Industrial Design Engineering in Three Projects

A Thesis

Presented in Partial Fulfillment of the Requirements for the

Degree of Master of Arts

with a

Major in Interdisciplinary Studies

in the

College of Graduate Studies

University of Idaho

by

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April 2015

Authorization to Submit Thesis

This thesis of Andria Wallace, submitted for the degree of Master of Arts with a Major in Interdisciplinary Studies and titled "Industrial Design Engineering in Three Projects," has been reviewed in final form. Permission, as indicated by the signatures and dates below, is now granted to submit final copies to the College of Graduate Studies for approval.

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Abstract

The interdisciplinary degree combining the fields of mechanical engineering and design addresses the concept of intersecting aesthetics and functionality, known also as industrial design. It demonstrates how both fields inter-relate to solve problems and improve overall product design.

The design field contributes to the desirability of a product. It encompasses the contextual nuances of social impact, future implications, alternative perspectives, and ephemeral qualities. The engineering arena is predominantly problem-solving, and contributes attributes such as the functionality, durability, reproducibility of a product.

For this study, engineering and design combine to influence aspects of three projects: a coffee shop, an adaptive device, and two building entrances. Key attributes include the overall design, usability, aesthetic look and feel, technical requirements, production, and installation. Each of these projects exemplifies how the combined disciplines of mechanical engineering and design can be applied to solve problems and create or improve a product, at various scales.

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Chapter 1: Report I- Coffee Shop

Introduction

This project is to build a coffee shop within unused rooms of the Janssen Engineering building on the University of Idaho campus. The build-out requires working with the sponsor, building contractors, coffee bar builder, Sisters Coffee proprietors, and health inspectors.

Purpose of Study

The purpose of the project is to combine design and mechanical engineering to build a place for students to enjoy coffee, and that the space be congruent with the look and feel of the previously re-modeled Think Tank study area on the second level of the building.

Mechanical engineering contributes the base for information gathering of the space itself, such as dimensions, usable space, utilities, materials used for the ceiling, walls and floors, and fixtures. From that information, it's possible to define the method and scope of the project, and begin basic research. Defining scope, constructing requirement lists, addressing electrical and water requirements utilize tools learned in engineering coursework within the program. They are the tools used to begin solving the problem of creating a new product, in this case, a shop.

Design contributes the base for how to look at the shop from both the customer's and proprietor's perspectives. It addresses traffic flow, textures, materials used, the "look and feel", ambiance, and workflow. It defines the basic aesthetic and use of the space.

Design Method and Scope

Researching this project to define the method and scope includes

- Defining the space of the engineering building
- Interviewing the Sisters coffee shop owners
- Observing the Sisters coffee shop flow, patrons and processes
- Measuring the Sisters equipment and assessing electrical, water, and storage needs
- Comparing Sisters equipment and special needs to the Janssen building space
- Research aesthetic options to match the design of the Think Tank
- Finding a cabinet builder that can build the counter with chosen materials
- Discussing space, electrical needs, and water needs with construction workers
- Coordinating schedules with builders, Sisters, cabinet maker, and health inspectors
- Staying within $3000 budget

Background Research

Researching the project

Defining the usable space of the engineering building, rooms 111b, 111c & 113.

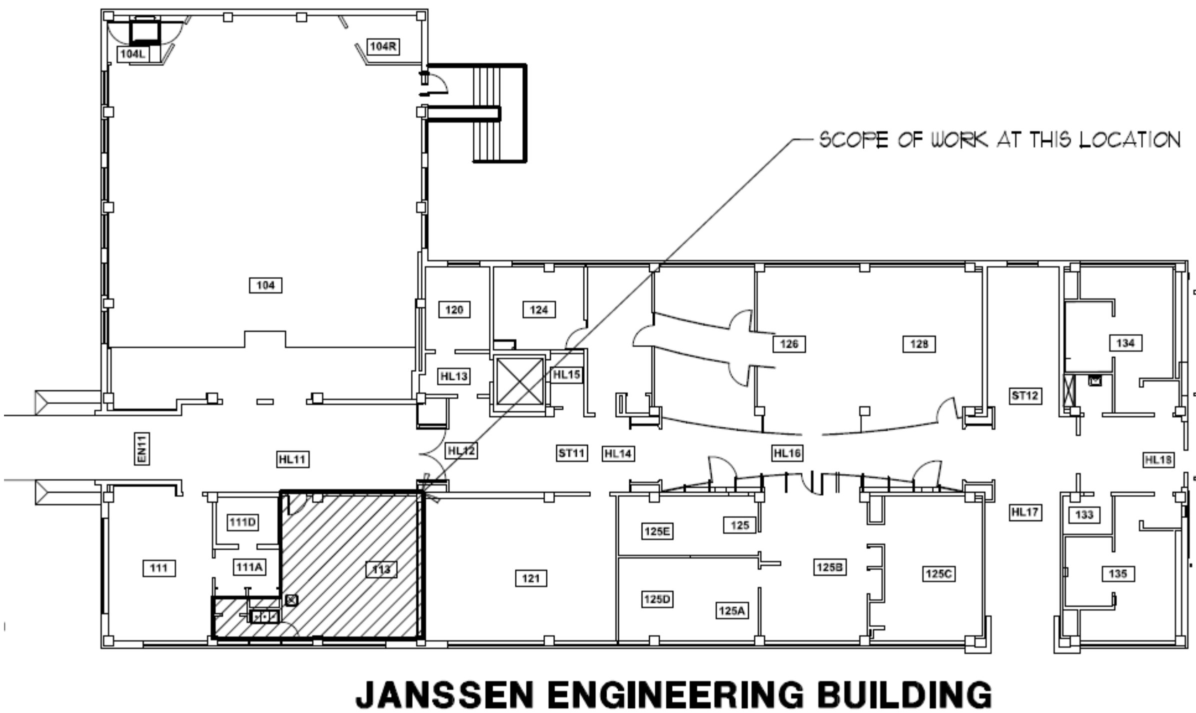


Figure 1 Project space

Measurements, blueprints (FIG. 1.), and observations are used to define the physical dimensions, water access, power access, room features, and usable square footage of the project space. Lighting, ceiling features, flooring, and outlets are also recorded (FIG. 2-3). Rooms 111b and 111c are spare rooms at this point.

Figure 2 Exterior and interior of room 113

Figure 3 Interior elements

The dimensions and features were drafted to enable an accurate design of the coffee counter, once determined. These aspects fall within the mechanical engineering discipline of the program.

Defining Requirements

Interviewing the Sisters coffee shop owners

The coffee shop will be managed by a company already doing business on campus, having multiple locations in Moscow. A meeting with the owners at their downtown location determined the basic requirements for the coffee shop counter to be built. They also require that the ambiance of their brand be maintained. Several interviews and visits to their downtown and campus locations enable me to define requirements and begin the design process. This is when the disciplines of engineering and design start to converge. Considerations for both physical and aesthetic elements and use of space must be met. The basic requirements include :

- Similar flow and size to current counter
- Similar height of counter (higher than the standard)
- Same or similar equipment for processing coffee, juices, teas, and food services
- Same or similar coolers and freezers
- Same space for coffee syrups, storage, equipment
- Same register and calculator size and layout
- Space for hot food plate
- Space for toaster and teas
- Space to add a refrigerator
- Add utility sink
- Add space for blenders

Development Process

Measuring the Sisters equipment and assessing electrical, water, and storage needs

Measurements were taken for the counter spaces (FIG. 4) as well as the equipment and food service items. Electrical specifications for each electrical appliance was recorded, as well as model numbers. The coolers and sinks were measured for water input, drainage, electric plug types, drain tube sizes, and configuration (FIG. 5).

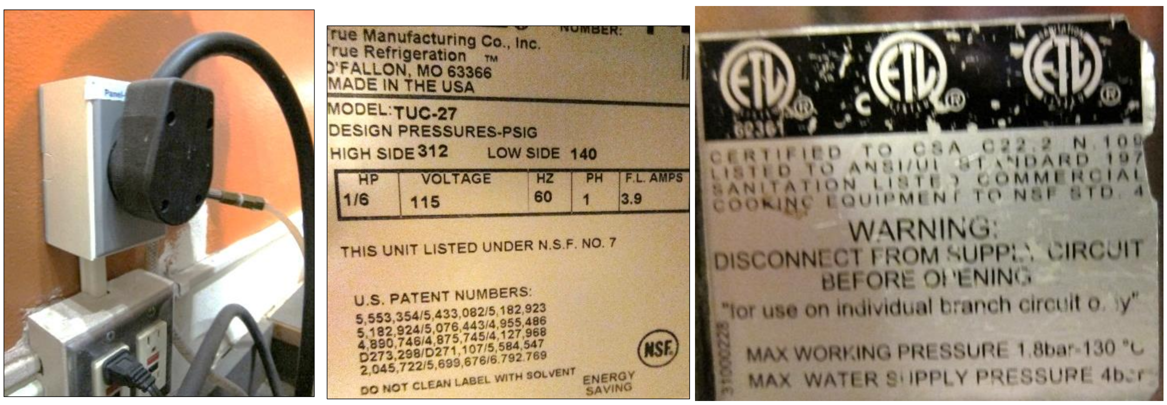


Figure 4 Details were recorded of electrical and water supply requirements for all equipment

To meet the builder's needs and schedule, a detailed list of electrical requirements was mapped (FIG. 6-8). This part of the process draws from the mechanical engineering discipline, addressing the nuts and bolts of physical, electrical, and water requirements that will become the base of the entire project. It is critical not just for the builders and to ensure all of the pieces fit as they should, but also to comply with state building codes and health codes. It is upon this base that the design and aesthetic elements can be built.

Figure 5 Sisters coffee shop, downtown Moscow

2 grinders, standard plugs,
110 volts 250 watts

Voltage (Volt)	220-380V	220-380V
Power (W)	3000	3000
Hint Installation		
Minimum Width	1100 (43 1/4")	1100 (43 1/4")
Deep (mm - inch)	600 (23 9/16")	600 (23 9/16")
Hight (mm - inch)	1040 (40 15/16")	1040 (40 15/16")
Hole Diameter	60 (2 5/16")	60 (2 5/16")
Max Dist. from Water Tap (mm-inch)	1000 (39 5/16")	1000 (39 5/16")
Pipe Connection	3/8"	3/8"
Max Dist. Discharge Conn.(mm-inch)	1000 (39 5/16")	1000 (39 5/16")
Max Dist. (mm - inch)	1000 (39 5/16")	1000 (39 5/16")
If 380 V	Trif. Con neutro	Trif. Con neutro
Ampere	14	14

Plumbing/drain required
Cold water supply and 220v 30amp (3400-4500w) electrical service required

220 / 30 amp....yes, a water supply (1/4 inch I think) and drain (3/4 inch I think)

merchandiser cooler:
Horsepower 1/3
Hz. 60
Voltage 115
NEMA config: 5-15P

ELECTRICAL

- Unit completely pre-wired at factory and ready for final connection to a 115/60/1 phase - 15 amp dedicated outlet. Cord and plug set included.

115/60/1
NEMA-5-15R

110/120 volts
ICB5 (Smoother18) 18 amps
2000 watts
110/120 VOLT BLENDTEC BLENDERS ARE REQUIRED TO BE PROTECTED BY A DEDICATED 20 AMP CIRCUIT BREAKER OR FUSE.

Figure 6 Partial list of detailed equipment list with power and water requirements

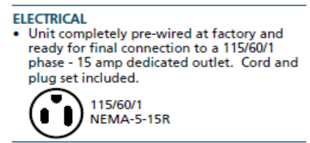
product	energy requirements	additional notes
coffee grinder #1	110 volts 250 watts	
coffee grinder #2	110 volts 250 watts	
espresso machine	Plumbing/drain required Cold water supply and 220v 30amp (3400-4500w) electrical service required	3/8" drain and water supply required
pepsi machine	merchandiser cooler: Horsepower 1/3 Hz. 60 Voltage 115 NEMA config: 5-15P	
smoothie blender	ICB5 (Smoother18) 18 amps 2000 watts 110/120 VOLT BLENDTEC BLENDERS ARE REQUIRED TO BE PROTECTED BY A DEDICATED 20 AMP CIRCUIT BREAKER OR FUSE.	
coffee brewer	Model: CBS-32Aap Volts AC: 120/208-240 Amps:17.3-19.8 KW: 3.5 - 4.7 Single Phase: 3+ Ground Wire	
coffee mill	Coffee mill: 120v/60/1-ph/ 9amps	
low fridge	requires 115V connection: 115 volts, 60hz, 1ph,3.9 F.L. amps	
register	standard plug	
calculator	standard plug	
card reader	standard plug	
microwave	Small microwave, std outlet, 1100 W	
toaster	toaster, std outlet	
warmer trays	220V-240V 50HZ, 200W	in wall with windows
standard 2-banger plugin	lamp	in wall with windows
standard 2-banger plugin	ipod	
standard 2-banger plugin	fan	
standard 2-banger plugin	extra	

Figure 7 Partial list of power needs for each piece of equipmen

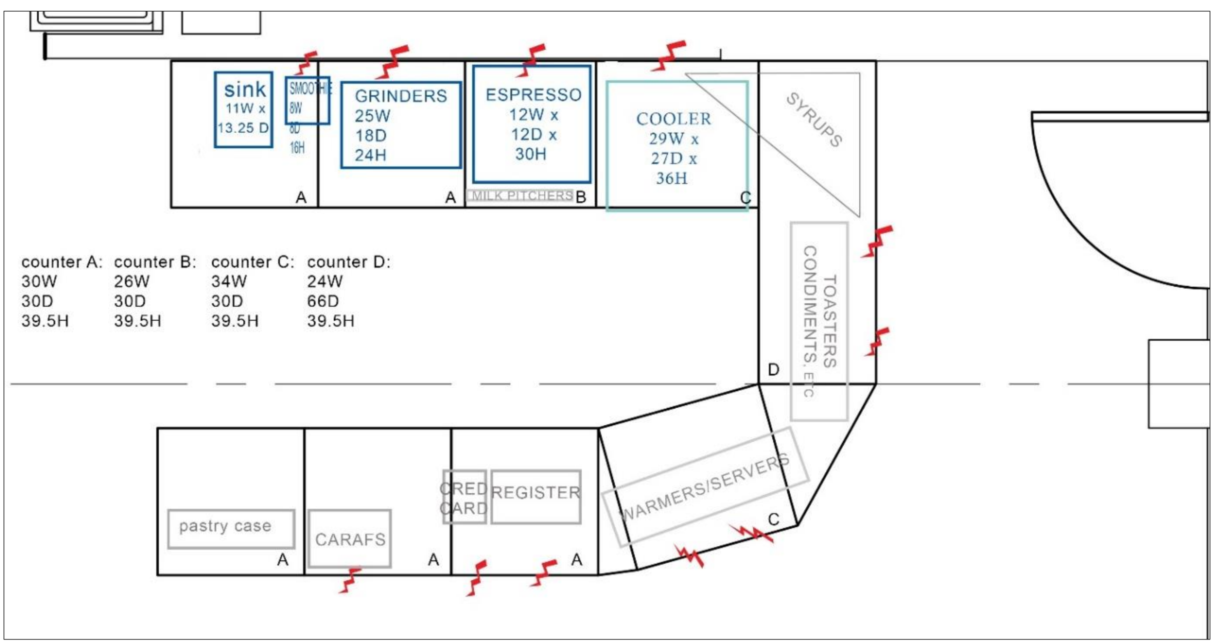


Figure 8 Partial map of power mapping with counter layout

With the basics defined, the builders could move forward to begin creating the space. Now more attention can be put towards the aesthetics. Design will contribute the base for the look and feel for the space, as well as the flow, the human factors elements, the materials used, material consistency, and overall ambiance. Design impacts behavior and patterns, and addresses potential problems or future needs. Gathering ideas for designs of the space comes from observation, research, sketching, and seeking best practices.

Observing the Sisters coffee shop flow, patrons and processes

A critical aspect of design is understanding and appreciating the ambiance of the Sisters coffee shops. They have a successful business because they have an inviting atmosphere that compels customers to enter and stay in their space to buy coffee and snacks. The setting is "homey", using warm colors, house plants, dark-colored rugs, art, and bucolic miss-matched furniture. Customers like to be there because it is relaxing and has pockets of comfortable meeting space.

The owners and baristas have years of experience using their production line, and attending to the needs of customers. Understanding how and why particular equipment is used, as well as equipment location, is key to creating and improving a new design. What may be a best practice for an ideal coffee shop in Seattle, may not be best (or even possible) for a coffee shop on a college campus, with outdated equipment. For instance, Sisters have tall counter height, which is simply a preference of the owners, who say it is easier on the back over long periods of time, and provides better viewing of the coffee-making process because of the viewing angle of their espresso machine production.

Observation reveals that the Sisters space is workable, but has great room for improvement of flow and use of space. The storage is disorganized. Items are over-stocked and not close to where they are used, necessitating extra movement (recalling an engineering principle of the 5 S's.) There are pieces of equipment in a back room, and along adjacent walls outside of the working area. The owners have reasons for the arrangement, such as limitations of space or accommodating equipment sizes and power outlets, but these limitations can be eliminated with an improved design.

The production flow is organized around the espresso machine and milk cooler. The espresso bean grinder is to the left, the milk to the right. The cash machine is to the far right, opposite the flow of customers. Thus, for one person to take an order and make a coffee, it requires travelling back and forth over the same area multiple times to make one drink. Customer flow is not obvious, signs above the counter help customers know where to order and where to pick up. There is no defined space for ordering or picking up, both require talking and reaching over a smattering of displayed items on the counter to receive a cup of coffee and exchange money.

To improve space and flow, additional research was done to understand best practices of established successful coffee shops. Documentation from a Seattle event called "Coffee Fest" was a key resource. These documents include *Design & Construction of Your Coffee Bar*, *Brewing a Hot Brand Best Practices*, and *Opening a Café?*. The HP food services provided their input as well as their *Design and Equipment for Restaurants and Foodservice book*. These resources cover lighting, sound-proofing, colors, traffic patterns, themes, modularity, materials, health code issues, equipment, branding, and overall customer experience.

To further investigate best practices, interviews were conducted with baristas in Boise coffee shops. Details and photos of their production lines proved invaluable to imagining a more efficient and cohesive counter design. Coffee shops included Big City, Java downtown, Java North end (FIG. 9), Starbucks (FIG. 10), and Moxie Java. From these, workflows and layouts were designed (FIG. 11). Some changes were made to the process flow and order of equipment. For example, an in-counter grounds catch basin designed into the counter, the sink is put into an optimum position, and the cooler and storage areas and moved closer to where they are used. More storage was created in the back room to lessen inventory under the counter. The counter was lowered where money and drinks were exchanged.

Figure 9 Boise Java (downtown)

Figure 10 Starbucks process

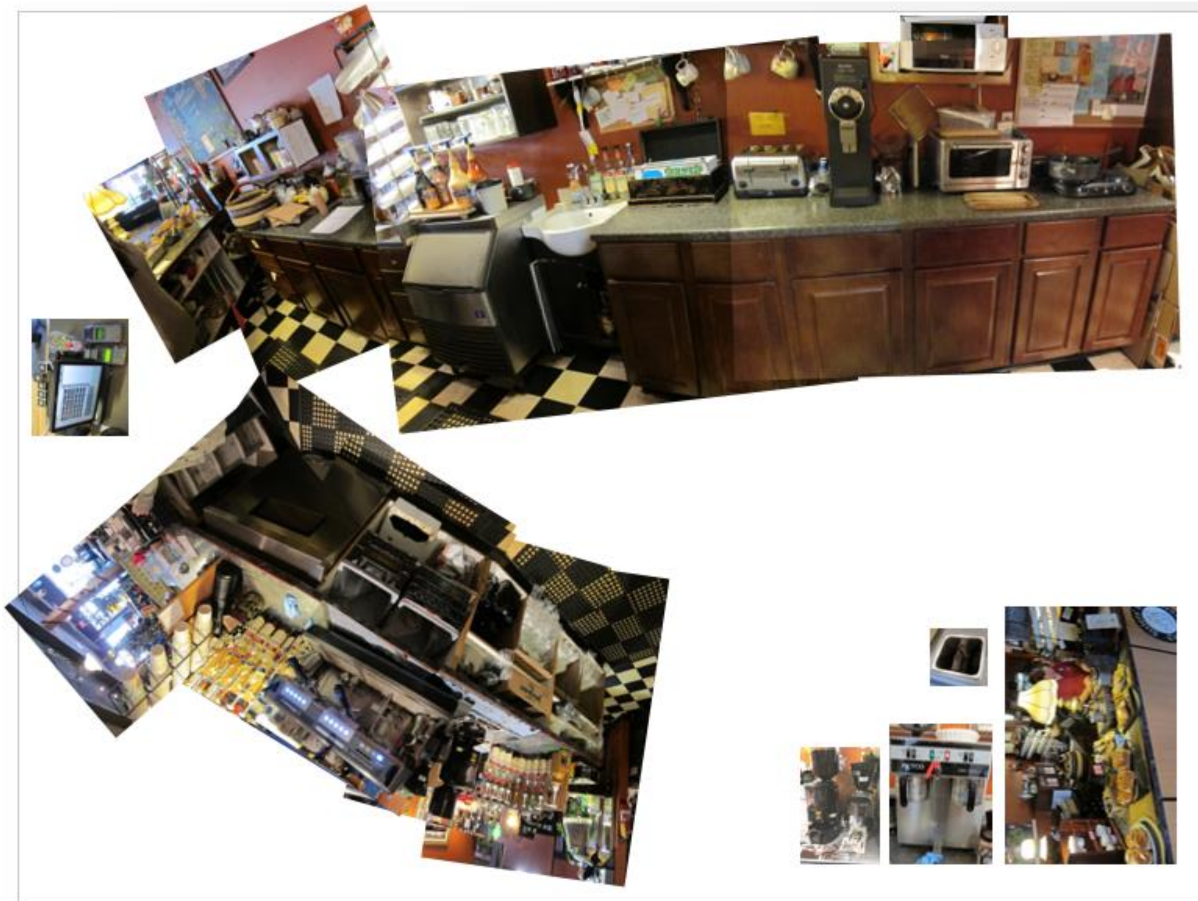


Figure 11 Workflow design- cutting and pasting to explore flow arrangement

The intersect of design and mechanical engineering

Using the requirements lists, measurements, facilities details acquired from the engineering discipline, and the observations, research, and aesthetic qualities of the design discipline, it was possible to start ideation, sketching designs, and working up various ways to properly create the space (FIG. 12).

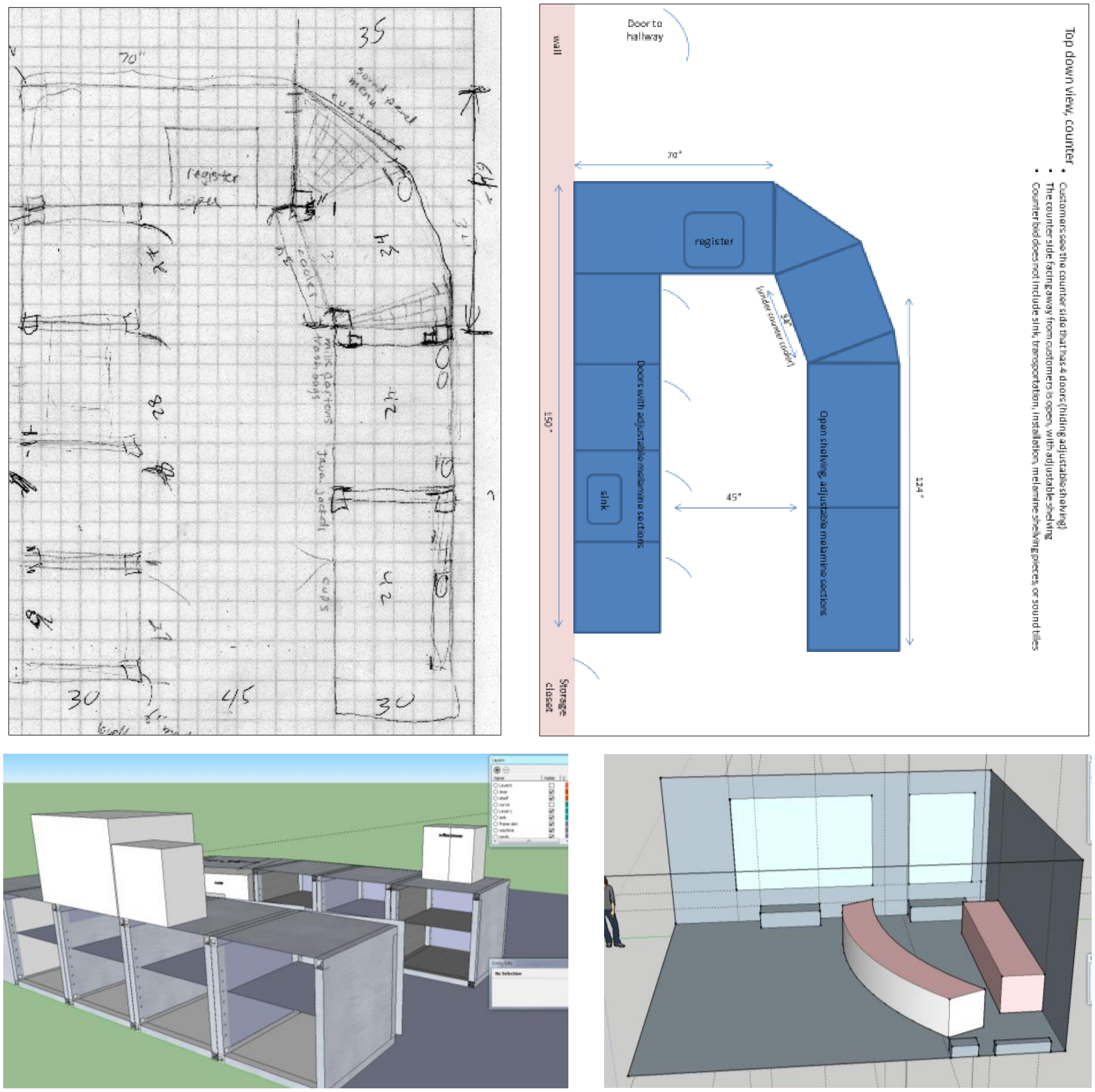


Figure 12 Prototyping the design from ideation to detailed CAD and mapping

Working with the builders

Multiple versions of counters were drafted, and discussed with the cabinet builder and contractors. Having an ideal design is only the base for what will be the final design. There are many forces that will cause changes to the design that are beyond the designer/engineer’s control. Designs can be negatively impacted by resource availability and cost, worker availability, schedule changes, and budgets, to name a few.

The cabinet builder significantly impacted the overall design. His expertise in materials was key, such as how to use full sheets of metal to reduce material cost, and how to design for transport and modularity. To match the "engineering" aesthetic related to the engineering, department, and the Think Tank, many ideas were considered, with metal being the best option. Metal allows for an industrial look, and has a modern feel, especially when left in a "raw" state, with mesh, welds, and visible marks showing how it was constructed. To reduce costs, I chose to use a lighter metal mesh to wrap the front of the counter, which also added a modern and industrial texture to the space. The lighter material didn't have a strength requirement since it was used to plate the front of the counter. This is another example of design and engineering working together, to improve a product. Lighter material, modern look, a great combination. I selected hollow tubing for the frame to allow for electrical conduit to be strung inside it, for electrical access along the extended wall of the counter. Ideally the counter would be modular, with as many similar pieces as possible to cut down on cost and materials (using standard size sheets of materials).

The contractors influenced the types of fixtures, sink location, outlet locations, and resource limitations. The materials were selected to comply with these elements, and fit the aesthetic, as well as functionality and budget. Further improvements and alterations were made with each iteration of the design. Changes included using hollow-tube steel as a conduit for electrical wires, allowing for electrical access to the far reaches of the counter. Shelving unseen by customers was designed without doors, to reduce weight and materials, and enable easier access for baristas. Decorative sound panels and signage were selected to support a modern ambiance, reduce noise and direct traffic flow. A venturi design was added to the front of the counter, and a glass door was added, to match the Think Tank design. Throughout the iterations, both engineering and design elements had to be addressed. This was done by making trade-offs and compromises, working through limitations, and fighting to keep important elements as much as possible (such as the glass door, matching both the think tank and allowing customers to see inside the shop for a more inviting entrance.) Communication between the builders was key, as changes occurred daily.

Working towards the final design

The final design is a series of modular cubes in sheet metal, creating a curve, with an exterior covered in metal mesh. Through the mesh one can see the shelving and interior of the counter. The cubes can be moved separately, then connected via fixtures for permanence. Each has 2x2 metal tubing to accommodate wiring and reduce weight of the frame. Doors can be added or removed. The shape of the counter can be adjusted to suit the needs of the space. Needs include:

- The power and water access through the West wall only.
- Counter will be above standard height to accommodate barista usability and storage
- Under-counter seen by customers will have doors to hide storage, under-counter not seen by customers will not have doors to enable easy access
- Sink moved to West wall for water supply access (less ideal for efficiency)
- Additional power for equipment (i.e. tubing for electrical wires along counter)
- Floor kick-plate along entire counter to comply with Idaho Department of Health
- Sanitation sink in compliance with Idaho Department of Health
- Drains in compliance with Idaho Department of Health (for sink and cooler)
- Utility sink in closet to comply with Idaho Department of Health
- Distance of counter to wall and fire extinguisher to comply with Idaho Department of Health

In addition to the counter, signage and sound-proofing was added to the layout. Sound proofing research yielded a decorative tile to reduce decibels from the espresso machines and grinders, however this idea was eventually replaced by in-house solutions to save cost.

Since it is modular, the counter could be built in Boise, and transported to Moscow for installation. As the builders worked on the space, the electrical, the water, and closet area, the metal worker gathered a materials list of sheet metal, metal mesh, and fasteners. [Note: the schedule was substantially delayed due to asbestos found in the flooring requiring abatement procedures.]

Coordinating schedules with builders, Sisters, cabinet maker, and health inspectors

The builder's first needs were electrical and water specifications. With those submitted, they worked creating the space (FIG. 13). Further meetings involved basic questions and answers regarding equipment, placement, and compromises as necessary. Compromises include changing the dimensions of the cooler module to allow for drain space, moving the sink to make water access easier, shortening the counter length to allow for more pass-through space, etc.

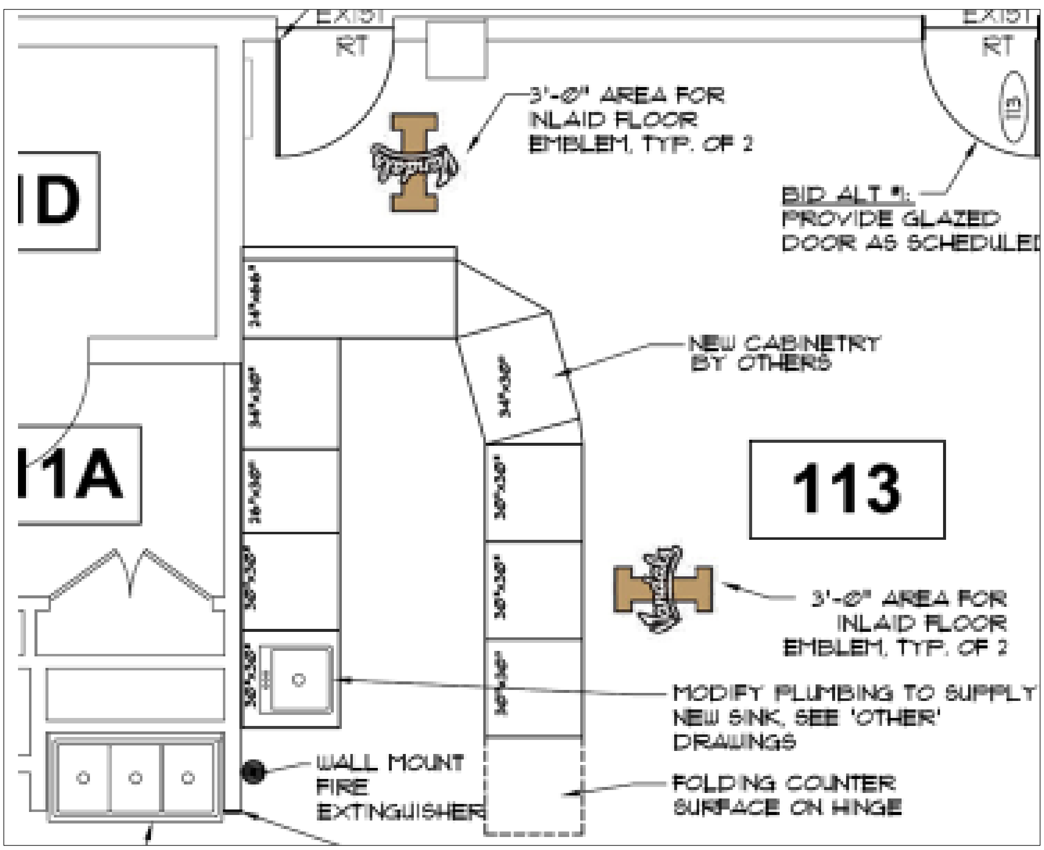
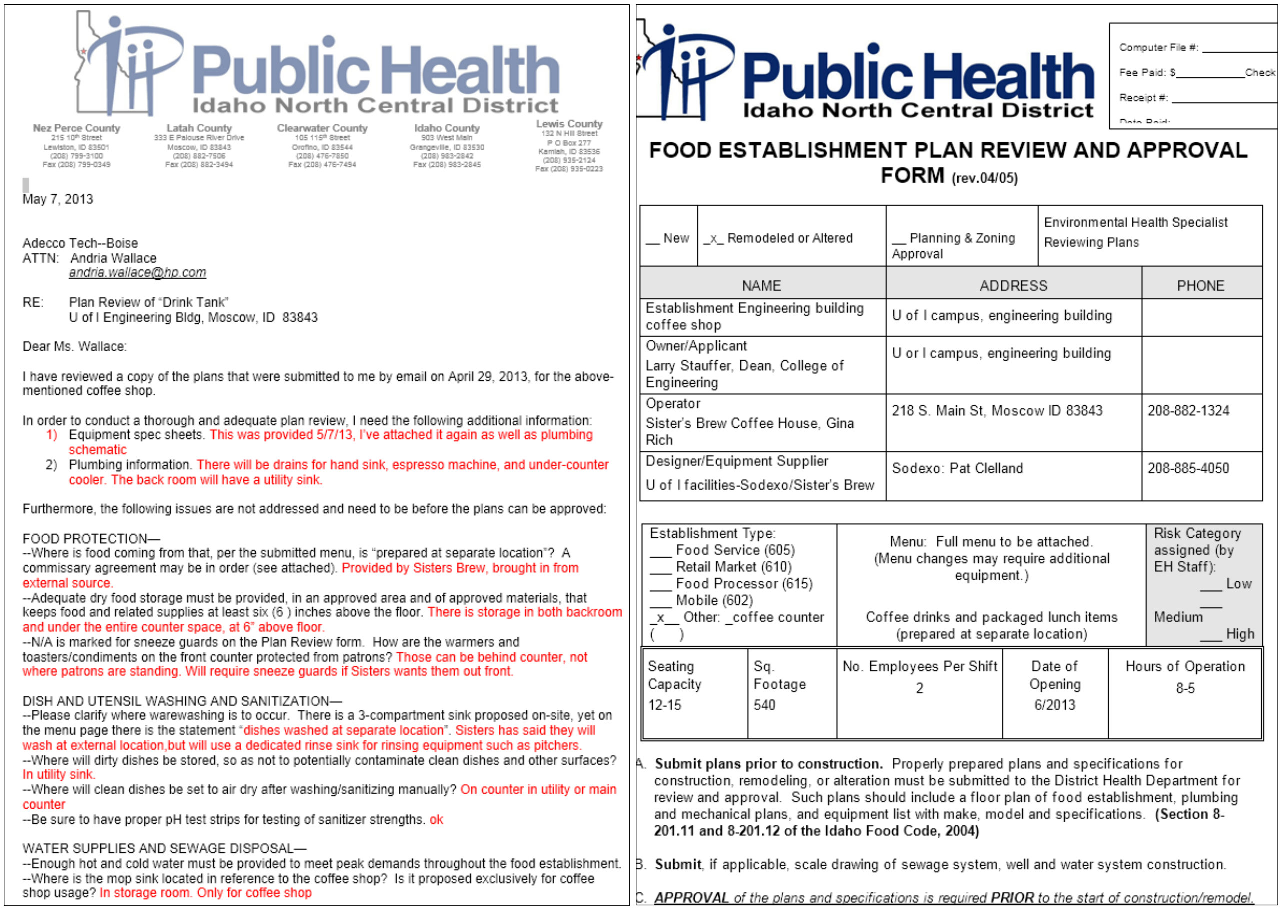


Figure 13 Final design outline

The cabinet maker scheduled the build 2 months out, and prepared to order materials with the purchase order. Weekly meetings kept the plan on track.

Concurrently, work was coordinated with the Idaho Department of Health, to ensure compliance as a food-service facility. I worked with Angela Scott, the Environmental Health Specialist who provided a list of required design elements and filling out various forms (FIG. 14). The forms were reviewed by both the State Fire Marshal and the Idaho Division of Building Safety. Multiple meetings and form submissions and updated designs resulted in final approval.



Public Health
Idaho North Central District

Nez Perce County, 215 10th Street, Lewiston, ID 83501, (208) 799-3100, Fax (208) 799-0349
Latah County, 333 E Palouse River Drive, Moscow, ID 83843, (208) 882-7506, Fax (208) 882-3494
Clearwater County, 105 115th Street, Orofino, ID 83544, (208) 476-7850, Fax (208) 476-7494
Idaho County, 903 West Main, Grangeville, ID 83530, (208) 983-2842, Fax (208) 983-2845
Lewis County, 132 N Hill Street, P O Box 277, Kamiah, ID 83536, (208) 935-2124, Fax (208) 935-0223

May 7, 2013

Adecco Tech--Boise
ATTN: Andria Wallace
andria.wallace@hp.com

RE: Plan Review of "Drink Tank"
U of I Engineering Bldg, Moscow, ID 83843

Dear Ms. Wallace:

I have reviewed a copy of the plans that were submitted to me by email on April 29, 2013, for the above-mentioned coffee shop.

In order to conduct a thorough and adequate plan review, I need the following additional information:

1) Equipment spec sheets. This was provided 5/7/13, I've attached it again as well as plumbing schematic
2) Plumbing information. There will be drains for hand sink, espresso machine, and under-counter cooler. The back room will have a utility sink.

Furthermore, the following issues are not addressed and need to be before the plans can be approved:

FOOD PROTECTION—
--Where is food coming from that, per the submitted menu, is "prepared at separate location"? A commissary agreement may be in order (see attached). Provided by Sisters Brew, brought in from external source.
--Adequate dry food storage must be provided, in an approved area and of approved materials, that keeps food and related supplies at least six (6) inches above the floor. There is storage in both backroom and under the entire counter space, at 6" above floor.
--N/A is marked for sneeze guards on the Plan Review form. How are the warmers and toasters/condiments on the front counter protected from patrons? Those can be behind counter, not where patrons are standing. Will require sneeze guards if Sisters wants them out front.

DISH AND UTENSIL WASHING AND SANITIZATION—
--Please clarify where warewashing is to occur. There is a 3-compartment sink proposed on-site, yet on the menu page there is the statement "dishes washed at separate location". Sisters has said they will wash at external location,but will use a dedicated rinse sink for rinsing equipment such as pitchers.
--Where will dirty dishes be stored, so as not to potentially contaminate clean dishes and other surfaces? In utility sink.
--Where will clean dishes be set to air dry after washing/sanitizing manually? On counter in utility or main counter
--Be sure to have proper pH test strips for testing of sanitizer strengths. ok

WATER SUPPLIES AND SEWAGE DISPOSAL—
--Enough hot and cold water must be provided to meet peak demands throughout the food establishment.
--Where is the mop sink located in reference to the coffee shop? Is it proposed exclusively for coffee shop usage? In storage room. Only for coffee shop

Public Health
Idaho North Central District

Computer File #:
Fee Paid: $ Check
Receipt #:
Date Paid:

FOOD ESTABLISHMENT PLAN REVIEW AND APPROVAL FORM (rev.04/05)

__ New	_x_ Remodeled or Altered	__ Planning & Zoning Approval	Environmental Health Specialist Reviewing Plans

NAME	ADDRESS	PHONE
Establishment Engineering building coffee shop	U of I campus, engineering building	
Owner/Applicant Larry Stauffer, Dean, College of Engineering	U or I campus, engineering building	
Operator Sister's Brew Coffee House, Gina Rich	218 S. Main St, Moscow ID 83843	208-882-1324
Designer/Equipment Supplier U of I facilities-Sodexo/Sister's Brew	Sodexo: Pat Clelland	208-885-4050

Establishment Type: ___ Food Service (605) ___ Retail Market (610) ___ Food Processor (615) ___ Mobile (602) _x__ Other: _coffee counter ( )	Menu: Full menu to be attached. (Menu changes may require additional equipment.) Coffee drinks and packaged lunch items (prepared at separate location)	Risk Category assigned (by EH Staff): ___ Low ___ Medium ___ High

Seating Capacity	Sq. Footage	No. Employees Per Shift	Date of Opening	Hours of Operation
12-15	540	2	6/2013	8-5

A. **Submit plans prior to construction.** Properly prepared plans and specifications for construction, remodeling, or alteration must be submitted to the District Health Department for review and approval. Such plans should include a floor plan of food establishment, plumbing and mechanical plans, and equipment list with make, model and specifications. **(Section 8-201.11 and 8-201.12 of the Idaho Food Code, 2004)**

B. **Submit**, if applicable, scale drawing of sewage system, well and water system construction.

C. *APPROVAL of the plans and specifications is required **PRIOR** to the start of construction/remodel.*

Figure 14 IHD communications and form samples

Final Design

The final design is a metal modular counter that accommodated the equipment, workflow, power and water needs of the coffee shop. Soundproofing was designed for the wall, with a sound panel above the coffee grinder and espresso machine. A glass door was ordered to replace the wooden door, both to match the aesthetic of the Think Tank, and act as a visual cue to the shop when the door is closed (necessary to prevent noise from the hallway). The closet and counter provide ample space with an improved production flow and customer flow. The aesthetic matched the Think Tank, with a modern engineering-style aesthetic.

Due to the asbestos abatement delays, the counter builder was unable to fit the build into his schedule. The job was eventually done at the university instead using wood as the base material (FIG. 15).

Figure 15 Finished coffee shop exterior & interior

Chapter 2: Report II- Adaptive Device

Introduction

This project is to use design and mechanical engineering in the exploration and subsequent design of a device that allows a person with limited hand mobility to secure a seatbelt into its receiver. It can also be used by parents to secure a car seat with one hand. The impetus for the project is my nephew Jamie, who has palsy on his left side. He cannot use his left hand to grasp objects. He struggles to buckle a seat belt, and often needs help (FIG. 16).

Figure 16 Jamie struggling to connect the receiver with one hand

Purpose of Study

The purpose of this study is to come up with a simple, portable and economically reproducible device. This device can be adjusted to fit to most seatbelt and seatbelt receivers, be used by one hand, and transferable from one seatbelt to another. It must be attractive, strong, flexible, safe, and not impede any safety functionality of the receiver or seat belt system.

Mechanical engineering attributes for this project include the physical requirements for the device, adherence to safety standards (or rather, not impeding on them), as well as the materials selection (for strength, flexibility, and tension). Defining scope, structuring requirements, and addressing usability needs utilize tools learned in engineering coursework within the program.

Design Method & Scope

To research this device, websites for adaptive products were explored to learn how products are made for those with limited hand functionality, and if there are already devices available to suit this need. Patents were searched world-wide to see if there was a device in planning stages. Interviews were conducted with parents of special needs children to get a better understanding of necessary requirements.

Background Research

Interviewing parents of special needs children revealed that they had not heard of any seatbelt adaptive devices. They provided a surplus of Websites specific to adaptive devices for further exploration. They also helped define the requirements for the product.

Research shows there are no adaptive devices offering this specific functionality (FIG. 17). There are, however, 4 patents (FIG. 18).

Figure 17 Adaptive devices for hand palsy. A seatbelt "handle" is available, (far right)

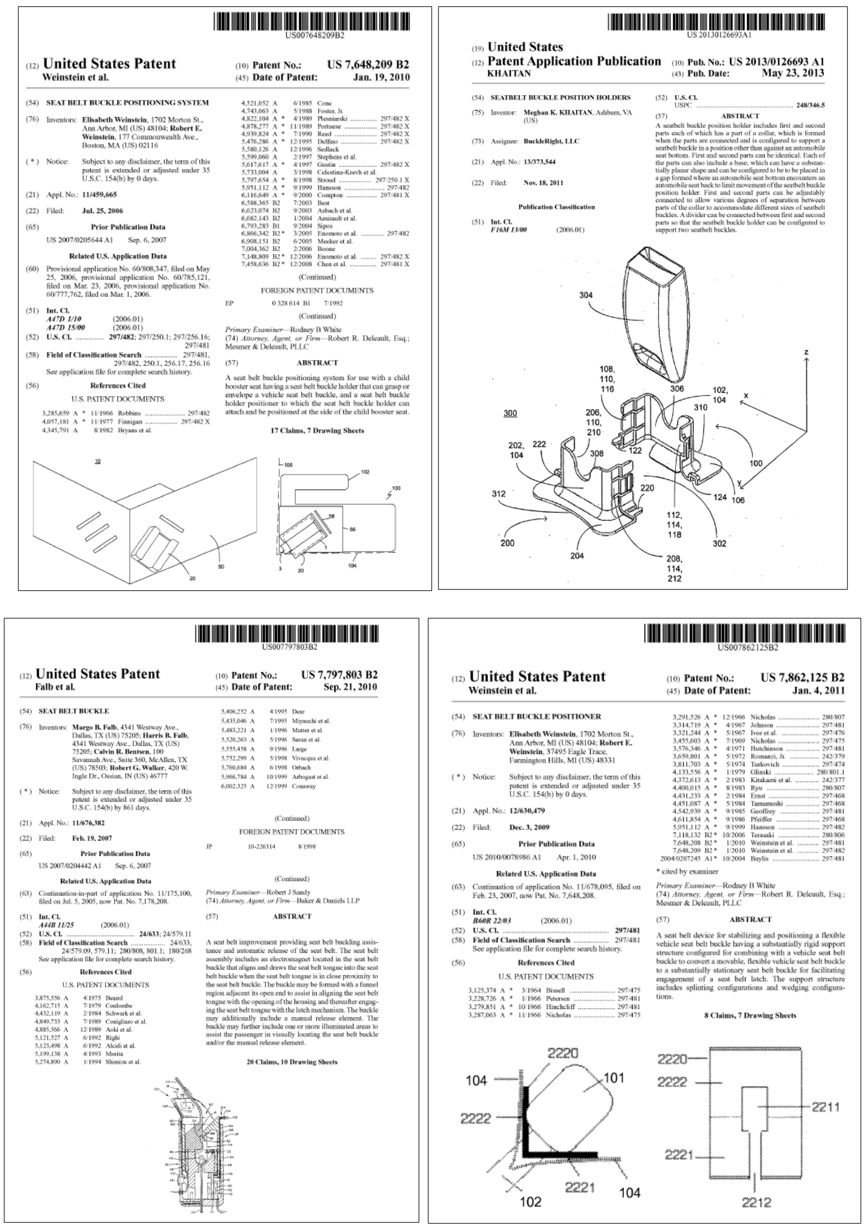


Figure 18 Patents found, all complicated and none found commercially produced

Defining Requirements

To be a useful device, the end product must meet the following requirements:

- Provide rigidity to enable insertion into the receiver
- Fit a variety of seatbelt types (FIG. 19)
- Work with various lengths of webbing
- Work with various styles of seats
- Be easy to reproduce
- Be portable
- Not impede safety features
- Be shatterproof/break-proof

Figure 19 Types of receivers

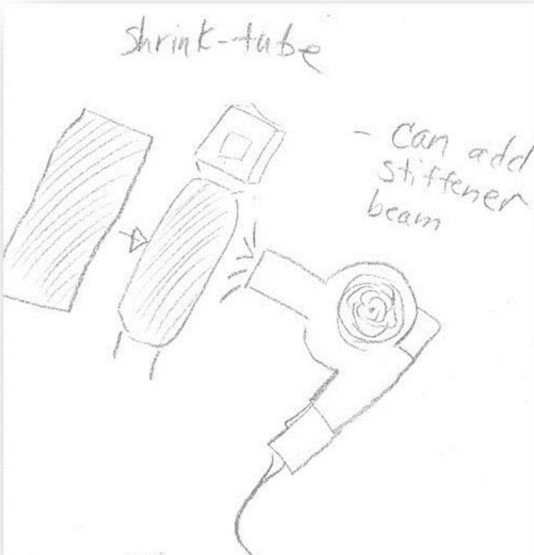
Further research includes interviewing Steve Koral, a local designer of performance racing motorcycle components. He provides ideas on the best type of materials to use for prototyping. He recommends visiting a local plastics company, Interstate Plastics (FIG. 20).

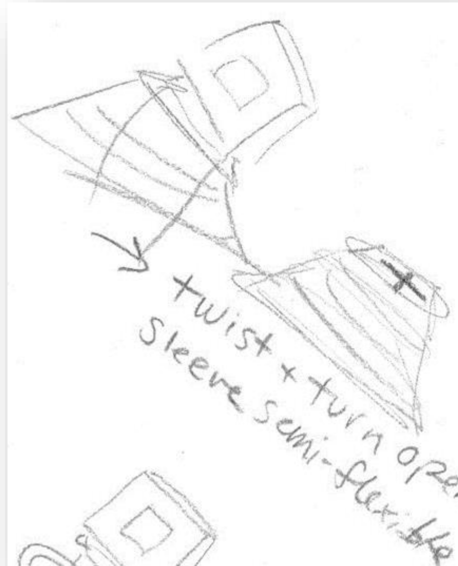
Figure 20 Visiting Interstate Plastics for prototype materials

Design contributes to the aesthetic look and feel for the device, and the human factors element of usability. It addresses the need for simplicity in structure, portability, and ease of implementation. Forming ideas for the project comes from observation, research, and trial and error.

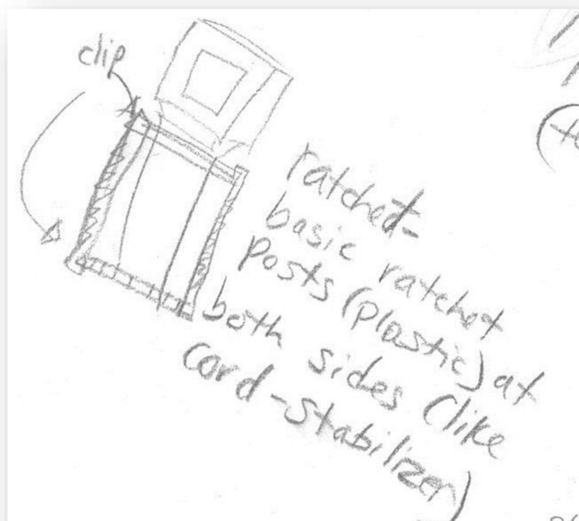
Development Process

The bulk of this project was spent in ideation. Looking for ways a seatbelt receiver could be held rigid, and satisfy the requirements. Pages of sketches started the ideation process. The top ideas are prototyped to enable further refinement (FIG. 21).


shrink-tube
- Can add stiffener beam


twist + turn ope
Sleeve semi-flexible


Plastic or rubber cone w/ Slot to thread receiver through


clip
ratchet-
basic ratchet posts (plastic) at both sides (like card-stabilizer)

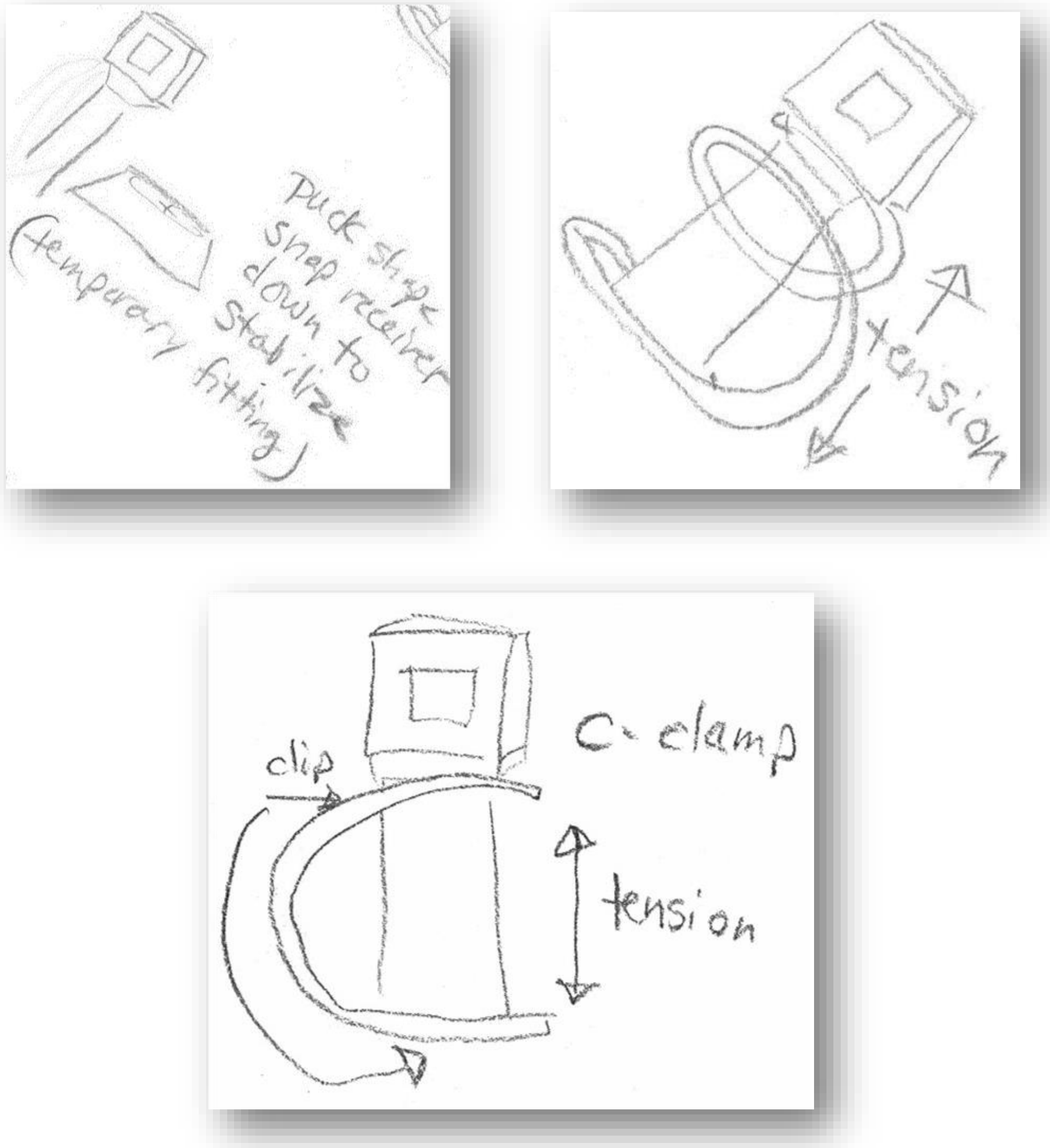


Figure 21 Sketches of ideas

An old car seat with seatbelt from a junkyard was obtained for prototype testing (FIG. 22). This helped with sizing, shape, and standardizing elements of the prototypes.

Figure 22 Seat for prototyping

Working towards a final design:

To get measurements and a better idea of sizes and best designs, basic cardboard and plastic models were tested (FIG. 23). Forms included spring-types, ratchet-types, detents, slides, and tension. Some ideas came from HP printer R&D experience and talking to the designers in the fabrication lab.

Figure 23 Prototypes were tested to further define ideas

Final Design

After testing various thicknesses and plastics with multiple designs, the best solution turned out to be the simplest. A basic “C” shape, that expands naturally against the seat and the receiver due to the material tension. It satisfies all requirements (except testing how many seatbelt types it accommodated) and would be extremely economical to reproduce. The design was sketched into Rhino (a Computer Aided Design program learned as part of this Interdisciplinary degree program) for a final prototype model (FIG. 24).

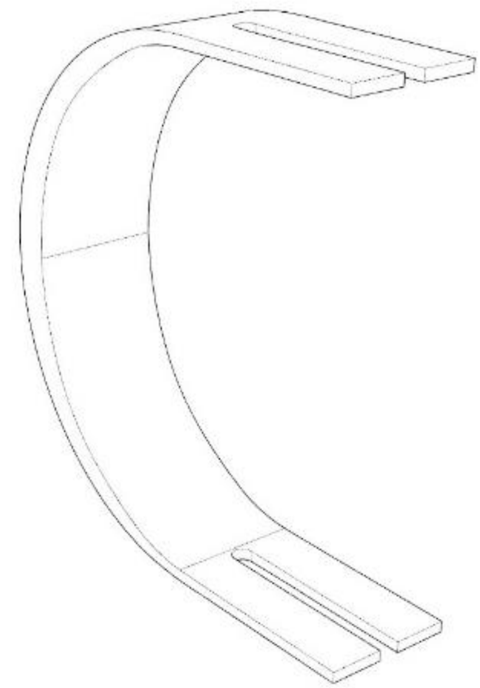


Figure 24 CAD drawing of final device

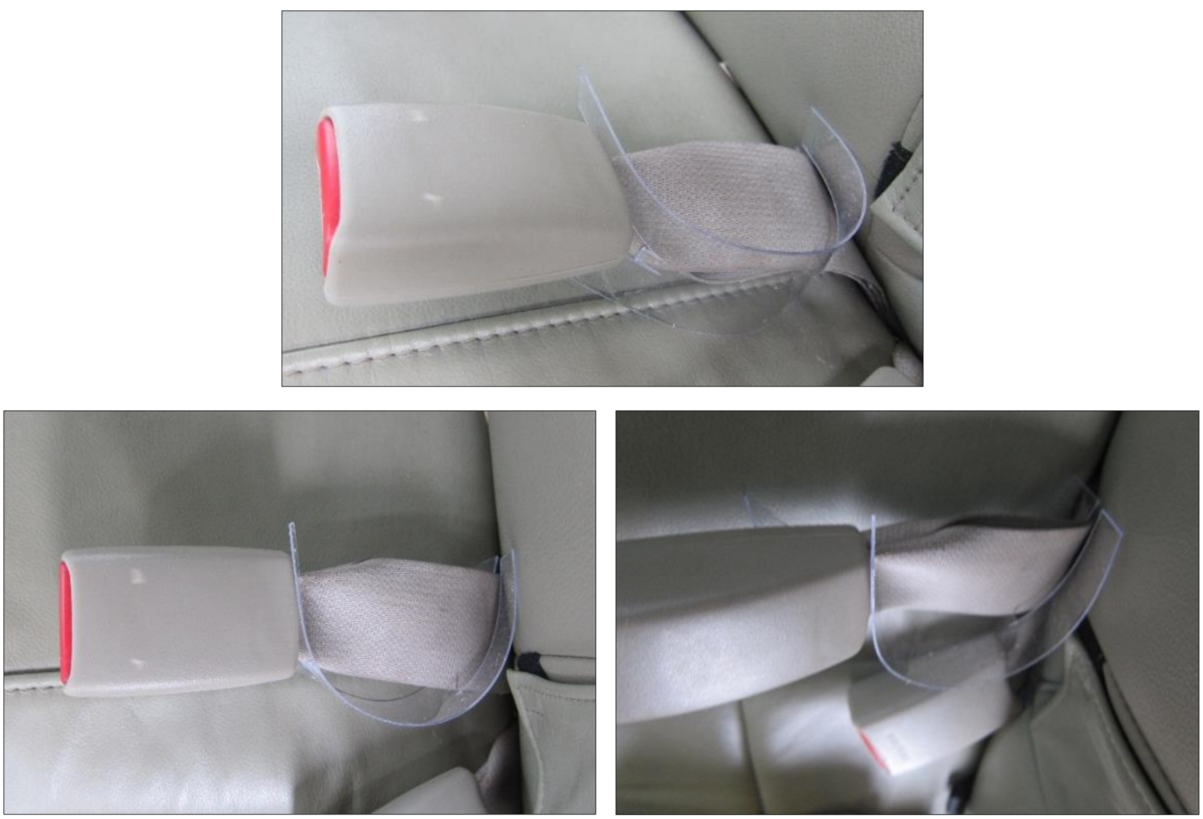


Figure 25 Testing prototype: various views

The intersect of design and mechanical engineering

Using the requirements lists, physical limitations, and material qualities (tension and strength) from the engineering field, as well as the usability attributes of simplicity, installation, and portability from the design field, it is possible to create a new, highly reproducible and sustainable product. This provides an aid to a population of consumers requiring help to buckle a seatbelt that has thus far been unaddressed.

Chapter 3: Report III- Engineering Building Entries

Introduction

The project is to update both entrances to the Janssen building with a technical interface that introduces guests and students to the Engineering College (FIG. 26-27). It will be part of a larger design including wall graphics and visual elements. Design and mechanical engineering contribute to the overall look which complements and matches the current “Think Tank” design.

Figure 26 Main Entrance

Figure 27 Student Entrance

Figure 28 Student and Main Entrance interiors

The *main entrance* audience includes student tours, alumni visits, students looking for engineering staff and classes. It is a more formal entrance, and will have more focus on technology interaction than the student entrance. This audience is more likely to loiter and take time getting information (FIG. 28 left).

The *student entrance* is primarily used by students going to class or going to the coffee shop. These are engineering students, as well as those taking courses in psychology and computer science. They know where they are going and are not there for investigative purposes, unless they are sitting on the benches waiting for classes to start (FIG. 28 right).

Purpose of Study

The purpose of this study is to come up with compelling and impressive entrances for both students and guests, which concurrently impresses and imparts knowledge through various forms of media and technologies.

Mechanical engineering attributes for this project include the physical requirements and limitations for the space, adherence to building codes and electrical access and parameters, technology selection and purchasing options. Defining scope, structuring requirements, and addressing technical aspects utilize tools learned in Engineering coursework within the program.

Design attributes for the project include the graphics, materials used, wall shapes, flow of space, aspects of usability, and which information is displayed at each location.

Design Method & Scope

To research this project, websites for community spaces such as museums, galleries, air terminals and retail stores were searched to learn how technologies are used to impress and educate consumers and customers. Interviews were conducted with college students to assess how various technologies and information is perceived (i.e. list of engineering alums =not cool, projected images =cool) (FIG. 29).

Background Research

Observations of University of Idaho I students in engineering building

- Students know where they're going
- They are in a hurry, not loitering
- They are using smart phones in spare time

Interviews of Boise State University students

- Would generally NOT use a kiosk to peruse historical data if they are going to class or finding an office
- Are generally NOT that interested in historical data from a kiosk
- Would generally not like a small screen, ok if large screen shows results

- Would read historical /informational data if waiting for a class and easily displayed, “like reading a cereal box”
- Think basic screens/kiosks area dated and old-fashioned
- Would like a modern and impressive space

Figure 29 Interviewing students at BSU Student Union building

Defining Requirements

The information that will be conveyed to guests comes from the college faculty and benefactors.

Information content

The content is limited and primarily static, thus it does not require internet connection, swipe technology, or a highly "interactive" component

- Map of engineering buildings [QRC code] (embedded, internet not required)
- Map of parking (QRC codes, embedded browser tile, internet not required)
- History of program with timeline and photos
- History of buildings
- Names of Deans of the college of engineering
- Names of Faculty
- Names of Academy of Engineers members
- Classes/rooms
- Any other legacy information from current entry walls
- Events list / calendar

Aesthetic- the aesthetic design of the entries must match the Think Tank as well as each other, for a cohesive look and feel. Elements include:

- Glass
- Curves
- Venturi
- Clean aesthetic
- New technologies

Development Process

The entry project needs an impactful "wow" factor. It must create an experience within the space to be successful, going beyond the basic technology required to transfer data.

Design contributes the aesthetic look and feel for the space, as well the usability of the technology. Design impacts behavior and patterns (in particular, how to interact with the technology interfaces, and traffic flow), and addresses potential problems or future concerns. Development comes from observation, ideation, and research.

Research designs and technologies

Researching technologies included touchscreens, kiosks, kiosk stands, projectors and interactive displays that all work together, are programmable, and fit the space (FIG. 30). It required learning how to calculate projection throw distances based on content, as well as touchscreen operating systems and servers (FIG. 31). The bulk of the time is spent on technology research and educating myself on the technologies and how they fit together, such as processor speeds, memory, video cards, and connections.
[Specific hardware details and shopping lists were provided to the sponsor]

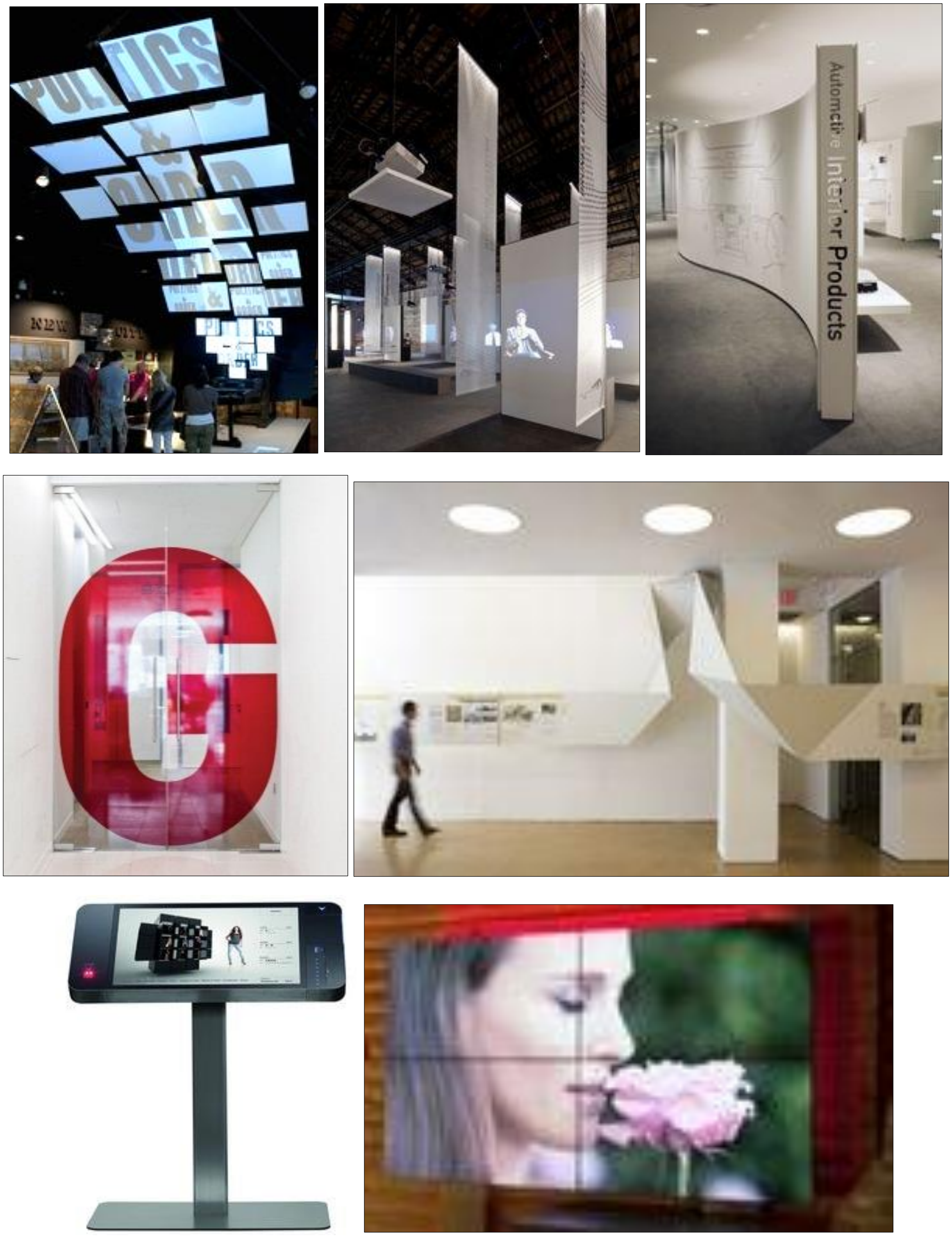


Figure 30 Researching architecture, museum, and retail shopping interiors

Figure 31 Example of notes created from technology research

Working towards the final design

I enlisted the services of two local technical experts from Quorent, in Boise Idaho. They helped make final adjustments to the equipment lists and technologies used.

Final Design

Option #1: Main entrance

The doors will be updated with a letter logo on the front, which will also be duplicated on the student entrance. This sets the tone for the modernized entries and ties them together with a matching aesthetic. Inside there will be a projected image spanning the entire left wall of water flow. This identifies with the venturi design of the think tank, and is an economical way to make an impression for visitors. The side walls will be built out with a slight curve in the center, directing the flow of guests and also identifying with the venturi flow. A kiosk allows guests to access data such as classroom numbers, events, and maps (FIG. 32). Other information will be displayed in signage along the right wall, such as the history of the building and engineering department, images of engineers in action, etc. There are several options for devices, a full list was provided for each scenario, with specs, pricing, and where to purchase (FIG. 33).

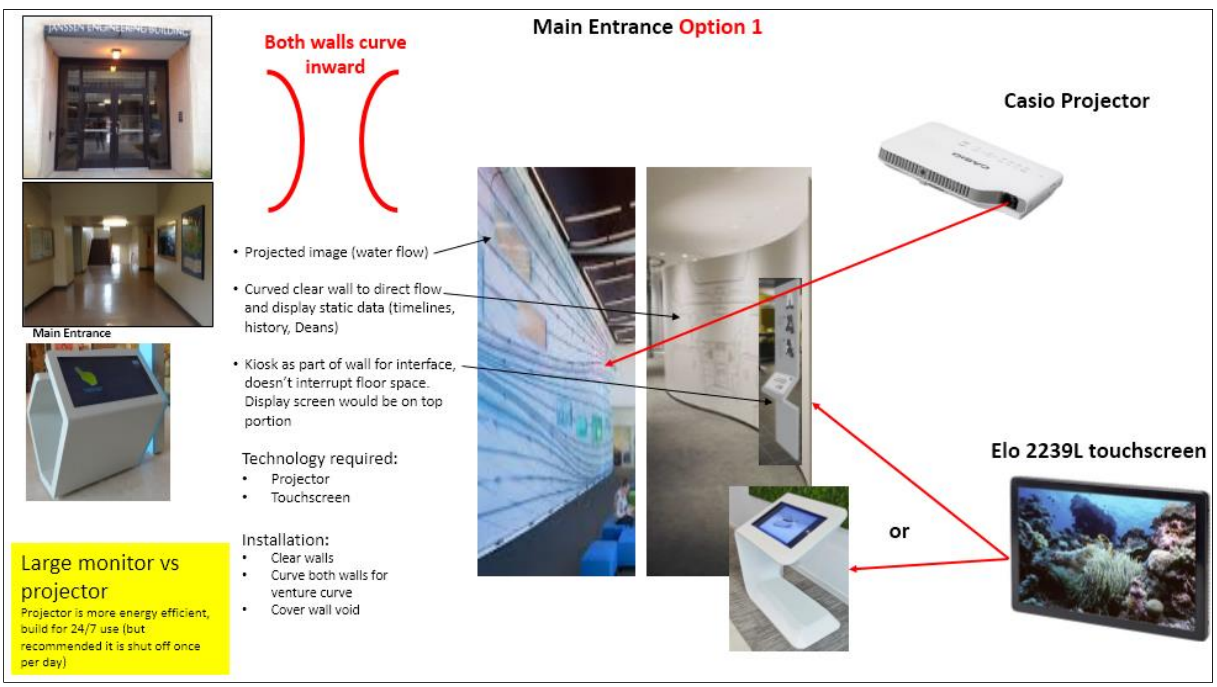


Figure 32 Main entrance proposal

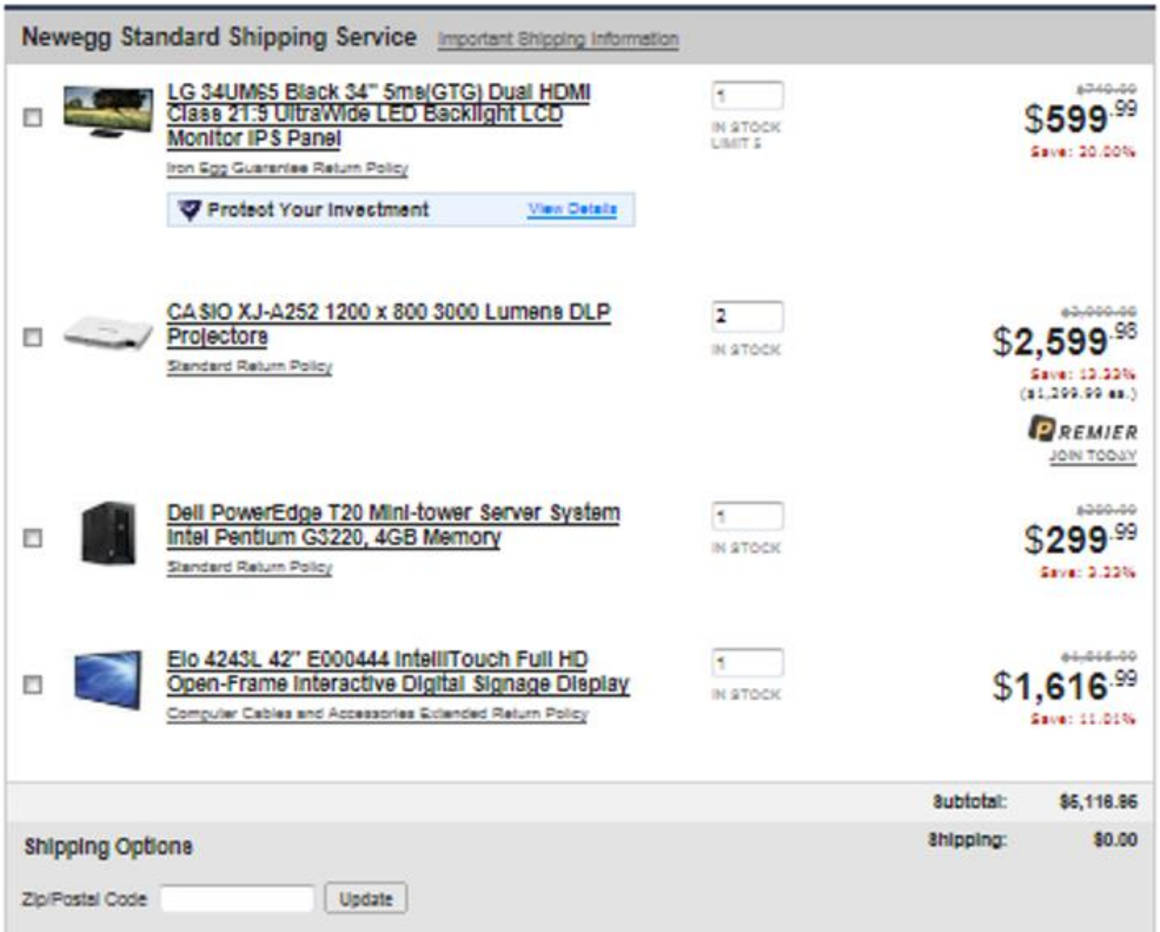


Figure 33 Example of technology "shopping cart", per scenario

Option #2: Main entrance

The second option is similar to the first, except there is no projector or projected image. Instead, a large monitor showing images would be mounted in the headspace in the ceiling (FIG. 34).

Option #2

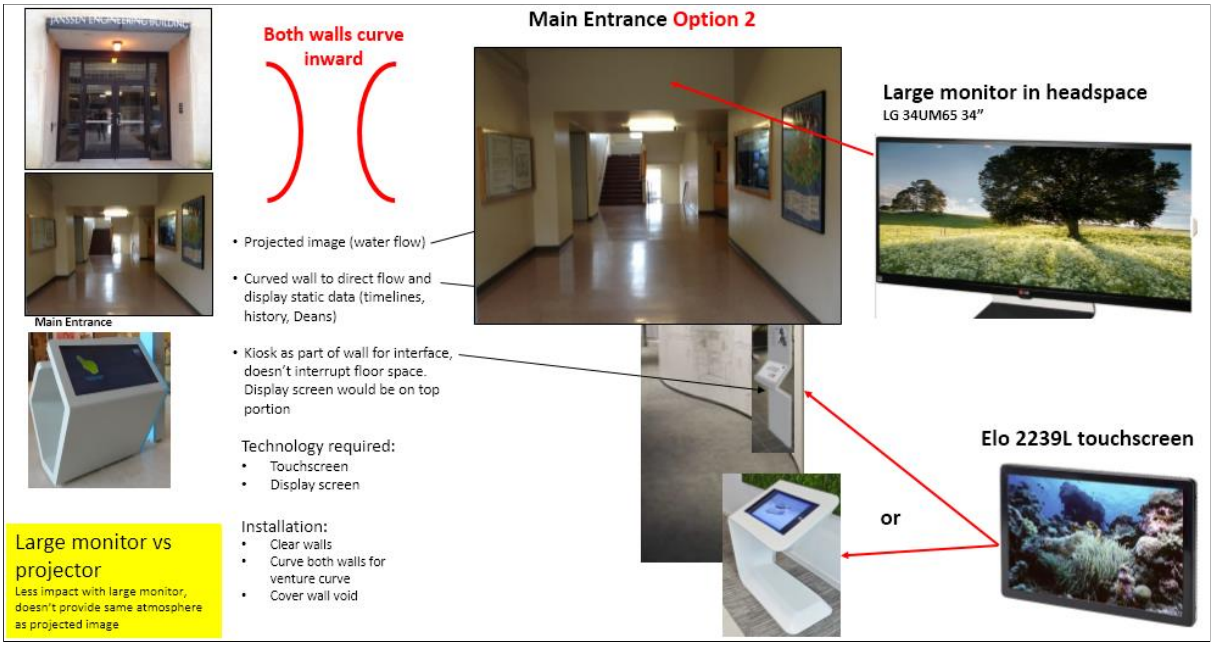


Figure 33 Main entrance proposal option #2

Option #1: Student entrance

The doors will be updated with a letter logo on the front, as with the main entrance to set the overall tone (FIG. 35). Like the main entrance, the walls will curve, using the same materials as the main entrance, and of the Think Tank. A projector will display an image on the opposing right wall, as with the main entrance. The image here could be a person such as a dean or Edison or any related image. Benches will be updated to a modern style, for students waiting to enter the lecture hall. An option to add a bank of monitors for extra visual effects is included in the schematics.

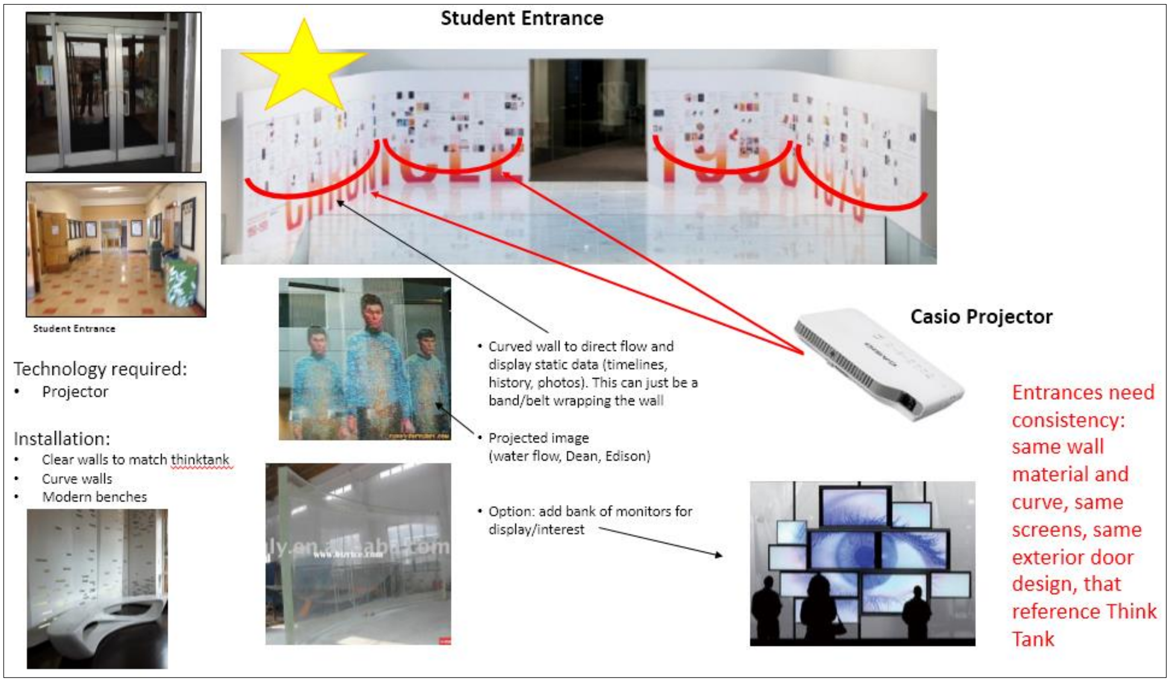


Figure 34 Student entrance proposal

The intersect of design and mechanical engineering

Using the requirements lists, space attributes of each entrance, and technical requirements from the engineering discipline, and the observations, research, and aesthetic elements of the design discipline, ideas were developed to create two compelling and educational spaces. Though the original scope was to define technologies only, it was increased to address the design element of the space as well. It is not possible to separate design from technology, when both must work together to create an experience, and impart knowledge.

Summary

The disciplines of design and mechanical engineering function in tandem in the creation of three major projects; a coffee shop, an adaptive device, and building entrances.
For each, engineering addresses the scaffolding of what a product should consist of, what it must include to function, to be safe, to adhere to regulations, to meet requirements and establish parameters. These projects demonstrate the impact of engineering principles, and importantly, that engineering a product should not be done without consideration and application of design.

For each of these projects, design provides elements for eliciting desirability. It does this by defining the look and feel, the “aesthetic” of the final product. It helps determine how one interacts with the product within its environment and purpose. Design addresses social implications of what is cool, what is preferred, and how a product design should be approached. Design cannot be done without consideration for engineering. It must work within the construct of engineering elements such as spatial parameters, forces of material strength and flexibility, electrical needs, infrastructure, and tools of measurement and analysis.

These projects are examples of how engineering and design principles can be applied not only to solve problems, but solve them beautifully. The belief that one should not be applied without the other, and that both are equally valid, is why I chose both disciplines for my Interdisciplinary Studies program.

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