• Farming and garden space in greenhouse outside in Bahen courtyard	
42	3D print food		

43	Copilot generated ideas - Hydroponic and Vertical farming	• Set up hydroponic farms in unused indoor spaces or rooftops fresh produce regardless of weather conditions and supply the food • Vertical gardens on building exteriors in the courtyard (decorative and functional)	
44	Copilot generated ideas - Fusion Hub retractable roof for outdoor seating	• Host indoor outdoor style restaurant/ cafe	
45	Copilot generated idea - digital menu restaurant with farm to table seasonal produce which is locally sourced	• “Interactive digital menu which display nutritional information and ingredient sourcing”	J
46	Copilot generated idea - CSA boxes a partnership with local farmers to offer subscriptions for students and faculty	• Students and community members can subscribe to receive weekly or biweekly boxes • It would have designated convenient pickup spots and the rest of the space could be redesigned for seating, cooking and reheating the food.	L
47	Copilot generated ideas - Cooking classes and demonstrations	• Special dining events to be hosted with partnered chefs to learn about ingredients and watch their meals be prepared • Live demonstrations to be heald to teach students how to prepare food	
48	Copilot generated ideas - Food sharing platform	• App where students and local businesses can share surplus food. Reducing waste and ensuring excess food is redistributed	
49	Student run restaurant (+46 sourcing by partnership with local farmers)	• Part Time positions for students to offer basic cooking at a reduced price • Cheaper food due to lower quality of food but basic variety available	S L
50	Robot service for indoor	• Small robots which serve pre	A

	outdoor styled restaurant	prepared food to students who order online for indoor and outdoor community dining	J

Table G.1.2. 50 solutions sorted by their primary approach

Categories	**Solutions**
Sector-Based (Partnerships)	10. Partnership with Popular Food Chain + Food Court Style Seating 11. Partnership with Food Trucks 40. Lunch Boxes from the Nearest Campus Cafeteria 46. CSA Boxes Partnership with Local Farmers 45. Digital Menu Restaurant with Farm-to-Table Seasonal Produce 48. Food Sharing Platform
Educational-Based	29. Lessons & Cycles of Food 41. Garden in the Courtyard 47. Cooking Classes and Demonstrations 49. Student-Run Restaurant 30. Mobile Order Food Service (with educational integration) 6. Daily Pan Station
Technological-Based	4. Conveyor Belt Service 14. Drone-Powered Delivery 22. Fully Autonomous Cooking Area 42. 3D Print Food 50. Robot Service for Indoor-Outdoor Styled Restaurant 7. Combination of Pan Station and Self-Serve

	28. Fold-Out Prep Station 43. Hydroponic and Vertical Farming 2. Self-Serve Vending Stations 33. Edible Packaging
Community-Based	6. Community-Based 1. Solar-Powered Induction Hotpot 3. Reopen the Cube with Old Menu (Student-Run) 5. Daily Organized Picnic 18. Club-Sponsored Food 25. Courtyard Co-op 34. Courtyard Picnic Zone 26. Flexible Cooking Area 17. End-of-Day Sales (Discounts) 35. Left-Over Meals

Table G.1.3. A morph chart, used to start thinking about solutions to each objective/function

FOC	**Means**	**Means**	**Means**	**Means**	**Means**
Using established recycling & composting systems	Sectioned trash cans	Battery/electronics bins	Food waste areas and bins	Design has easy to use trash disposal via current systems	Acknowledge current systems' requirements
Clear signage	Neon/contrasting colours	Avoid foliage	Indoors and outdoor weatherproof signs	Online signage (Insta, website, etc)	Use existing poster walls
Minimize waste	Avoid producing waste	Publically inaccessible single use plastics	Convenient trash cans (avoid littering)	Reusable items	Reward for returning items (plates)
Provides	Wide	Methods of	Dedicated	Features for	Ordering

accessible mobility	walkways	ascension other than stairs	seating areas	doors	counters not exceedingly tall

Appendix G.2

Figure G.2.1. Graphical Decision Chart with waste management and provides options for all four dietary restrictions as its axes

Figure G.2.2. Graphical Decision Chart with flexible layout and ease of use as its axes

Figure G.2.3. Pugh chart comparing the three selected solutions to the 8 objectives that has been prioritized.

	Cook-it Box (Standard)	Pan Harvest	Patio Commons
Time-efficient interaction with food service (1)	0	-1	-1
Minimize waste production (2)	0	1	-1
Supports group gatherings (3)	0	1	1
Minimal damage to utilities in food center (4)	0	-1	-1
Facilitates people with mobility challenges (5)	0	0	0
Maximize energy efficiency (6)	0	0	-1
Addresses dietary restrictions (7)	0	1	1
Support native plants/grasses and wildlife health (8)	0	1	1
Total	0	2	-1

Figure G.3.1. Benchmarking table comparing the three selected solutions against St. George Food Trucks and Sid's Cafe to the 8 objectives that has been prioritised

	St George Food Trucks	Cook-it Box	Pan Harvest	Patio Commons
Time-efficient interaction with food service (1)	S	1	-1	1
Minimize waste production (2)	S	1	1	-1
Supports group gatherings (3)	S	0	1	1
Minimal damage to utilities in food center (4)	S	-1	0	0
Facilitates people with mobility challenges (5)	S	1	1	1
Maximize energy efficiency (6)	S	1	1	-1
Addresses dietary restrictions (7)	S	1	1	1
Support native plants/grasses and wildlife health (8):	S	1	1	1
Total		5	5	3
	Sid's Cafe	Cook-it Box	Pan Harvest	Patio Commons
Time-efficient interaction with food service (1)	S	1	-1	-1
Minimize waste production (2)	S	1	1	1
Supports group gatherings (3)	S	-1	0	1
Minimal damage to utilities in food center (4)	S	1	0	0
Facilitates people with mobility challenges (5)	S	0	0	0
Maximize energy efficiency (6)	S	1	1	1
Addresses dietary restrictions (7)	S	0	0	0
Support native plants/grasses and wildlife health (8):	S	0	1	1
Total		3	2	3
		8	7	6