The Ohio State University

Technical Design Review

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Dr. Meagan Ita – 8:00 a.m.

12/09/2021

Table of Contents

[Executive Summary 4](#_Toc387574038)

[R1 – Problem Definition Review 4](#_Toc1666364807)

[Introduction 4](#_Toc917360943)

[Problem Definition 5](#_Toc451331029)

[Research Plan 6](#_Toc2144488613)

[Research Results 7](#_Toc767245422)

[End user 8](#_Toc405337255)

[User Persona 8](#_Toc1420227200)

[User Needs 9](#_Toc46703119)

[Pairwise Comparison 10](#_Toc719669387)

[Market Character 10](#_Toc280498331)

[Stakeholders 10](#_Toc1419997751)

[Market Size 11](#_Toc1898301312)

[Current Alternatives 11](#_Toc778434665)

[Design Focus 12](#_Toc49729448)

[R2 – Conceptual Development Review 13](#_Toc184626392)

[Concept Brainstorming & Ideation 13](#_Toc1240559532)

[Process Description 13](#_Toc845840113)

[Brainstorming Results 13](#_Toc777341775)

[Evidence & Revised User Needs 19](#_Toc123596444)

[Concept Selection 20](#_Toc943711971)

[Two concept descriptions with sketches 20](#_Toc1549033707)

[Pugh Scoring Matrix 21](#_Toc332292143)

[Final concept Selection 22](#_Toc585381647)

[R3 – Final Design Review 22](#_Toc1224206215)

[Description of Prototype 22](#_Toc1276221413)

[Prototype Design Requirements 23](#_Toc390641202)

[Testing Methodology/Verification Plan 24](#_Toc1053518270)

[Correlation Matrix and Scorecard 24](#_Toc1822381079)

[Prototype Fabrication and Evolution 25](#_Toc1355280378)

[Final Prototype Design 25](#_Toc22844534)

[Final Verification 26](#_Toc47283388)

[Stress Test 26](#_Toc1650552711)

[Size 26](#_Toc1334181075)

[Acoustic Dampening 27](#_Toc1589911621)

[Time to Dismantle 27](#_Toc417245939)

[Operating Lifetime 27](#_Toc1959852967)

[User Validation 27](#_Toc1437649931)

[Impact Project 27](#_Toc255749662)

[Economic Impact 28](#_Toc284570789)

[Social Impact 28](#_Toc1159524272)

[Recommendation 28](#_Toc250587641)

[References 28](#_Toc812437346)

[Appendix 30](#_Toc1716192826)

# Executive Summary

The problem that the team identified was making Zoom calls while living in student housing. Some of the needs associated with this task are a good internet connection, having few distractions, the ability to speak without disturbing others, and good desk space. There are currently many options for students living in student housing, however, they fail to satisfy all these needs. For example, a student can do their zoom classes in the library where there is good internet and little distractions, however they cannot talk on their zoom calls there without disturbing others. Or they can make a zoom call outside, but there will likely not be a good internet connection. Thus, we designed a pod that the user can sit inside and make their zoom calls. This pod is 4’ x 5’ x 7’, has sound dampening foam inside, a window on top, and has a desk and outlets. Unlike the alternatives, this pod satisfies all of the user needs. This was verified through testing the weight capacity, noise cancelling capabilities, operating lifetime, size, time to dismantle, and energy conservation. The next steps for the project would be to take in more user feedback and making the appropriate changes. The first changes that should be considered are changed the material of the floor to regular steel and replacing the back wall with a glass panel. After these next design changes are made, a physical prototype can be built

# R1 – Problem Definition Review

## Introduction

The target users of this product are college students living in student housing. This is because there are many students living in one space, and nearly all have roommates. This makes it difficult to do zoom classes. Attending a zoom class has many needs associated with it, such as a good internet connection and charging capability. The need that is most specific to college students living in student housing is the ability to speak on zoom calls. While there were options that satisfied the other needs, such as going to the library, finding an option for these students where they could talk on a zoom call without disturbing others is difficult. As opposed to a student who lives in an apartment or at home, in a student living in on campus housing’s dorm room, their roommate may be sleeping, doing something noisy, or be on a zoom call themself.

There are many negative effects of not being able to properly do zoom classes. If a student cannot talk on a zoom call it will certainly affect their level of engagement. Certain environments also facilitate distractions, particularly those that are noisy or have tempting alternatives to doing schoolwork such as gaming consoles. However, if a proper environment for doing zoom classes is provided it can help students improve their academic performance. If a student can talk without disturbing others, then they will be mor engaged and will feel more comfortable asking questions. Other benefits include more privacy. The student can talk without feeling like others are listening, and privacy of their background if they must turn on their camera.

Overall, this product will provide value to its users by providing the perfect environment to do zoom classes, which will help them improve their academic performance.

## Problem Definition

The task chosen was attending zoom meetings for college classes while living in the dorms. The following chart shows the different ways that the user interacts with this task.

User Experience Chart

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Leave the room dorm | Find a good place to sit that has a desk and is quiet | Plug in the laptop | Sit in a chair for a long time | Listen to the speaker | Take notes | Talk on the zoom call | Type in the chat or use the reaction buttons |
| **++** |  |  |  |  |  |  |  |  |
| **+** |  |  |  |  | X |  |  | X |
| **0** |  |  |  |  |  | X |  |  |
| **-** | X |  | X | X |  |  |  |  |
| **--** |  | X |  |  |  |  | X |  |

User Experience Chart: Details of the user experience when performing this task

Pains

The pains are the negative effects that the user might experience if this task is not improved.

* Being on zoom and not interacting with students and teachers in person can affect your engagement levels.
* In your dorm room, you will have your roommate, gaming console or any source of entertainment can cause a lot of distractions.
* Sharing internet with the whole dorm building can cause unstable internet.
* Another effect of no interaction with the class could cause boredom which will hugely affect grades.

Gains

The gains are what the user stands to gain from the improvement of this task

* For some students, studying away from the classroom could provide a less nerve-wracking experience which ends up with better grades.
* When studying at home, you tend to be more comfortable because it's an environment you are familiar with.
* You tend to have more privacy, like not being forced to turn your camera on or speak like you would be in a classroom.
* If you can focus and be interested in the lecture zoom can provide a calmer environment for you to ask questions rather than having background noises in class.

## Research Plan

Research questions

|  |  |  |
| --- | --- | --- |
| **Research Question** | **Qualitative Data Collection** | **Quantitative Data Collection** |
| Where do students usually make their zoom calls? What issues do they encounter in these places, what do you like about them? | Web article containing their opinions on the good and bad parts of zoom classes (Rimer, 2020)  Web article discussing the environmental problems of attending zoom classes (Getahun, 2021) |  |
| How do online classes affect students differently than in person classes? What is their favorite part of doing zoom classes? | An article containing reviews from students on doing class through zoom (Searle, 2020) | A research study analyzing the benefits and detriments of zoom (Minhas et al., 2021) |
| Is learning material harder or easier through zoom? | *W*eb article containing interviews with multiple college students about their thoughts of in-person vs online classes (Cyr, 2021) |  |
| What technology is required for zoom calls? | Article of college student about the preparation needed for online courses (Meinke, 2020) |  |
| How many zoom calls does the average student have to attend a week? Who else is using zoom calls? |  | Zoom user stats (Dean, 2021) |
| How do zoom calls affect college students differently than other students? | A news article about the specific challenges that colleges face when doing zoom classes (Amenabar, 2020) |  |
| How many students are there living in dorms that could benefit from a product like this? |  | A report on the number of students living in university owned housing (Mueller & Havsy, 2020) |
| How many high school students are in the U.S. that could also possibly use our product? |  | NCES data (“*The NCES Fast Facts Tool”)* |

The goal for the research is to find the best way for students who live in dorms to have the best zoom experience for online classes. The research focused on the essentials of a great zoom “environment”, stable internet, a quiet place, and most importantly comfort. Some research involved identifying when, where, and what students use to do zoom calls. For example, an article was found where students talk about how they prepare for their zoom classes (Meinke, 2020). An opinion article on the timing of zoom classes to analyze what time of day most students had zoom classes was also found (Blum, 2020). The pains and gains of zoom classes will also be discussed, which varies from the comfort provided by staying at home to the struggles with interacting with the class. One of the research sources was an article from Boston University that helped us analyze these pains and gains by providing interviews from students where they describe their experience (Rimer, 2020). The main purpose is to be able to find the perfect set up for students to have the perfect zoom interactions. The research table above will investigate some of the basic questions associated with zoom. A student-based audience will be targeted and asked about their experiences with zoom, what they like about it and what they do not. After the responses and the experiences students have had with zoom are analyzed, solutions to the problems and design for a clearer plan on how to move forward with zoom can be made. Most importantly, after students are talked to, all the information recorded about them will stay private and responses will be made anonymous. The ethical code should never be broken, everything will be kept confidential so that the trust of students is not broken.

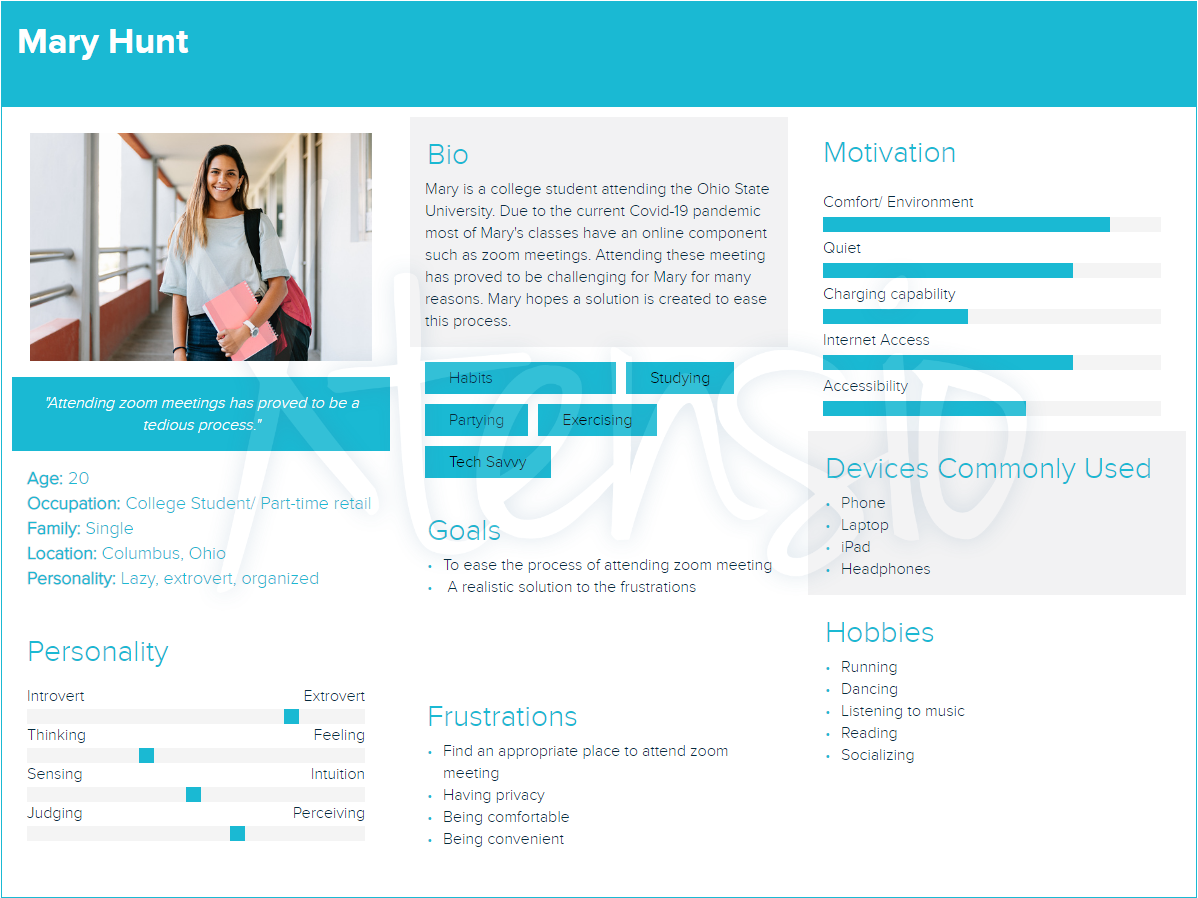
## Research Results

#### End user

After a task had been identified and thorough research had been conducted, the proposed end user needs were evaluated and ranked based on importance. A representative persona was created to accurately depict the end user of the product. The aspects of this persona were inspired by interviews with college students that were found during research. For example, one article included a couple of interviews with students who discussed how zoom allowed better schedule flexibility, which made it easier to work a part time job (Cyr, 2021). This inspired us to include that the representative persona works a part-time job. The frustrations were also inspired by complaints voiced in these articles that were found. Finding a comfortable place to do zoom calls was mentioned as a concern in a particular article from a California newspaper that interviewed several college students on their zoom experience (Getahun, 2021). And, finding an appropriate place to attend a zoom meeting when living in the dorm where one can speak and listen easily was also mentioned as a common problem (Rimer, 2020). This is also a problem that the team has experienced since they themselves are college students. One of the sources containing interviews with college students was used to determine what technology the target user for this product would use (Meinke, 2020). Additionally, one common theme that was noticed in the research articles was a concern over the lack of social interaction that comes with zoom classes, which inspired the addition of outgoing personality traits to the representative persona (Searle, 2020). Finally, details were also included about needing good internet access. Concern about having a good internet connection to make zoom calls was mentioned across several articles in the research, most notably a research article that surveyed users on what they liked and disliked about zoom classes (Minhas et al., 2021).

#### User Persona

The following is a description of a typical user for the product.



User Persona: Description of a possible end user for the product

#### User Needs

This chart describes what the users would need the product to accomplish. These needs were based on the market research that was done. More specifically, the team looked at the user persona and the sources described in the discussion above to determine needs that the user would have.

|  |  |
| --- | --- |
| User Needs | Score (1-5) |
| A quiet environment | 4 |
| A comfortable / ergonomic setup to do work | 3 |
| To get work done efficiently | 3 |
| To be able to speak and listen on zoom calls | 5 |
| An inviting environment that motivates the user to get work done | 2 |
| Be able to charge multiple devices | 1 |
| Desk space to take notes or do work | 4 |

User Needs: Different user needs ranked from 1-5 (5 being most important)

#### Pairwise Comparison

The following chart shows a comparison of the importance of the different user needs.



Pairwise Comparison Chart: Importance of previous user needs compared against each other

## Market Character

#### Stakeholders

* Students’ parents
  + benefits child’s education
  + Another cost to their kid’s education
* Universities
  + Better student participation and performance
  + More academic misconduct because classes are easier to keep online
* Professors and university staff
  + More engaged audience
  + Some of their classes may be more likely to stay on zoom if this product makes zoom classes more convenient
* Video calling companies (such as zoom)
  + More users due to greater accessibility

#### Market Size

The target market is students living in university run dormitories. According to data collected by the National Multifamily Housing Council, there are about 8.6 million students living in on-campus university housing (Mueller & Havsy, 2020). Possible secondary markets include high school students and those working a job that requires zoom calls. According to the National Center for Education Statistics, there are about 15 million high school students in the U.S. (“The NCES Fast Facts”). And, according to data published by Zoom, they have 467,100 customers with over 10 employees. In other words, 467,100 companies have purchased zoom licenses (Dean, 2021).

#### Current Alternatives

Current alternatives include going to a library, going outside, using noise cancelling headphones, staying in the dorm room (and hoping the roommate is not there or is being quiet), going to a coffee shop. The following chart shows which user needs each alternative fulfills.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| User Need | Library | Outside | Dorm Room | Coffee Shops | Noise Cancelling Headphones |
| Quiet Environment | ☺ | X | X | X | ☺ |
| Comfort | X | X | ☺ | X | X |
| Efficient | ☺ | ☺ | ☺ | ☺ | ☺ |
| Speaking/Listening ability | X | ☺ | X | X | X |
| Motivating Environment | ☺ | X | X | ☺ | X |
| Charging Accessibility | ☺ | X | ☺ | ☺ | X |
| Desk Space | ☺ | X | ☺ | X | X |
| Internet Access | ☺ | X | ☺ | ☺ | X |

When performing a market character analysis, it is important to consider factors such as stakeholders, market size and secondary markets as well as current alternatives for your solution. Several stakeholders for the product were identified. The obvious stakeholders are students who would be using the product. The product could help them focus on their classes better and achieve better grades. However, it could also lead to them being less aware of their environment and interacting less with others. Another stakeholder would be these students’ parents. The product could help the students achieve better grades. However, it could be another cost that they must pay for. Universities would be an additional stakeholder. The product could improve the performance of college students living in dorms and lead to students interacting more in zoom classes. However, if the product makes it easier to do online classes more classes could stay online. Online classes are prone to academic misconduct, so this could be an issue for them. The professors teaching zoom classes would also be a stakeholder. The product could help their students be more engaged in class. However, if it makes zoom classes more convenient for students, universities might keep more classes on zoom. This would lead to professors having to teach more online classes. Finally, video calling companies (such as zoom) would be a final stakeholder. This product could make it more convenient for universities to use their platforms to teach classes. This would lead to more profit for these companies.

Several alternatives that users could use were identified. One was going to the library; however, people cannot talk when they are in the library. They can talk when they take zoom calls outside, however it is not as quiet, and you cannot charge devices. Doing zoom calls in the dorm room is great for being able to talk, however it can be an unmotivating environment to do classwork and you never know if your roommate will be loud there. Coffee shops can be motivating to do work at; however, they can also be loud and might have limited desk space. Noise cancelling headphones are great for being able to focus, however they do not provide the other benefits like being motivating or providing the ability to speak. Overall, the factor that most spaces lacked was providing the ability to speak easily on a zoom call.

The main target market size for the product is college students living in dormitories along with high school students and workplaces being secondary markets. These markets experience the issues this product aims to resolve and will be the most beneficial and profitable. Current alternatives to the product include libraries, dorm rooms, coffee shops, outdoor spaces, and the use of noise canceling headphones. After completing a competitive alternative matrix, all these locations lacked certain aspects of the user needs. This product should focus on meeting the user's needs of comfort, desk space, and being a quiet and motivating environment. Targeting these areas will produce a highly successful product.

## Design Focus

After assessing the main problem and the user needs, the team have decided that they want to create a pod for students to do zoom classes in. They named this product the Zoom Room. From the research, the team identified certain aspects that would make the product more marketable to its target audience. The main problem identified, which was mentioned in many of the sources, is speaking on zoom calls. It can be difficult to find a quiet place where you can talk on a zoom call without disturbing anyone. Therefore, the Zoom Room will close completely around the student and be soundproof to allow them to talk easily on their zoom calls.

In an interview with Boston University students, one student pointed out Wi-Fi connection as an issue, so it was decided to add space in the back of the chair to conveniently place a router for optimal signal (Rimer, 2020). In this article, a couple of students also described how they set up their workspace for zoom calls, and this highlighted that ample desk space would be important for users. An advice piece on how to set yourself up for success for zoom calls mentioned making sure your devices are fully charged, and this was identified as an excellent need that this product could fulfill (Amenabar, 2020). Therefore, the team decided to include outlets inside the pod so the user can charge their laptop, phone, or any device that they need to use. Another one of the research articles discussed how students found time management to be more difficult in online classes. This led to the decision to include a weekly calendar whiteboard in the pod so students can manage their time better (Meinke, 2020). A final issue that was identified was motivation. Several articles included interviews from students who mentioned that they struggle to find the motivation to do work when their classes are online, the most notable of which was a research study about students' attitudes about zoom calls (Derar, 2020). The team decided that the aesthetic design of the pod would therefore be important, as having an aesthetically pleasing design would motivate students to go to class and get work done. Overall, research led to the identification of several crucial parts of the design that are necessary to include.

# R2 – Conceptual Development Review

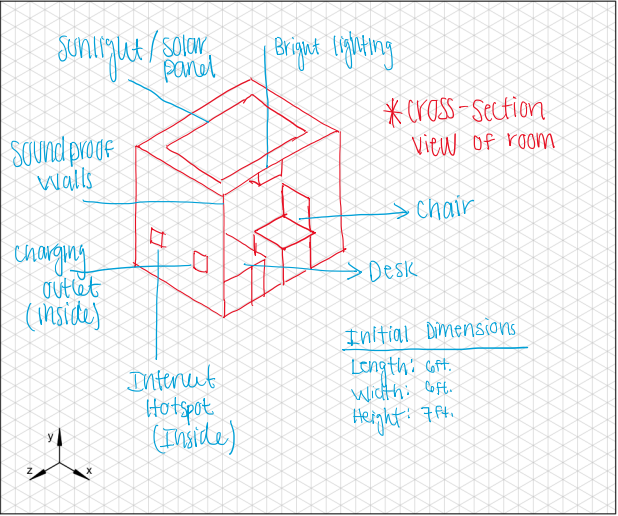
## Concept Brainstorming & Ideation

#### Process Description

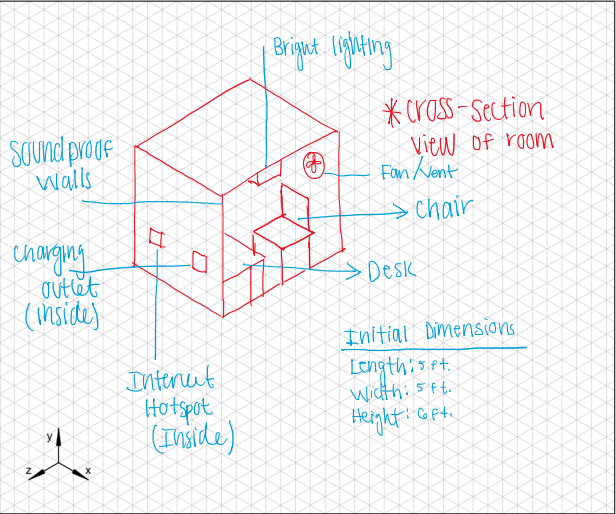
To brainstorm, the team used Miro boards and concept maps to put all the ideas into one place so the team can build off each other's ideas. The techniques that were used helped us to see the different mind processes of each team member and allow each of us to build off each other. Seeing each other’s ideas also allowed everyone to see new perspectives that could be used to further develop each individual sketch. Mapping all ideas clearly so each member could easily trace how the person came to that idea was a priority in this process. No constraints were faced while brainstorming because the appropriate time was taken to go over each members’ thought process. This led to some great ideas that would later be developed into updated concept sketches.

#### Brainstorming Results

While brainstorming, each member mentioned many varying ideas that ended up benefiting all individual sketches. Ideas about the material, ventilation, charging capabilities, portability, etc. were all discussed while brainstorming.

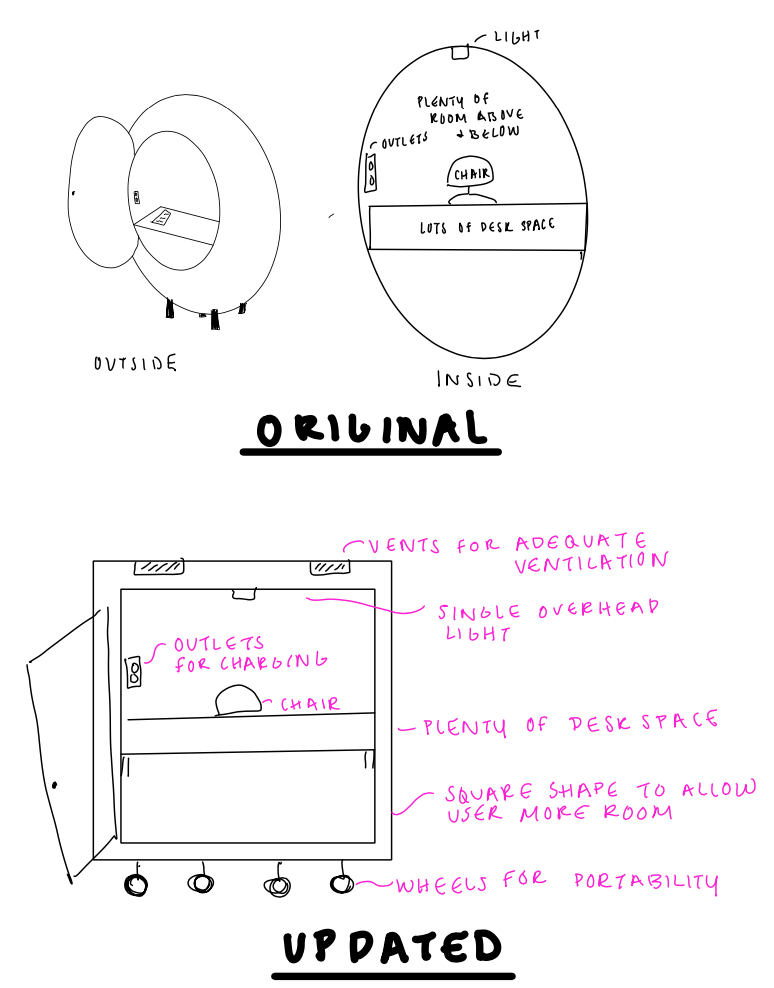


Initial concept sketch (Faleh)



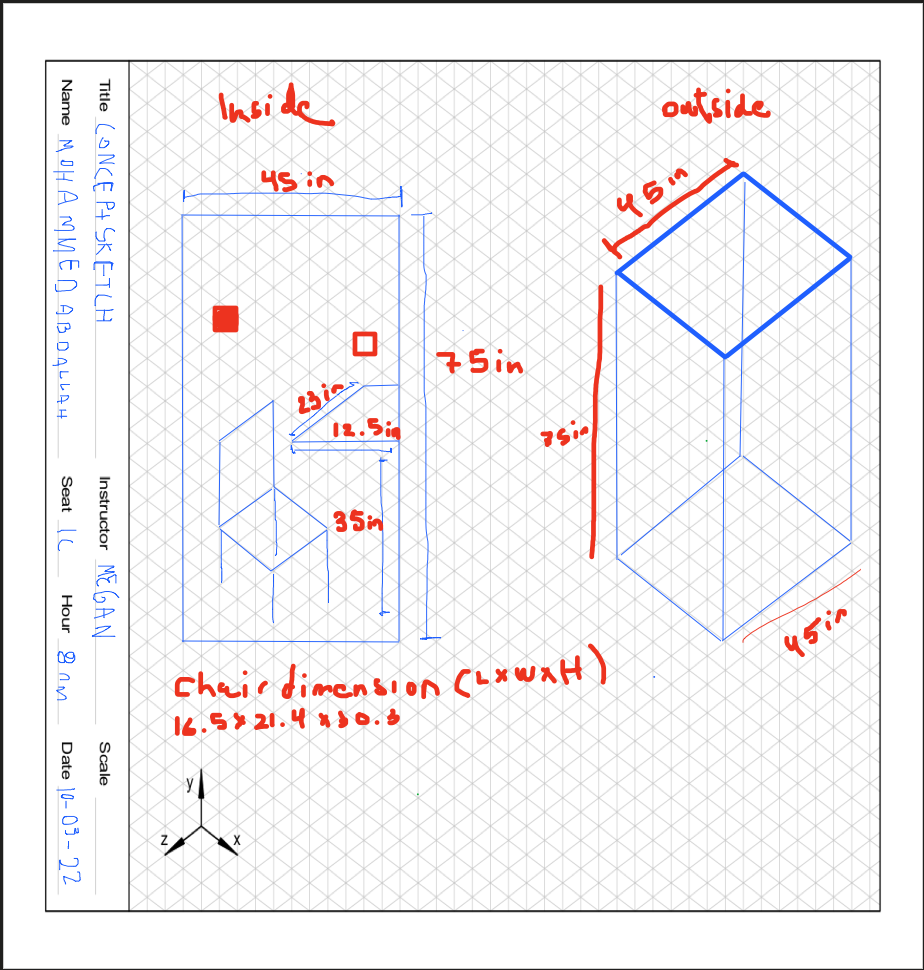
Revised concept sketch (Faleh)

After brainstorming with the team and reviewing input and feedback from the industry leaders a couple of changes to the initial design were made. The sunlight/ solar panel features were removed since the design is meant to be used in an indoor environment. Furthermore, a fan/vent was added to the design to help with temperature control and additional comfort. Finally, the dimensions were reduced by one foot in each direction to make the design more practical and easier to move.

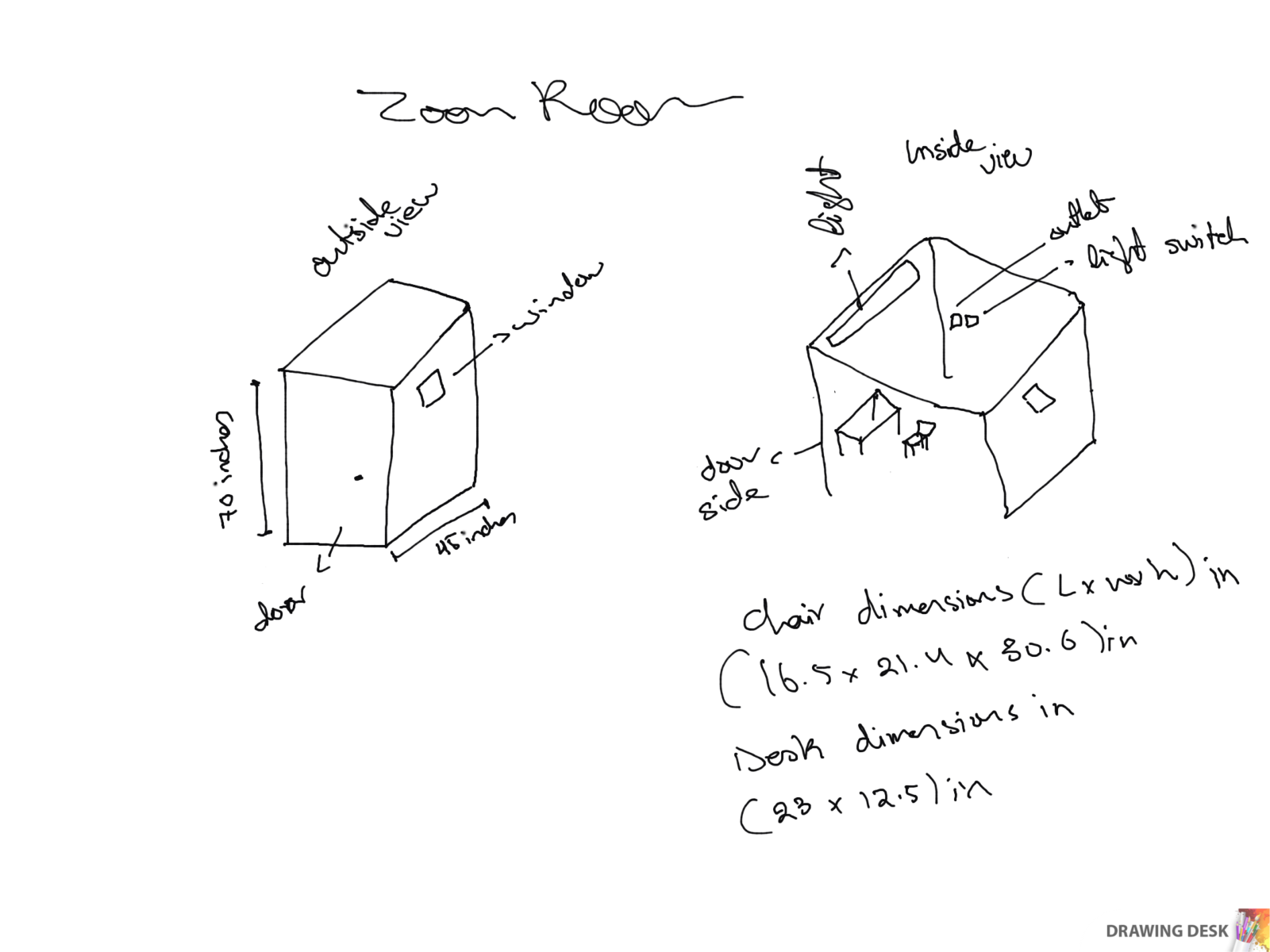


(Bella Scholtes)

After brainstorming, my concept changed by adding more space and portability after it was identified as an important user need. This updated concept sketch includes wheels for better portability and is a square object in order to allow the user even more space to do their work. I also added vents at the top of the pod in order to allow better ventilation which was a concern brought up during brainstorming.

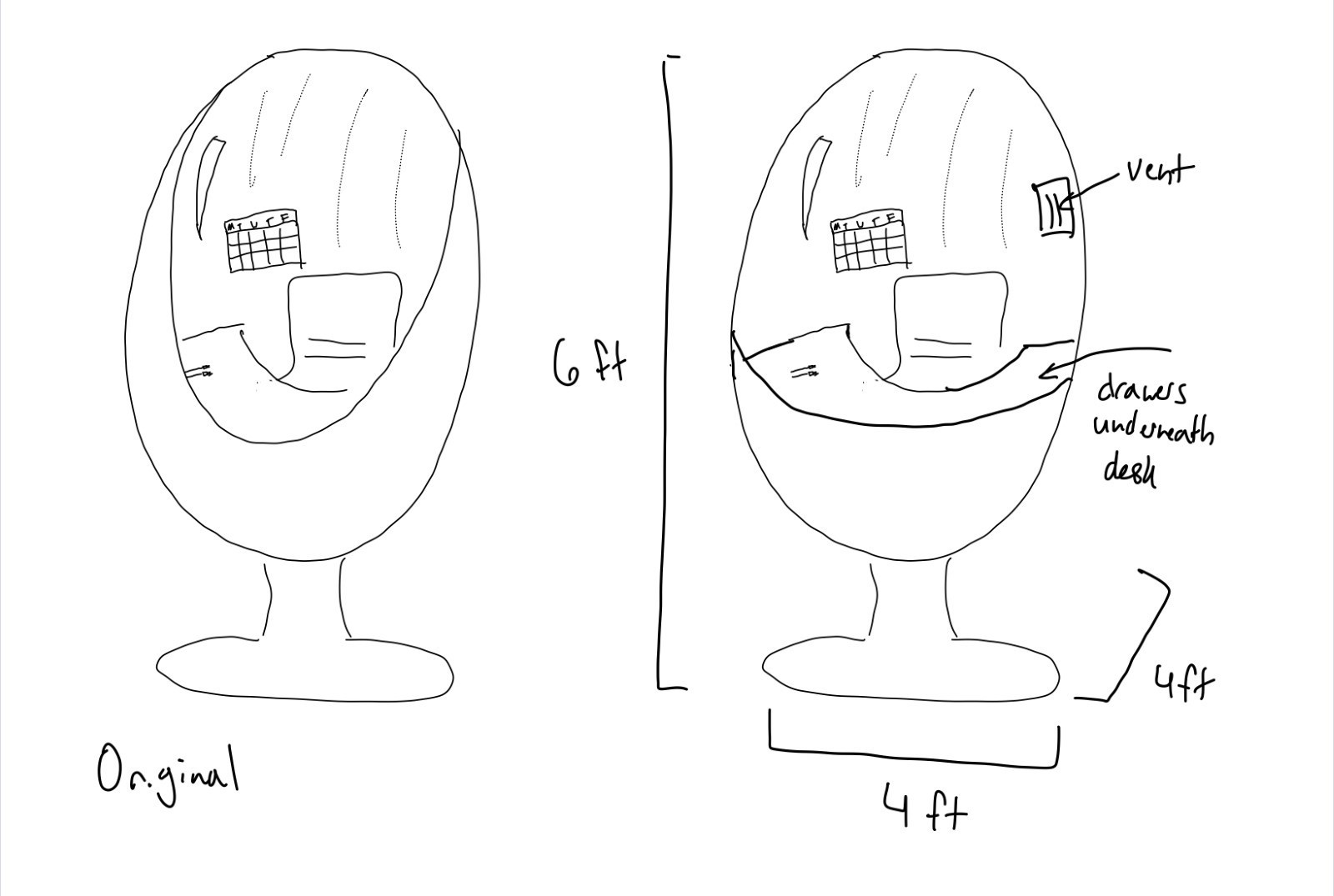


Original Concept Sketch (Mohammed)



Updated Concept Sketch (Mohammed)

After meeting with the industry leaders and my team and taking the advice into consideration, I decided to add a window to the design. Another major thing was I made the height smaller, went from 75 inches to 70 inches. The change in size makes it more accommodating in smaller areas. It includes light, soundproof walls, outlets and of course a desk and chair.



(Victoria Smith)

The first change made was to add size specifications. The industry mentors had some questions about this, so I realized it would be important to include in the design. I also decided to add other factors after the brainstorming session. One thing that was discussed was ventilation, and I thought that it would be very important to add to the design. Additionally, I thought about how I would want the maximum sunlight to come in because that creates a more inviting environment, so I made the window on the top larger. Finally, drawers were added underneath to help keep the user organized.

#### Evidence & Revised User Needs

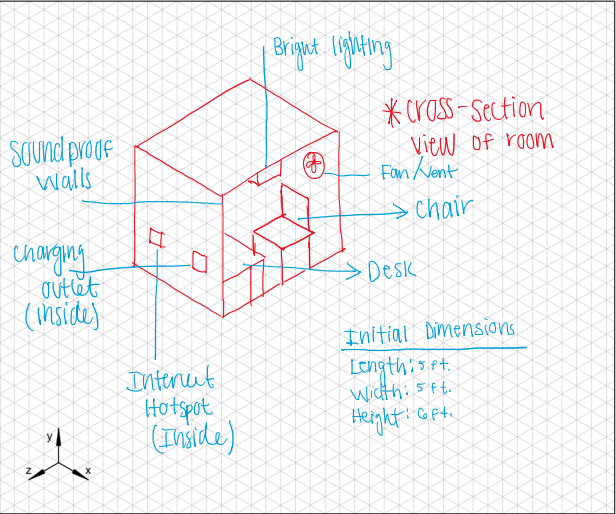
The team generated these ideas after consulting with the industry mentors. After hearing their individual feedback, the team started brainstorming what could be added to the concepts and how the product could be improved. The mentors brought up ideas of portability, ample desk space, and how the primary users could be expanded to anyone who needs a quiet space to work. The user needs chart now includes portability after discussing the product with possible primary users. It was decided that in order to have the product be the most efficient it must be portable and be able to move in between buildings for wherever someone might need a quiet place to study. The user needs to be able to have a quiet place to study in locations like airports, libraries, dormitories, or anywhere that the user seems fit. Therefore, the product needs to be able to fit in most doorways or have some sort of easy assembly.

User Needs Chart

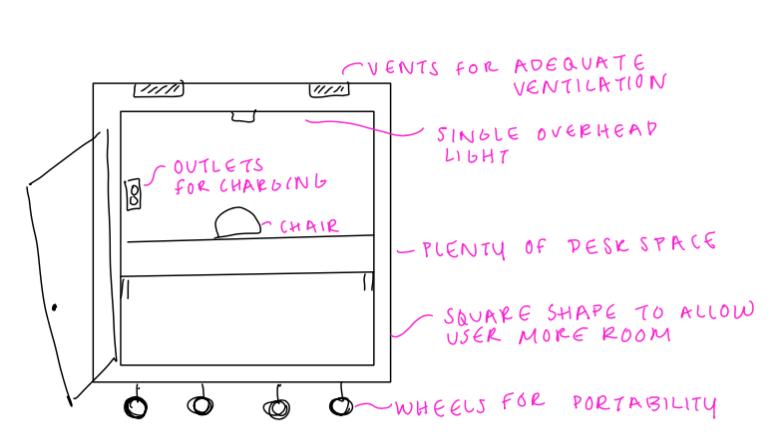
|  |  |
| --- | --- |
| User Needs | Score (1-5) |
| A quiet environment | 4 |
| A comfortable / ergonomic setup to do work | 3 |
| To get work done efficiently | 3 |
| To be able to speak and listen on zoom calls | 5 |
| An inviting environment that motivates the user to get work done | 2 |
| Be able to charge multiple devices | 1 |
| Desk space to take notes or do work | 4 |
| Light enough that it can be moved in and out of a building | 3 |
| Small as possible while giving enough desk space | 3 |
| Portability | 4 |

## Concept Selection

#### Two concept descriptions with sketches



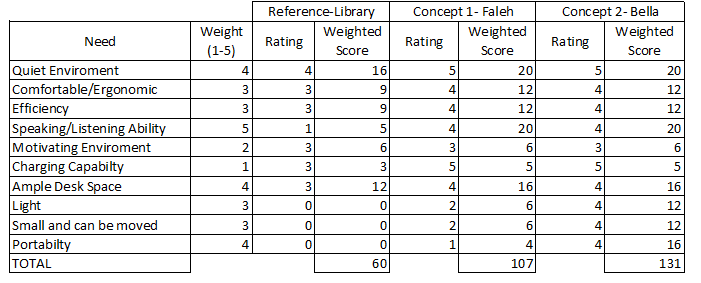
The first concept sketch that was chosen is pictured above and meets most of the user's needs. It is a simple “cube-like” shape with the dimensions of 5ftx5ftx6ft. It includes features such as soundproof walls, charging outlets, internet hotspot, bright lighting, fan/vent, desk, and chair. These features work to address the many user needs of the design. The desk and chair provide a comfortable and ergonomic space to do work that also has plenty of space. The soundproof walls provide a quiet environment where one can talk and listen without bothering others. The charging outlets and internet hotspots are to address the user’s technological needs. The fan/vent and bright lighting address the comfort and create a motivating environment. However, this design fails to meet the user needs of portability and weight requirements.



This concept sketch considers all the updated user needs that the team determined needed to be added. This design has wheels for it to be portable to any workspace, library, etc. that it would need to be transported into. It also has features like outlets for any charging necessities and a single overhead light for subtle, non-distracting light. This design also covers functional needs for the user like overhead vents for proper ventilation and plenty of desk space so the user can spread out while they work. There is enough space for the user to comfortably fit a computer and a notepad/iPad so they can work efficiently in the space. This design provides all the functional and comfortable needs that the user might find useful and allows the user to have a quiet, comfortable place to get their needed work done.

#### Pugh Scoring Matrix

Needs were based off those listed in the user needs charged, and then additional user needs were added based on feedback from industry mentors. They had concerns over the size and portability of the product, so a need concerning this issue was added to the chart. For the first few rows about having a quiet environment, the team ranked Faleh’s, and Bella’s designs the same because they both did an equally good job at addressing these needs. Both had charging ports, lighting, plenty of desk space, and several other factors that addressed these needs. Where these two designs differ is that Bella’s can be moved around and is light while Faleh’s is not designed to be portable. Thus, Bella’s design was ranked higher in the categories of being small, light, and portable.



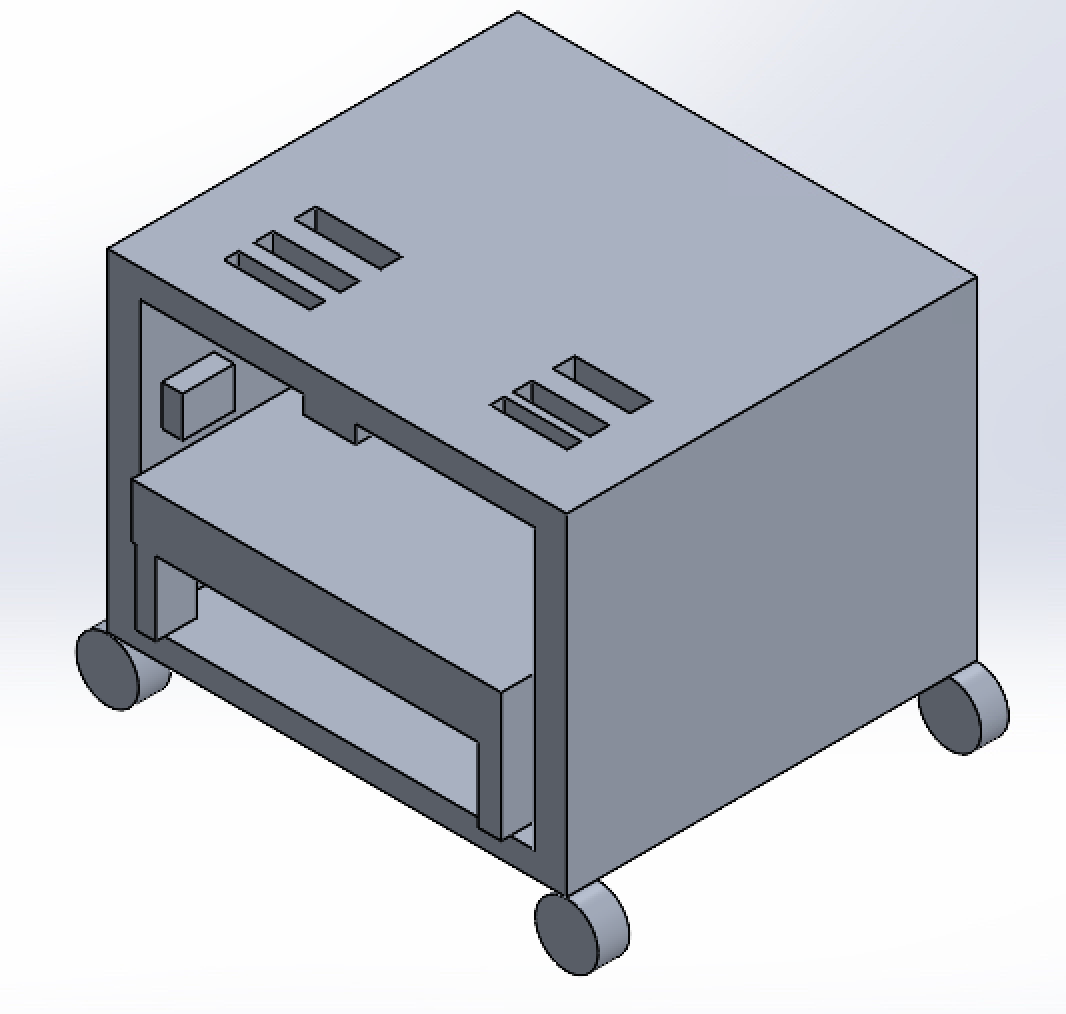
#### Final concept Selection

Based on the results of the Pugh Score Matrix, the team will be moving forward with Bella’s design. Both designs would create good environments where a user can comfortably speak and listen to a zoom call. However, Bella’s design is more portable and would take up less space. This is a key factor in the practicality of the design, so the team will use Bella’s design.

# R3 – Final Design Review

## Description of Prototype

Based on the final concept sketch shown above, our final prototype will be in the form of a SolidWorks design. The final level of prototyping that will be reached is the “prototyping” stage due to the wide range of limitations and delimitations will be encountered. This pretotype will be used to gauge and generate interest in our idea and product. With additional resources, the team then can advance to other levels of prototyping. Online tools and simulations will be used to test and showcase our design and product. Some of the limitations associated with this stage include size, weight, quality, resource, manufacturing and cost constraints as well as general logistics concerns. Some delimitations include our limited design and manufacturing skills and experience. More so, time constraints as well as the scope of this project are also limiting factors.



The preliminary SolidWorks model above highlights the most prominent features of our design. Major features such as the vents, power outlet, lighting, desk, and the wheels are shown. The remaining features as well as adjustments to dimensions and materials will be added during later stages of the prototyping process.

## Prototype Design Requirements

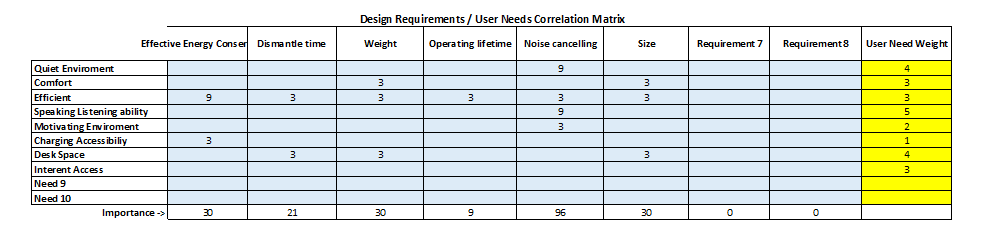
|  |
| --- |
| **Design Requirement** |
| Effective energy conservation |
| Time to dismantle for transportation and storage |
| Weight bearing |
| Operating lifetime |
| Noise Canceling Capabilities |
| Size |

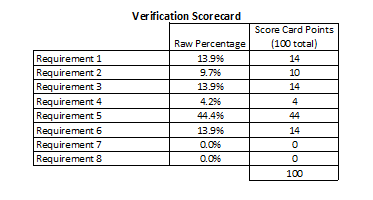
## Testing Methodology/Verification Plan

The weight and size of the prototype will be tested in SolidWorks. The weight will be tested using a stress test and the size using the measurement tool.

Several of the other factors will be verified using research. For example, the auditory dampening will be tested by researching the dampening power of the foam on the inside of the Zoom room.

## Correlation Matrix and Scorecard





|  |  |
| --- | --- |
| Energy Conservation Test | * Full points if outlet uses <8.76 kWh/year |
| Weight Test | * Full points will be awarded if 350 lbs is applied and the stress does not exceed the yield strength of the material * If stress does exceed yield strength, prototype will be repeatedly tested subtracting 50 lbs each time until yield strength is not exceeded   + -.5 points for each additional test that is needed |
| Size test | * Full points will be awarded for a prototype that is 8” x 8” x 8” or smaller * For every .25” that a particular dimension exceeds 8”, .25 points will be subtracted |
| Acoustic | * Full points if dampens 60 dB to < 40 dB |
| Assembly time | * Full points if it contains no more than 15 parts |

## Prototype Fabrication and Evolution

The initial goal for the design was to produce a pod that is soundproof, hold any height or weight and give the consumer their own personal space. After the meeting with the mentors and receiving their feedback, the design changed into a more portable pod that is easily assembled and disassembled and possesses the feel of being in your own personal space.

The first part of the refining process was to figure out the new dimensions and test out the maximum weight it can hold. The team decided to conduct a Yield Strength test on SolidWorks. The initial dimensions were 4x3x6 ft and the initial weight capacity was 350lbs. This test resulted in extremely high stress areas in the center of the pod, the team tried to change materials for that se dimension but nothing major changed so increased to the current 5x4x7 ft. The material was then changed to carbon steel and a test of 350 lbs was conducted. It did not exceed the yield strength of the material and thus passed the test with no major stress on the pod

As for the soundproof walls, the auditory dampening will be tested by researching the dampening power of the foam on the inside of the ZoomRoom.

During this process the team had to take a few decisions that had a huge trade-off regarding some aspects of the design

* Switching the material from plastic to carbon steel was a hard decision because it was necessary to choose between saving money or producing a sustainable product.
* Taking off the wheels was another tough decision because the wheels would have saved time transporting through a building and made it easier just to wheel it around, but that would have prevented the ability to disassemble the pod which in the bigger picture is a more important than the wheels.

## Final Prototype Design

The prototype matches the research and development findings in many ways. It is the perfect size to fit in a typical floor, since ceiling heights are usually 9’ (Jernigan, 2021). The SolidWorks testing shows that the material will be strong enough to hold 350 lbs., so the Zoom Room will not break if another person steps inside. While not included in the SolidWorks model due to the limited materials available, the research shows that the auditory dampening foam would provide sufficient sound dampening. And, since it was noted in the research that being able to charge devices during online classes is important, the Zoom Room has an easily accessible outlet.

The first two nonstandard parts are the ceiling and window that fit in the ceiling. The window is a glass square centered in the ceiling (which is also rectangular). The idea is that the window will let in light. The next part is the floor. It is a square on which everything else is built. Another nonstandard part is the door. It is a rough approximation of what the door would look like. A short sphere represents the doorknob. Next are the back wall and side walls. These are rectangular squares of metal that serve as the walls of the Zoom room. All parts mentioned thus far have been made from plain carbon steel except for the window. Then, there is the outlet. It is a rough approximation of the size and shape of an outlet. If it were in more detail, it would have four outlets, two on each rectangle. This is made from Rigid PVC, as is typical of outlets. Finally, there is the desk. It has four legs, is not physically attached to the zoom room, and provides plenty of desk space for the user.

The metal parts of the zoom room would be made by molding the metal. Holes for screws would be drilled in the sheets. These metal sheets would be assembled by the user using screws. The plastic outlet would also be molded. Electric wiring would be assembled in the factory and would only involve the wall that has the outlet attached to it. The glass would be made in large panes and then cut to size. It would be fit into the ceiling on the manufacturing floor using notches and adhesive. Finally, the table would be cut from sheets of wood. It would come in a flat pack and the user would assemble it with screws and nails.

## Final Verification

Through testing, the following six metrics were verified. These were selected with the user needs in mind.

#### Stress Test

The first was a stress test in SolidWorks. This test was done on the floor part and analyzed how the floor behaved under 350 lbs. This metric was set with the idea that if a second person stepped inside the Zoom Room it would not break. While it is only designed for one person, realistically someone else will likely come inside at some point. The team found that the force did not exceed the yield strength of the material, thus it passed.

#### Size

The second metric that the team wanted to analyze was the size. It was necessary to make sure that the size would fit under an average ceiling, and not take up too much space in the length and width. Upon research, it was found that the average ceiling is 9’ tall (Jernigan, 2021). So, it was decided that the prototype should be less than equal to 8’ x 8’ x 8’. The design is 4’ x 5’ x 7’, so it meets this metric.

#### Acoustic Dampening

To dampen the sound that enters the pod, the Zoom Room was designed to have acoustic dampening foam. The goal was for a 60 dB sound outside the pod to be dampened to 40 dB inside it or vice versa. Upon research it was found that the foam reduces sound by 40% ("What does the NRC Rating"). This would dampen a 60 dB sound to 36 dB, so the prototype also passes this metric.

#### Time to Dismantle

It is important that the prototype be easy to dismantle, and goal was for it to take less than thirty minutes to dismantle. It was reasoned that each part would add about two minutes to the assembly process. Thus, the goal was set for the prototype to have fifteen parts or less. The prototype has eleven parts, so it does pass this validation test.

#### Operating Lifetime

To identify the operating lifetime, individual components were researched to make sure that each would last more than the goal for the overall lifetime. The goal was for the pod to last more than 7 years. The walls and ceiling are made of high-density polyethylene (HDPE), and the research showed that this material lasts upwards of 50 years (“Life Expectancy”). The solid wood furniture was estimated to last 10-15 years (“How long real wood”). The outlets were estimated to last 15-25 years (“How long do GFCI”). Finally, the expected lifespan of the steel floor is about 35 years (Cooper, 2014). This shows that the product with the shortest lifespan is the wood furniture, which lasts 10-15 years. Since all components last more than 7 years, the design passes this validation test.

## User Validation

The team determined that the three highest ranked user needs were listening/speaking ability, quiet environment, and desk space. The design was created to allow users to speak and listen in meetings without being interrupted or interrupting others. It also insulates the user from outside noise and distractions using a sound-proof foam coated inside the pod’s walls. Finally, the design has ample desk space and a smart outlet for any charging abilities that the user might need. The final design was presented to the industry mentors and their feedback was taken into account. Given this feedback the design was changed to be a bit harder to disassemble to prevent theft and design the pod more spacious or with more windows to prevent user claustrophobia.

## Impact Project

The main value that this product brings is improving the academic performance of students by providing an environment that encourages them to be more engaged in zoom classes. This product was designed with the idea of dormitory buildings buying these to put in common rooms. It was estimated that the costs would be about $700, and the selling price was set at $2,000. A breakdown of how these costs were estimated is provided in the appendix. This would be within the budget of a dormitory building and therefore would not need to be subsidized.

#### Economic Impact

The three main categories that the costs would fall under are Research & Testing, Manufacturing, and Upkeep. Research & Testing involves researching the user ad their needs, prototyping the product, and getting user feedback. Manufacturing is the most expensive category; it involves making and shipping out the product. Additionally, it would be necessary to advertise to the target audience so that they are aware that this product exists. The advertising category contains the costs associated with this. The main way of advertising this would be sending company representatives to talk to the people who oversee student housing and sell them on this idea. Advertising space on paper or digital media consumed by those in charge of student housing would also be purchased.

The main source of revenue would be from schools purchasing this product. This product will also have official mechanics to work on the Zoom Rooms if they get damaged or need regular upkeep. This would be a smaller additional source of revenue.

#### Social Impact

The social impact of this project mostly focuses on student improvement. It helps students reach their academic goals away from all distractions and provides them with a space to feel the classroom vibe away from the classroom. This product will have a positive impact on the students' performance. It eliminates distractions by placing you a in “study bubble”. It also might act as a motivator for students to study because it might feel as if they have their personal space to attend school, in a sense their own office. These factors are the ones that will lead students to improve their academic performance. The only complication that might have to be addressed is taking up space, it requires public space so some might not like the idea of it taking open space in buildings.

## Recommendation

The next step would be making a couple of design adjustments. The main one would be replacing the back wall with a glass wall. This was a recommendation made by the industry mentors after the final presentation. Additionally, the material of the floor would be changed from carbon steel to regular steel. When cost analyses, it was found that steel is much less expensive than carbon steel. It would need to be verified with testing, but regular steel would likely be sufficient for the needs of this product.

The next step would be moving on to making a physical prototype. The overall idea for the product is to be like flat pack furniture. One of the main aspects that would need to develop is how the sides are attached to each other. Testing would have to be done on how well screws would work to assemble products, and then the physical prototype would be developed from there.

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# Appendix

1. Brainstorming

The following shows our brainstorming ideas for possible problems and products to solve them:

-Charging electronics

-How to prepare for a virtual class

- Checking for assignments and due dates

- Keeping track of course work

- Updating technology

- Zoom calls

* Finding place to study
* how to be Interactive through zoom

-Getting enough exercise

* walking to class
* Scheduling time for exercise

-Commuting to work

-Taking care of pets on campus

* Dog controlled garage doggy door

-Sustainable travel

* Public transit
* Electric scooters
* Walking
* COTA

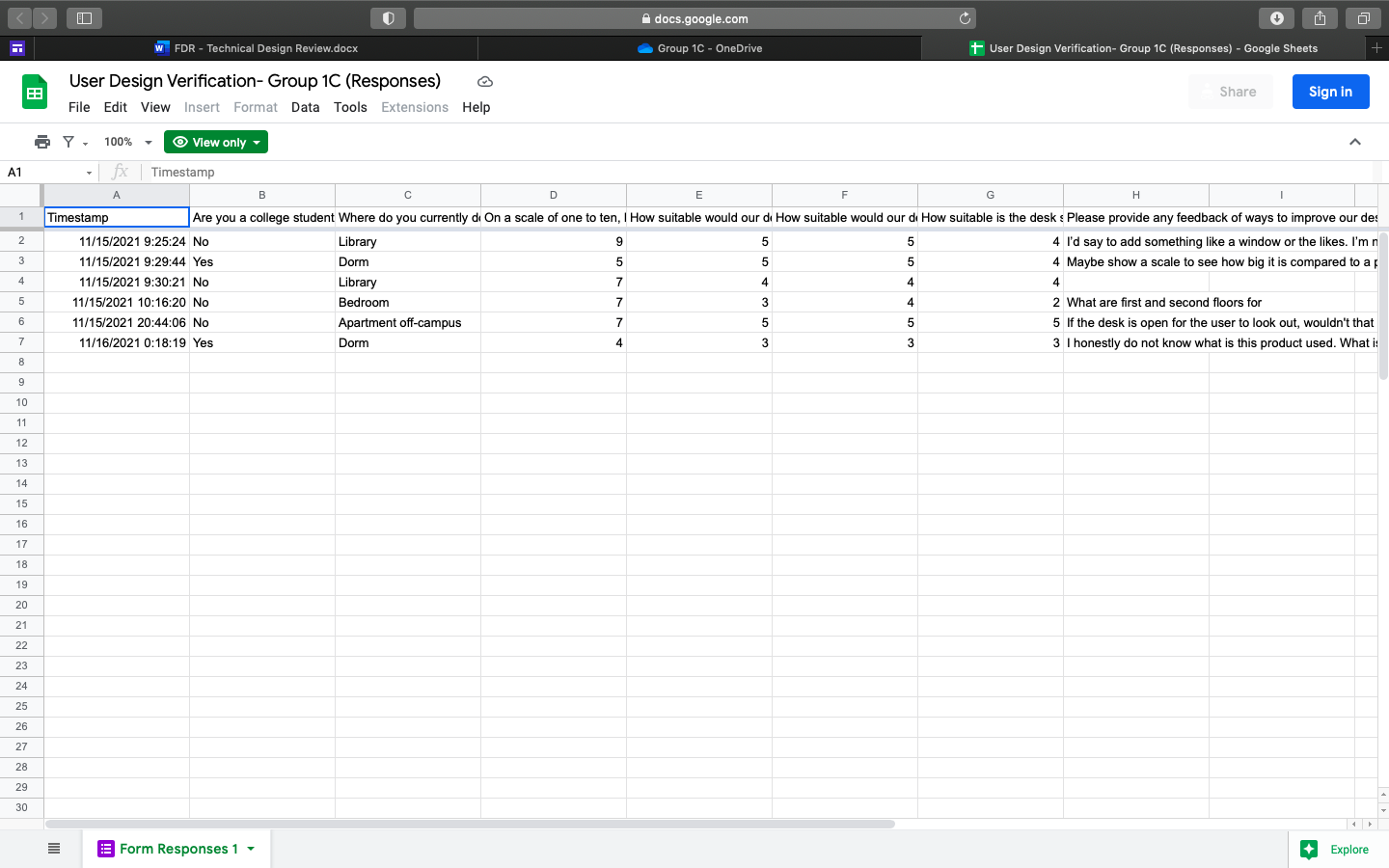
-Recycling

* Knowing what to recycle

-dining halls

* Waiting in line
* all u can eat
* socializing

1. Research Methodologies



1. Prototyping Plan

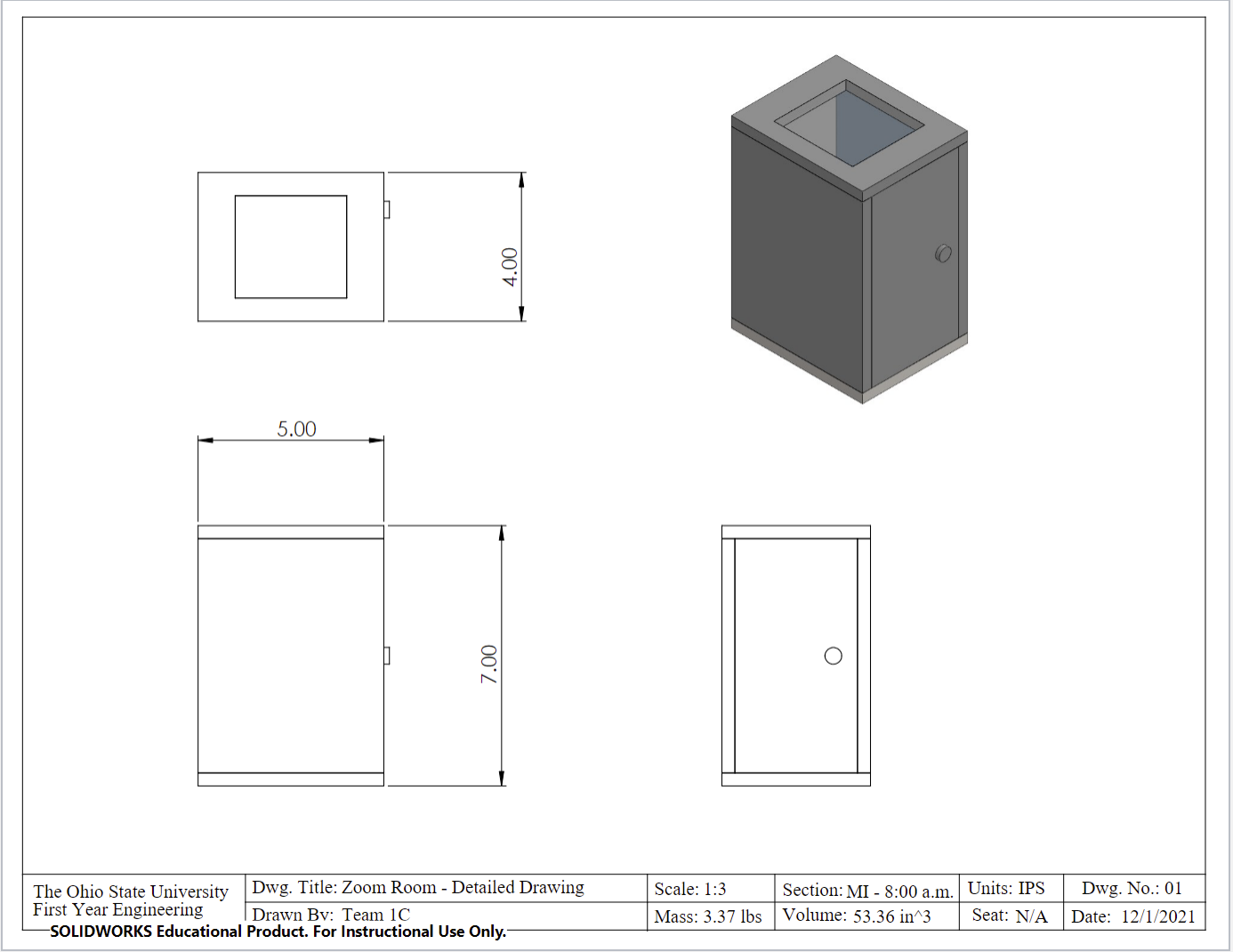
The following is the initial description of the prototype:

Based on the final concept sketch shown above, the final prototype will be in the form of a   
SolidWorks design. The final level of prototyping that will be reached is the “prototyping” stage   
due to the wide range of limitations and delimitations will be encountered. This pretotype will be used to gauge and generate interest in our idea and product. With additional resources, the prototype can then be advanced to other levels. Online tools and simulations will be used to test and showcase the design and product. Some of the limitations associated with this stage include, size, weight, quality, resource, manufacturing and cost constraints as well as general logistics concerns. Some delimitations include our limited design and manufacturing skills and   
experience. More so, time constraints as well as the scope of this project are also limiting factors.

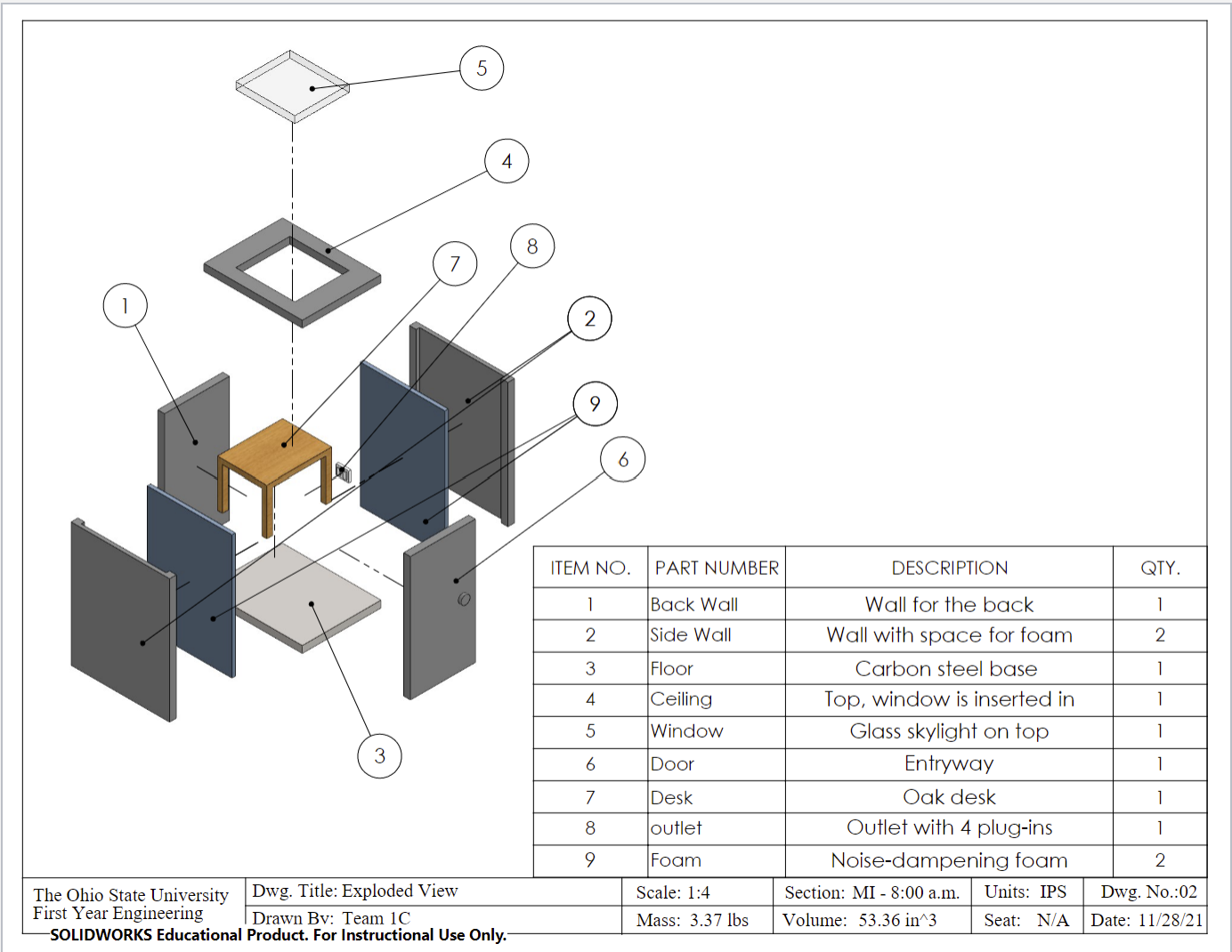
The following table shows our initial design requirements that we came up with:

|  |  |  |
| --- | --- | --- |
| **Design Requirement** | **Threshold** | **Goal** |
| Effective energy conservation | 1200W-1800W | 1400W-1500W |
| Time to dismantle for transportation and storage | 15 to 30 minutes | <20 minutes |
| Weight bearing | >250 lbs | 350 lbs |
| Operating lifetime | >5 years | 7 years |
| Noise Canceling Capabilities | 50 to 130 decibels | >110 decibels |
| Size | 6x6ft - 9x9ft | >5x4x7ft |

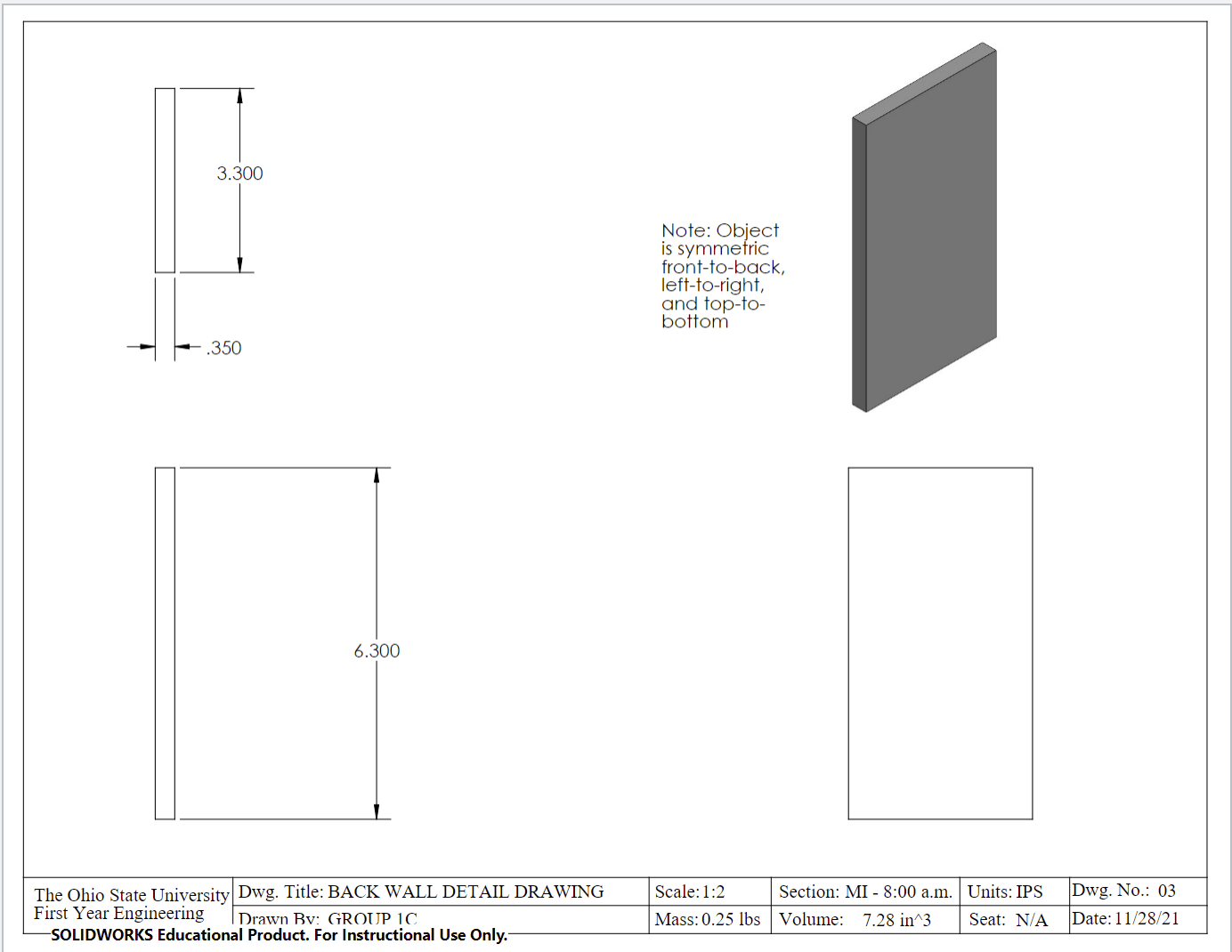
1. Detailed Design Documents
   1. Multiview Drawing

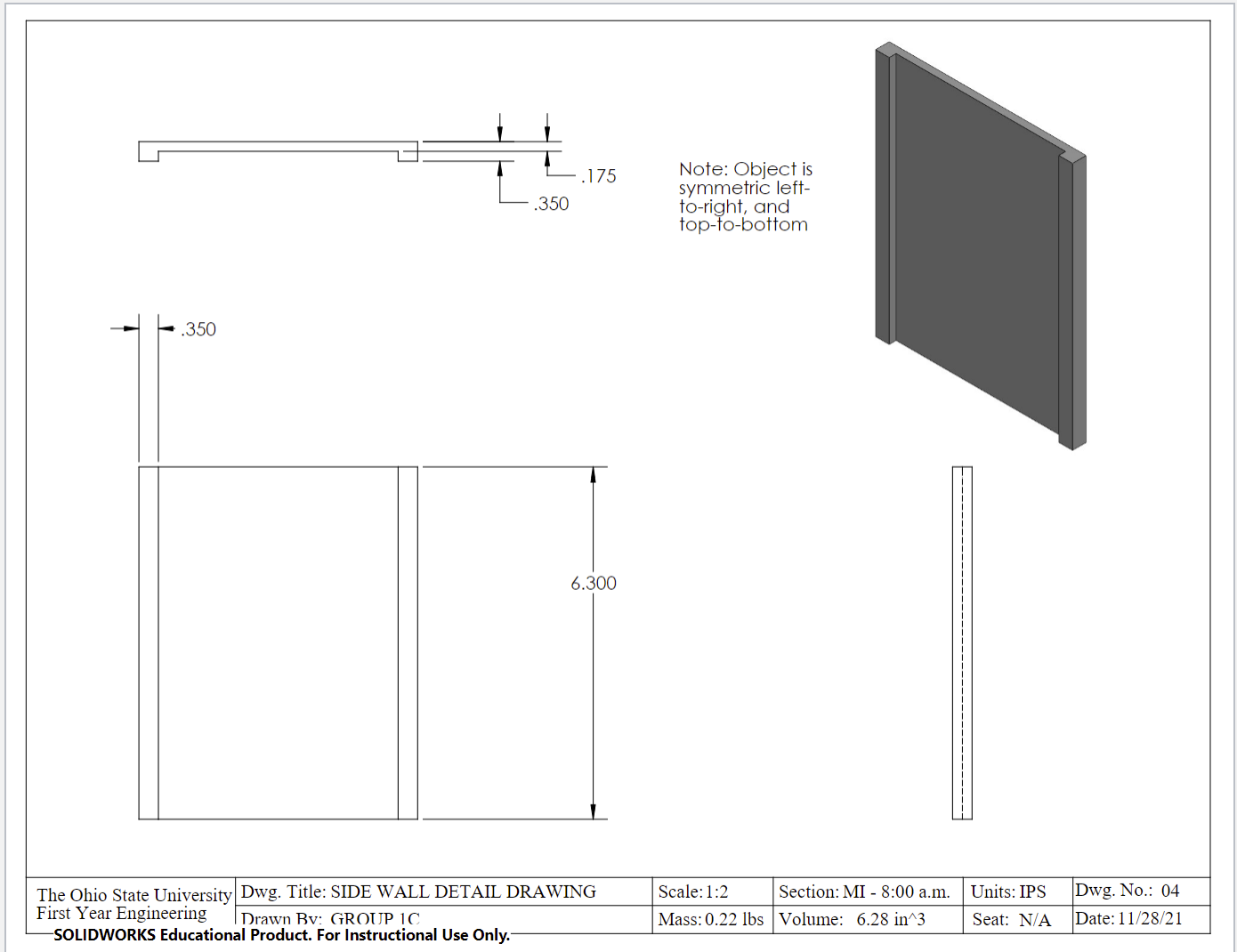


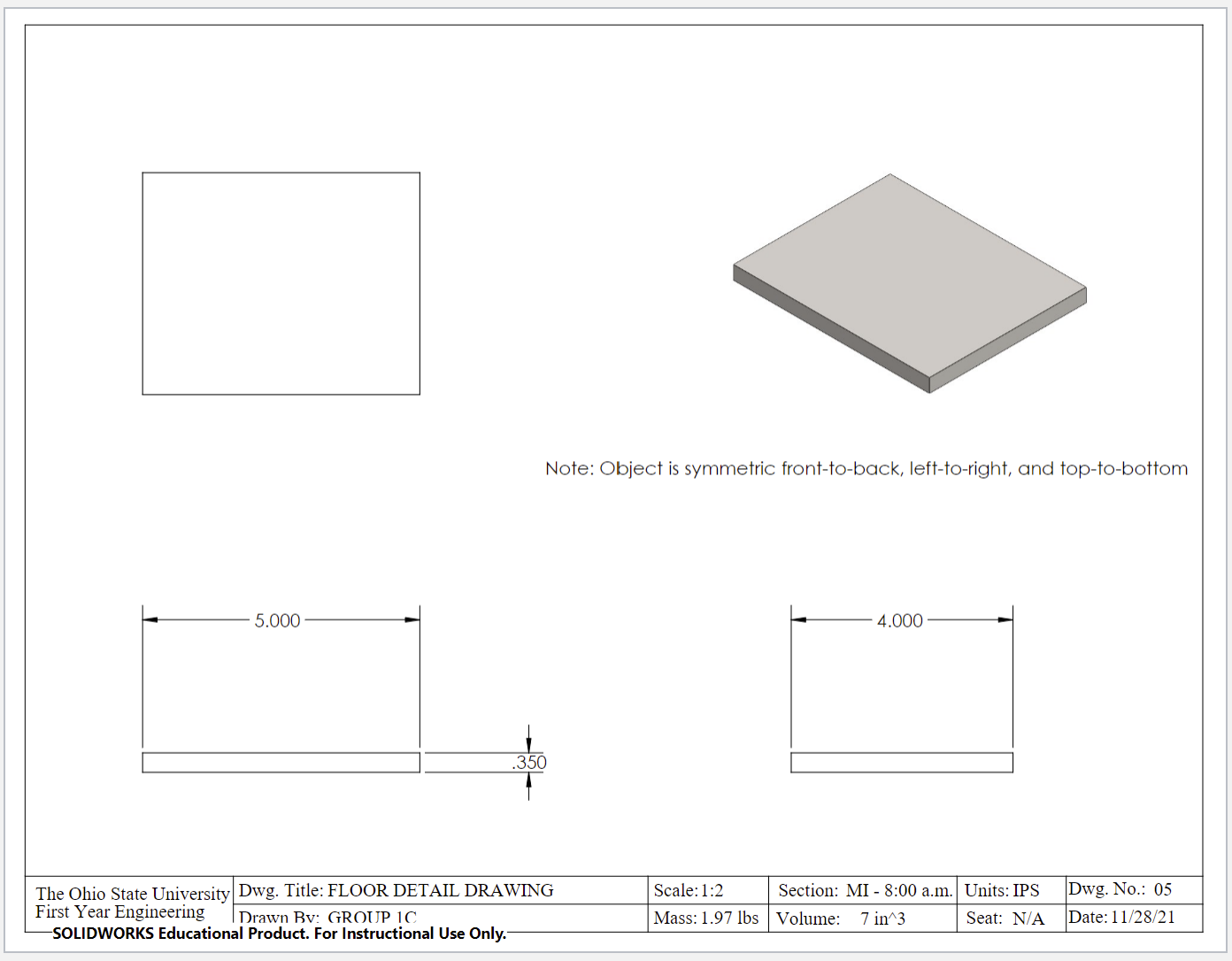
* 1. Exploded Assembly Drawing with BOM

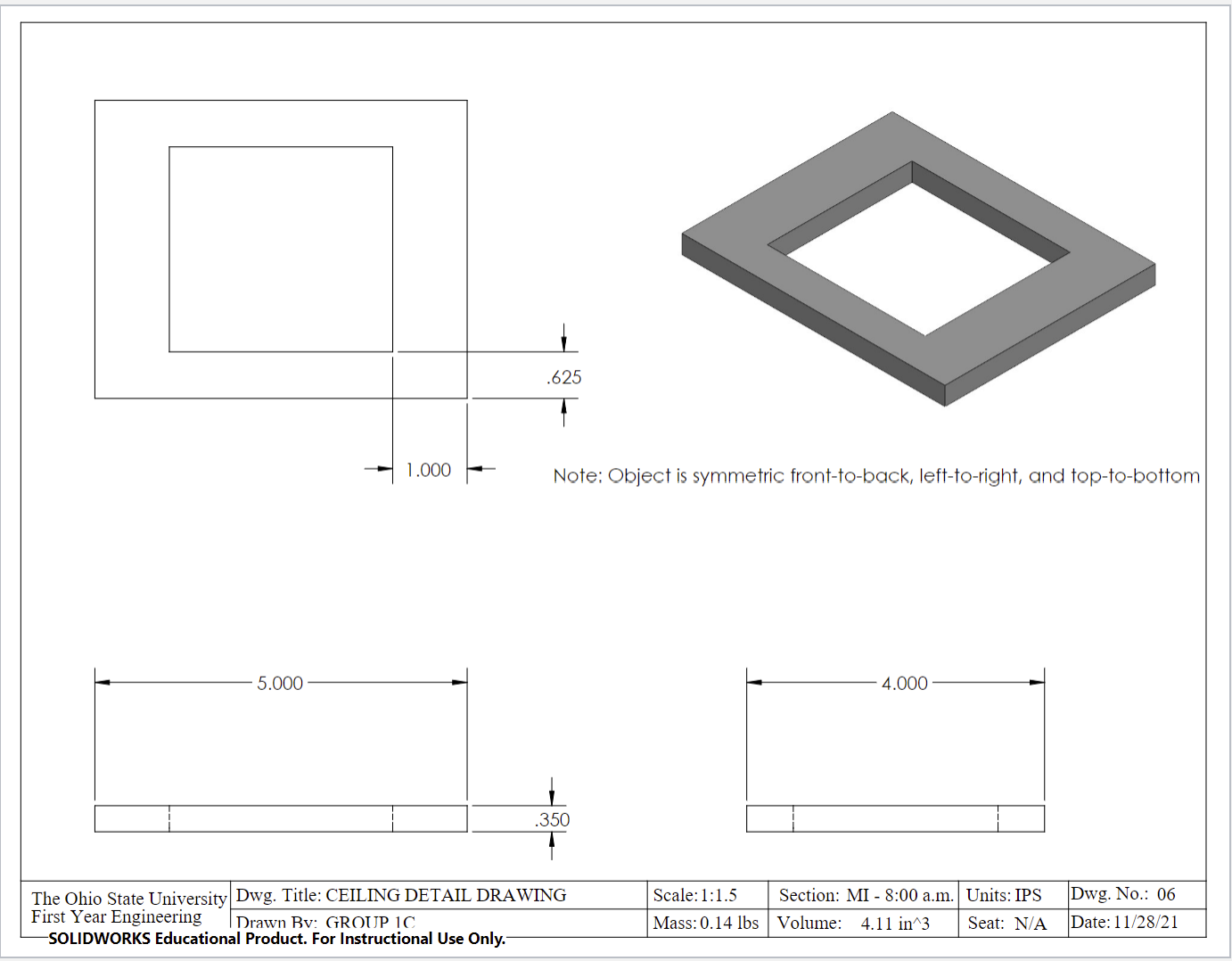


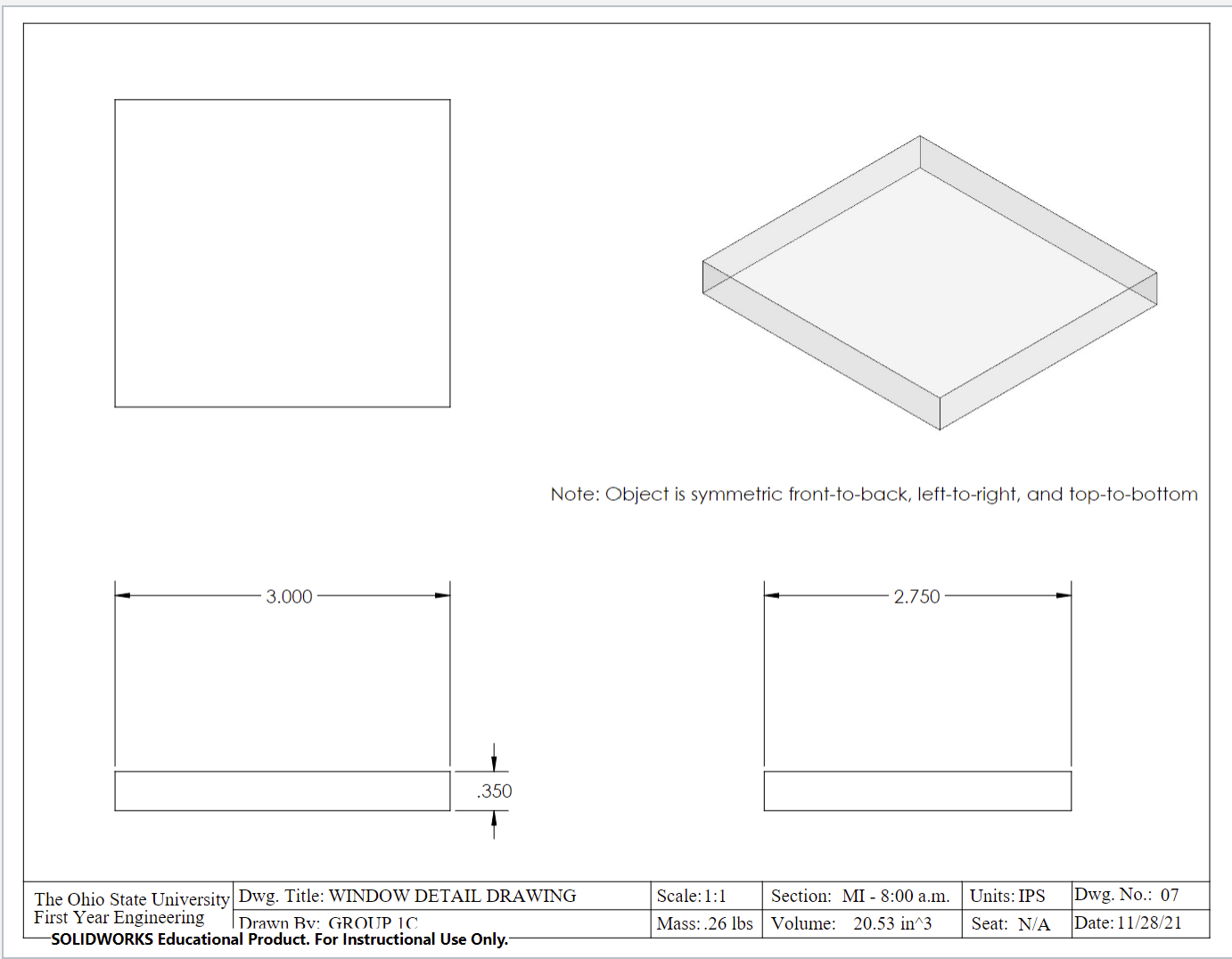
* 1. Detail drawings for fabricated parts

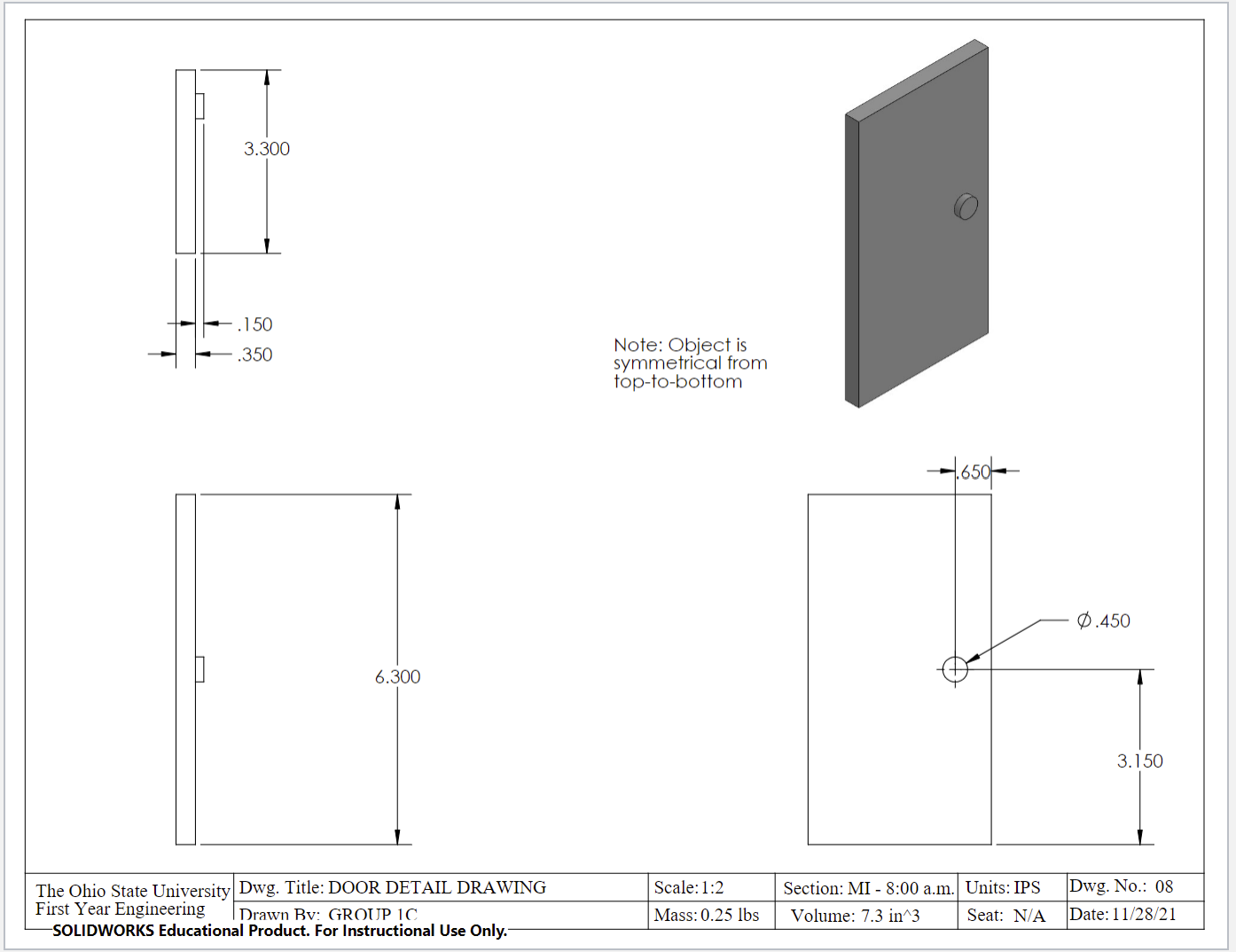


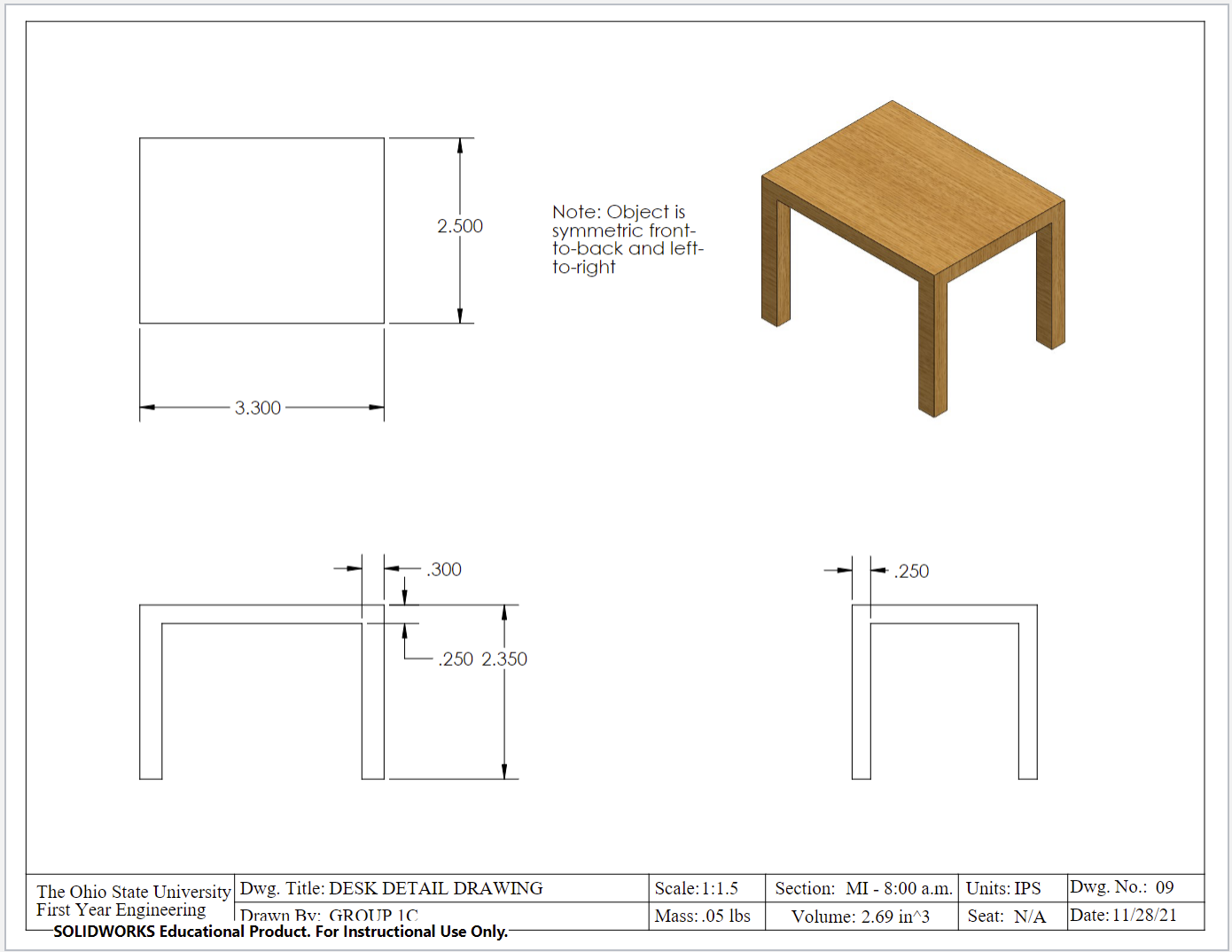


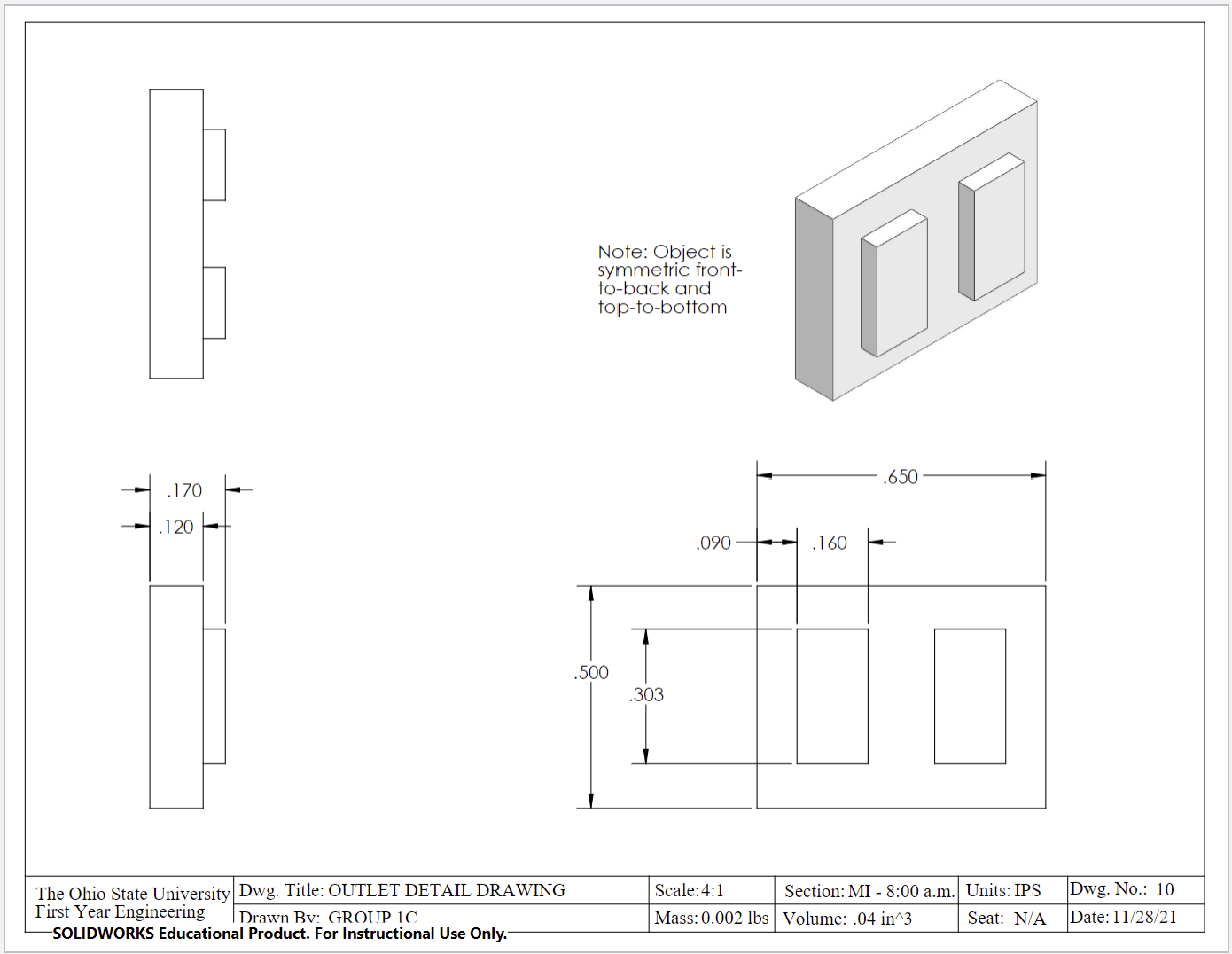


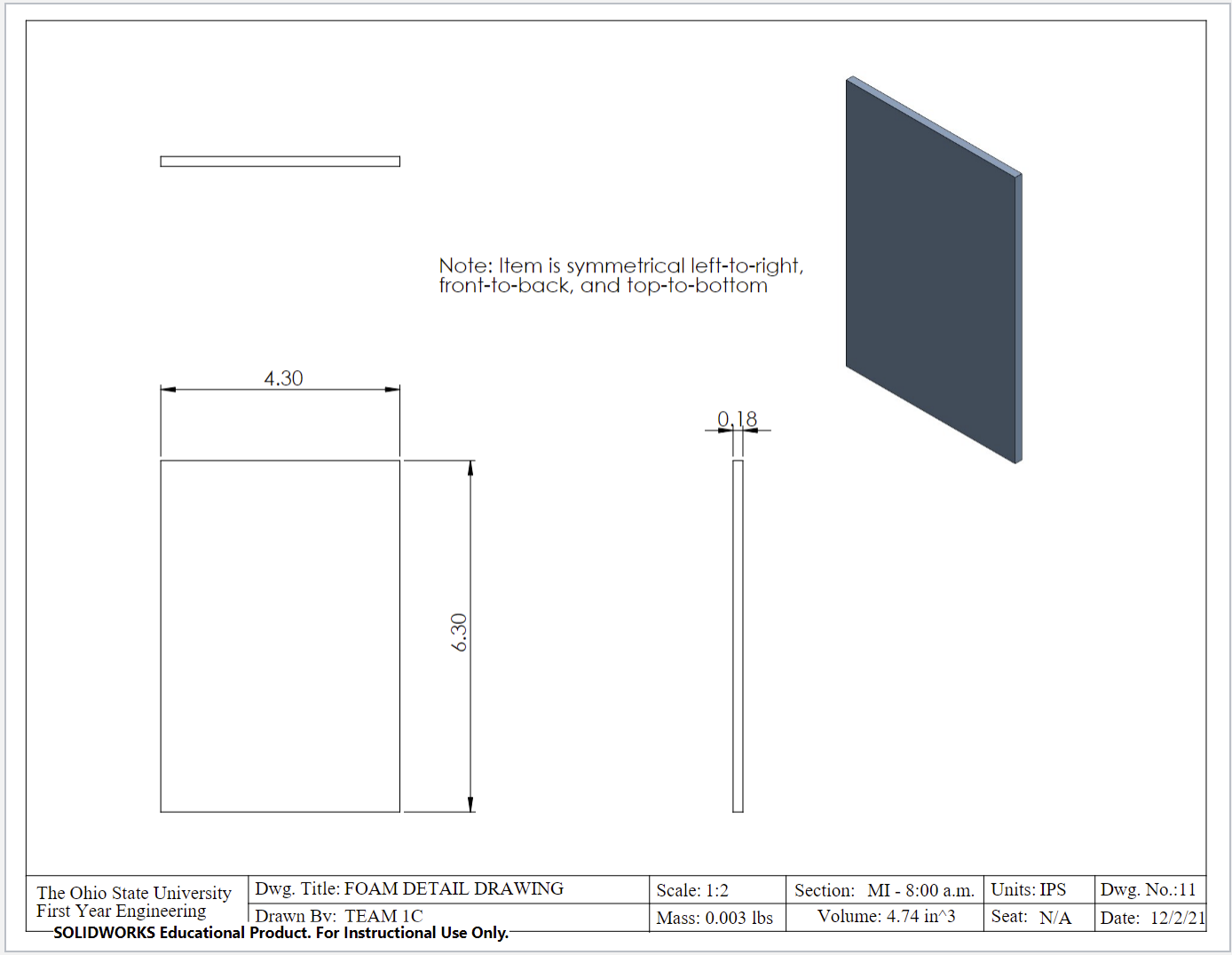












1. Raw Data
   1. Plan of pricing
      1. Exterior Material ( $254.30 )
         1. ("BuyPlastic Natural White")
      2. Interior Material ( $120 )
         1. ("Tyumen 100 ft")
         2. ("VINEXT computer desk")
      3. Manufacturing Overhead ( $280 )
         1. ("Car production cost breakdown")
      4. Marketing ($50)
      5. Total ( $704.30 )
         1. Selling Price $2,000
            1. Revenue: $1,296
2. Team Working Agreement

**Team Working Agreement**

Autumn 2021

1. Group Information

Lab Section #: 28368

Table Letter: 1C

Instructor: Dr. Ita

GTA: Alexia Leonard

1. Contact information

|  |  |
| --- | --- |
| Mohammed Abdallah | [abdallah.69@osu.edu](mailto:abdallah.69@osu.edu) |
| Faleh Alzoubi | [alzoubi.2@osu.edu](mailto:alzoubi.2@osu.edu) |
| Bella Scholtes | [scholtes.4@osu.edu](mailto:scholtes.4@osu.edu) |
| Victoria Smith | [smith.14610@osu.edu](mailto:smith.14610@osu.edu) |

1. Team Goal

As a team we will strive to work together to achieve the best possible outcome in every assignment. Every member will have to put equal amounts of effort into every project to make it the best possible. Roles will be distributed evenly and fairly so everyone does the same amount of work and not one single member does most of the work. All members should contribute to assignments and in meeting to reach the best results as group.

1. Meetings

The group will communicate through a Group Me group chat and email. Group chat messages will be sent out at least once every week to go over the coming assignments. Group members are expected to respond to messages on group me or emails within 24 hours. If we need to meet on zoom, we will do so on a Tuesday, Wednesday, or Sunday, and the time will be decided in the team Group Me. If any unexpected conflict arises, we will set up an emergency meeting through Group Me to discuss when is the best time for all to meet. Furthermore, the group will use breakout room time to discuss assignments, due dates, questions, comments, and concerns any member might have. Due to difficulty of scheduling meeting outside of class, members should use breakout room time to participate as much as possible.

1. General Team Member Expectations

Each team member is expected to attend all lectures/labs in order to keep up to date with the materials so they can participate in our weekly meetings. If a team member must miss a section, they are expected to communicate that to their other team members. Workload, brainstorming, and development will be equally split between each team member. All members will do the tasks that need to be done while working with each other when they need help. Each team member must be responsible with their time and their teammates time in order to get assignments done by the deadline. Each team member is responsible for participating and contributing to group discussions. Each team member must be respectful and understanding of other team members. Each team member is to be held accountable for their portion of the project and assignments. Each team member is to give constructive feedback to the other team members. Team members should communicate issues and conflicts respectfully. Team members should communicate often or when questions or suggestions arise for an assignment. Team members are expected to work on their part of the assignment early so that we don’t rush the assignment and turn in the best possible product.

1. Individual Team Member Responsibilities/Deadlines

Mohammed Abdallah – Creating and sharing documents (Ex. a word doc) for the group to work together on.

Faleh Alzoubi – Note taking during brainstorming and development.

Bella Scholtes – Schedule and send out zoom meeting links.

Victoria Smith – Review assignment and corresponding rubric and submit group assignments.

1. Conflict Resolution

Team members should speak about any problems or conflicts that arise. If any conflicts arise, all members of the team will meet at our weekly zoom meetings and address the problem. All team members will work together to formulate a good solution to the problem that everyone agrees with. If this conflict cannot be resolved by this method, the instructional team will get involved to work out a solution that works best.

1. Expectations of Faculty and GTAs

If a team member fails to comply with this agreement, the situation will be reported to the staff. The team will continue to be responsible for submitting all assignments. Staff will be available to meet with teams to resolve issues. Staff are expected to help resolve team disagreements in the fairest way possible.

1. Team Signatures

Mohammed Abdallah

MBA



Faleh Alzoubi



Bella Scholtes



Victoria Smith