The Robins

Deliverable D - Project Schedule and Cost

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Client: Frederick Conn

Abstract

This report presents the design and development of our team's bat box design which is equipped with a touchpad back sensor, to enhance our understanding of bat activity and provide a safe place for endangered bats. The objective of this project is to create a functional environment that not only attracts bats but also allows for real-time monitoring of their behaviour using our sensor. The report details each team member's personal design, our global concept designs, and finally our finalised design. It also outlines the construction materials that will be used, such as cedar wood for durability, and the dimensions & features of the bat box, such as ventilation holes, a slanted roof to prevent debris accumulation, and a secure hinged door for easy access. The touchpad back sensor is the vital feature of this bat box, as it provides precise data on bat entries and helps to track occupancy patterns throughout the seasons. This report showcases the design process of each team member, along with the finalised decision made as a team, and portrays the next steps we are going to be taking into creating our bat box prototype.

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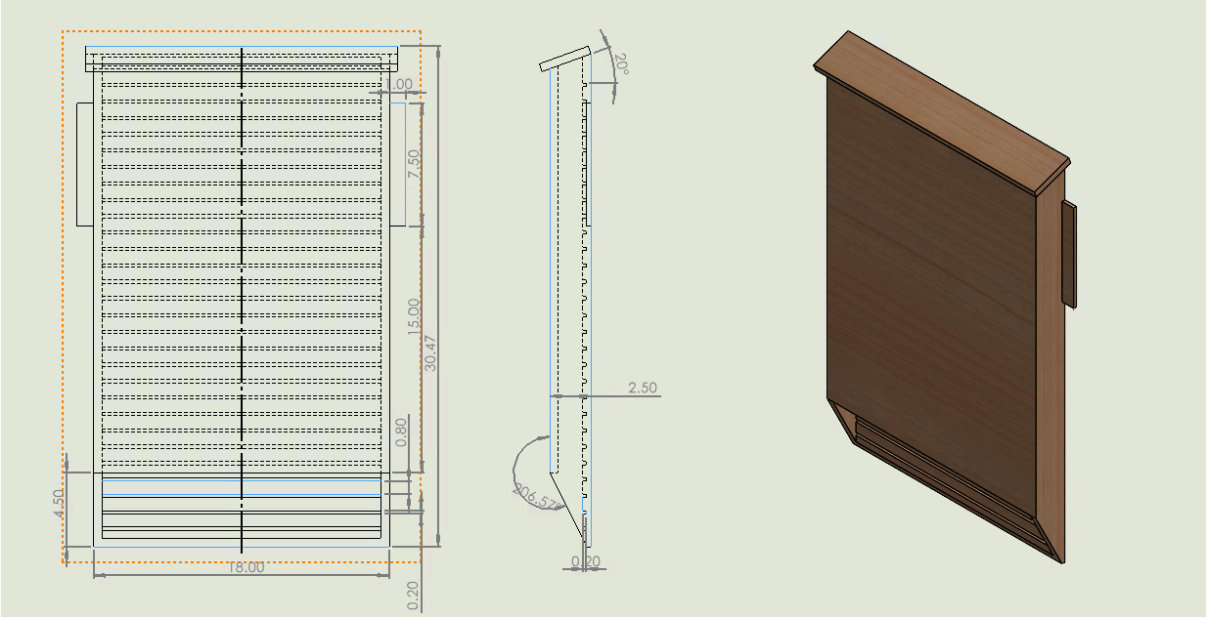
1. Introduction

In this deliverable, each team member is proposing a design for a bat box that meets the design criteria outlined in Deliverable C. The positives and negatives of each design will be discussed and global designs will be created from the information discussed. These global designs will be based on the elements of each of our team members' designs, taking what we have determined is best from each design and eliminating the least effective design elements. These global designs will then be evaluated and from this, we will determine our final design that incorporates the best elements from the global designs.

As discussed in Deliverable C, the bat box must be weather resistant and protective of the bats, have a bat capacity of 50-150 in 1 chamber, be roughly 25.5x18x2.5 inches in size and be made of cedar wood. The bat box must be roughly 3.7 pounds or less and cost less than CAD 39.99 to produce and install. The bat box should also be easy to install and easy to maintain/clean. With these criteria in mind, the following team member designs have been created.

2. Team Member Designs

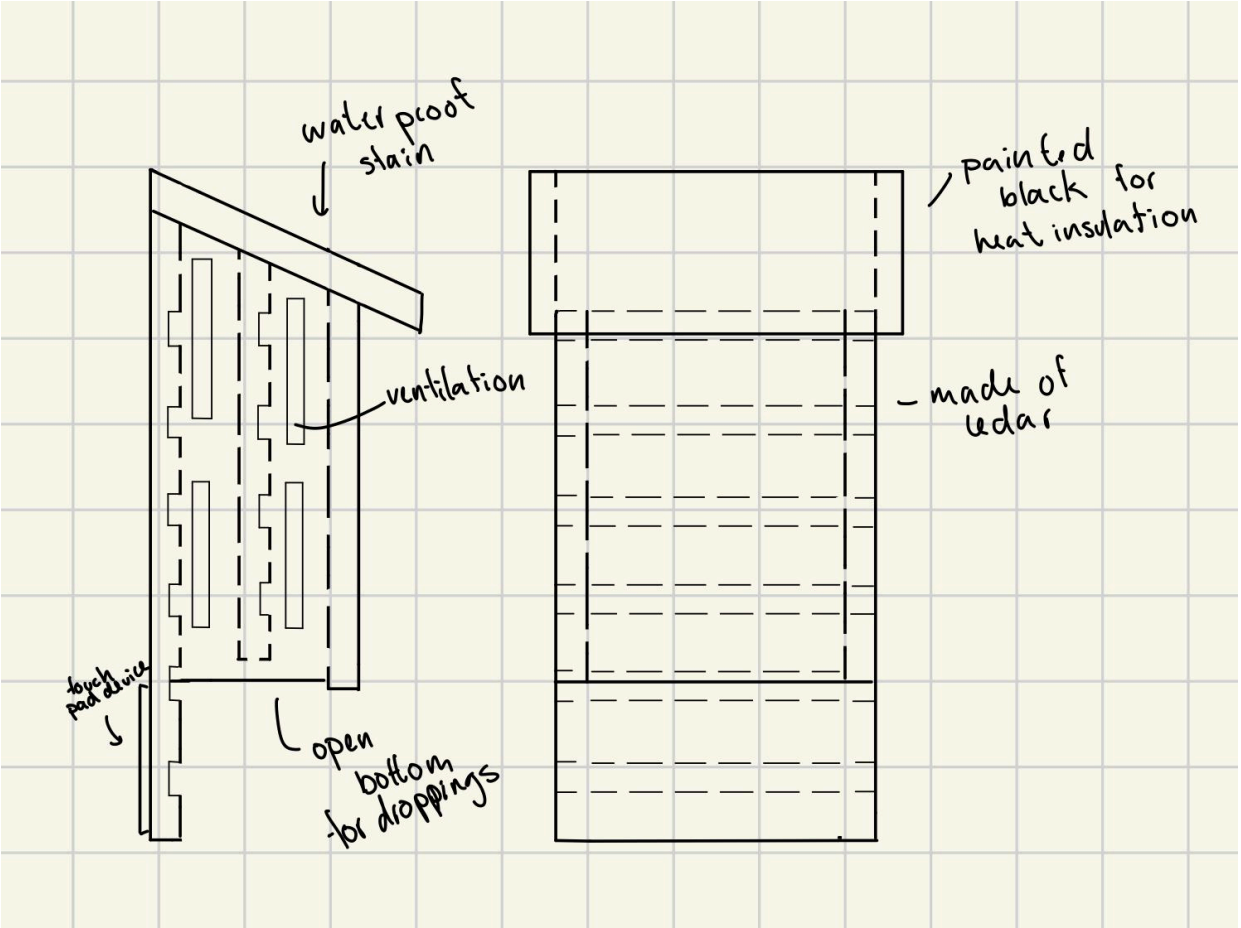
2.1 Jonathan Pereira



This design follows the length, width and height criteria while adding about 4.5 inches of height for a landing space for the bats. The back wood panel has 0.2-inch wide and 0.2-inch deep slots for the bats to grip onto to climb in and roost. The roof is sloped to allow rain and snow to more easily slide off and not pile on top. Small pieces of wood are positioned on each side sticking out 1 inch beyond the box's width to allow nails or screws to be drilled in to mount the box on a wall or tree. The box is made of cedar as specified in the design criteria. The walls of the box are 1 inch thick and are stained brown to allow for insulation during the winter months and absorption of heat from the sun, but the wood is not

painted black to avoid overheating the enclosure during the summer months. A counting mechanism, whether that be a vibration sensor or an infrared laser can be easily mounted via a clip, glue, screws or another method to the wood on the sides of the entrance. The colour of the wood is meant to not only be able to absorb heat from the sun but also look aesthetically pleasing in urban environments. One possible challenge of this design is the weight. The thick cedar wood will likely bring the weight of the box above 3.7 lbs.

2.2 Maria Hal



For this concept, the bat box has a vibration sensor device that is attachable to count the bats as they fly into the box. For weather resistance, the box is painted black, made of cedar, and painted with a waterproof stain, along with ventilation openings on the side. The box itself has two chambers which should allow for a large number of bats. Cleaning would be minimal considering that the box has an open bottom and wooden groves. The box itself has a slanted roof to allow water to run off.

2.3 Lara Al Nakeeb

Figure 1

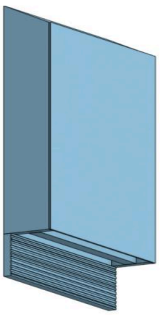


Figure 2

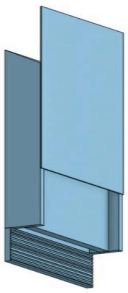


Figure 3

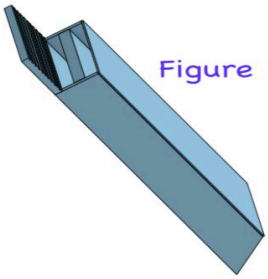
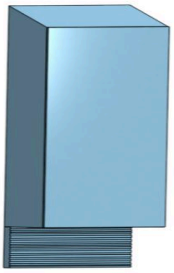
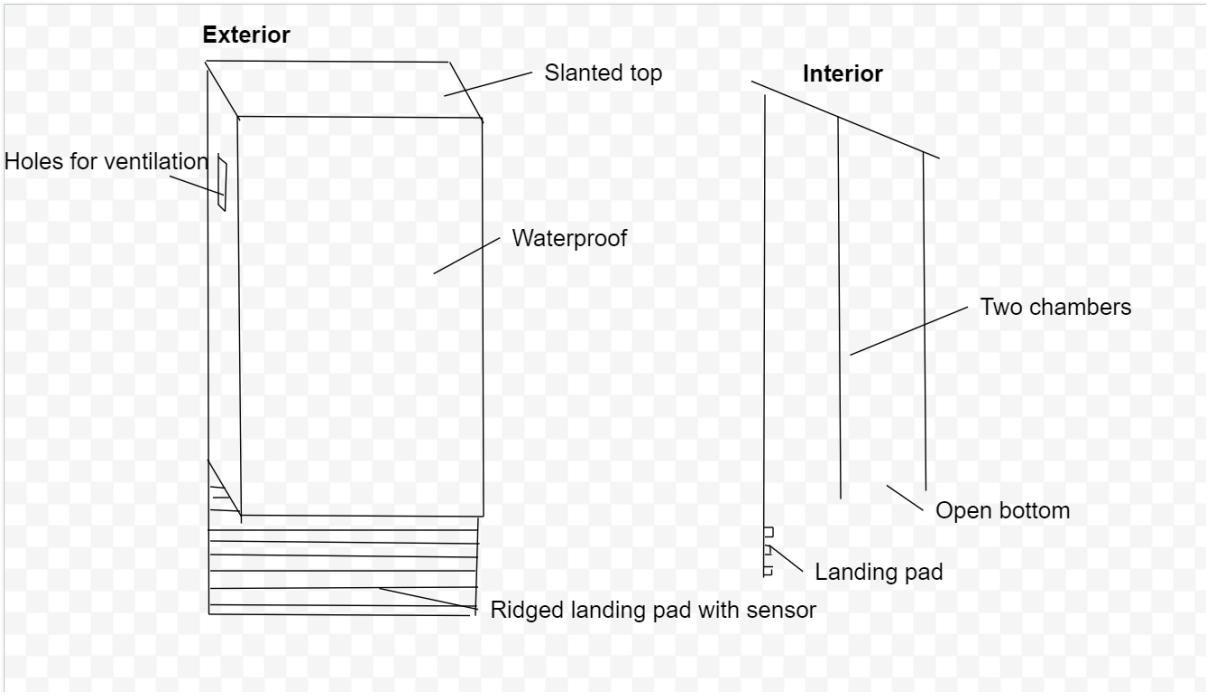


Figure 4



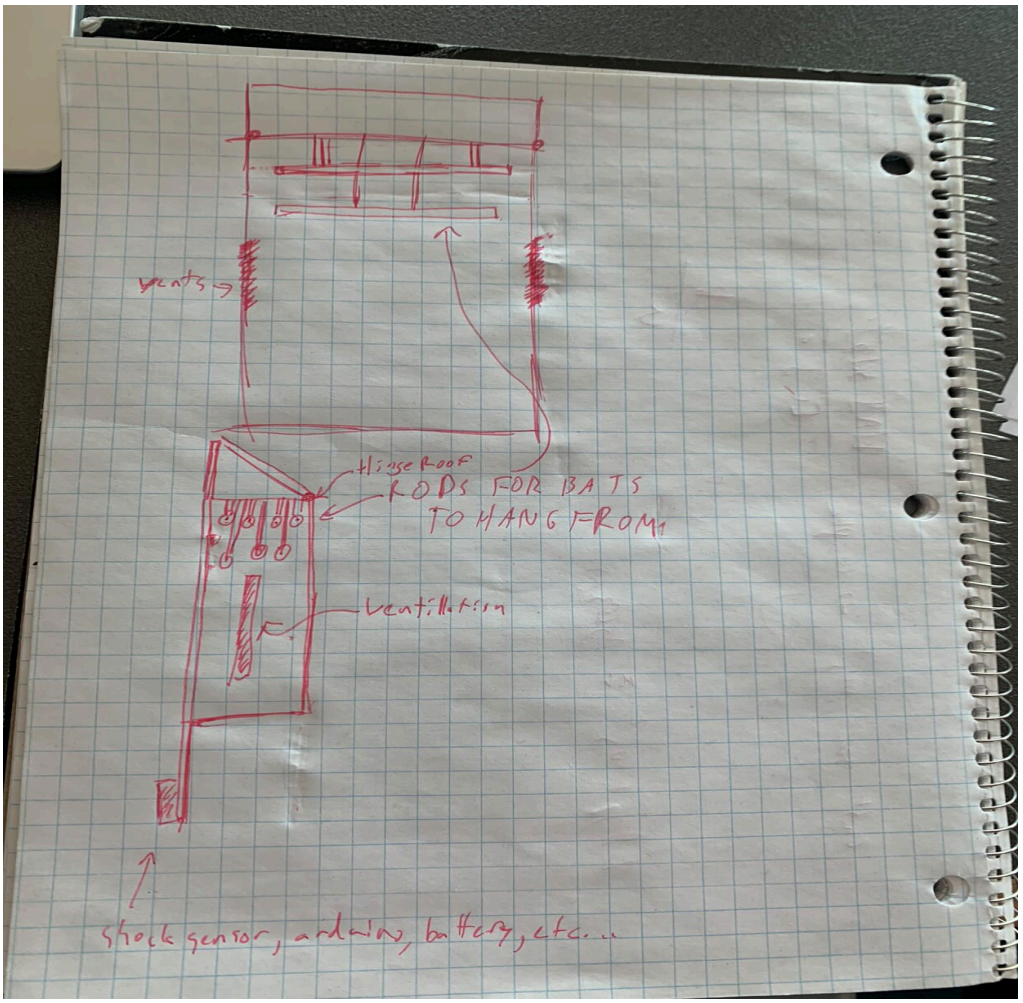
This design focuses on features that will not only benefit the bats but also help with easier cleaning. As shown in Figure One, the landing platform is textured, providing a secure grip for the bats as they land and climb into the bat box. This texture is very crucial for helping them climb into the box. Moving to Figure Two, I opted for a sliding door to ease the cleaning process of the box. However, while a sliding door is more convenient, I realized that a hinged door may be more reliable as hinged doors are easier to open and close and are less likely to get stuck in compared to the sliding mechanism, which can sometimes jam. In Figure Three, we see the design shows two separate chambers within the bat box. This feature is beneficial as it allows for multiple bats to fit without overcrowding, thus providing them with a more spacious environment. However, this design does create a challenge for cleaning both the front and back chambers, as each chamber will require to be cleaned separately. Lastly, Figure Four shows a slanted roof design. This slant is intentional, as it serves to prevent the piling of debris such as snow, leaves, and rainwater on the top of the bat box. The slanted feature helps maintain the structural integrity of the box. Excess weight from piled debris could potentially lead the bat box to collapse. Additionally, rainwater and snow may lead to the wood deteriorating over time. By incorporating this slanted rooftop, the design ensures that the bat box remains durable for many years.

2.4 Sophia Hos



This bat box design has a vibration sensor placed behind the landing pad to count the number of bats flying into the box. This design has an open bottom to allow easy entry for the bats and allows less maintenance and cleaning as droppings can fall out naturally, this makes it convenient for the bats and the owners of the bat box. This also helps prevent predators such as snakes from climbing in the box as there is no flat surface to climb onto. Inside the box, there are two chambers which create narrow roosting spaces. Bats prefer tight spaces that mimic the crevices they naturally roost in. Multiple chambers increase the capacity of the bat box, allowing more bats to roost comfortably. The multi-chamber design also helps with temperature regulation by allowing the bats to choose between different microclimates within the box. Small holes are placed near the top of the bat box to allow air circulation, preventing the box from becoming too hot during the day. This will help the bats stay comfortable during the day, especially in the hot summer months. This design also contains a hinged door which allows for easier cleaning while not disturbing the bats.

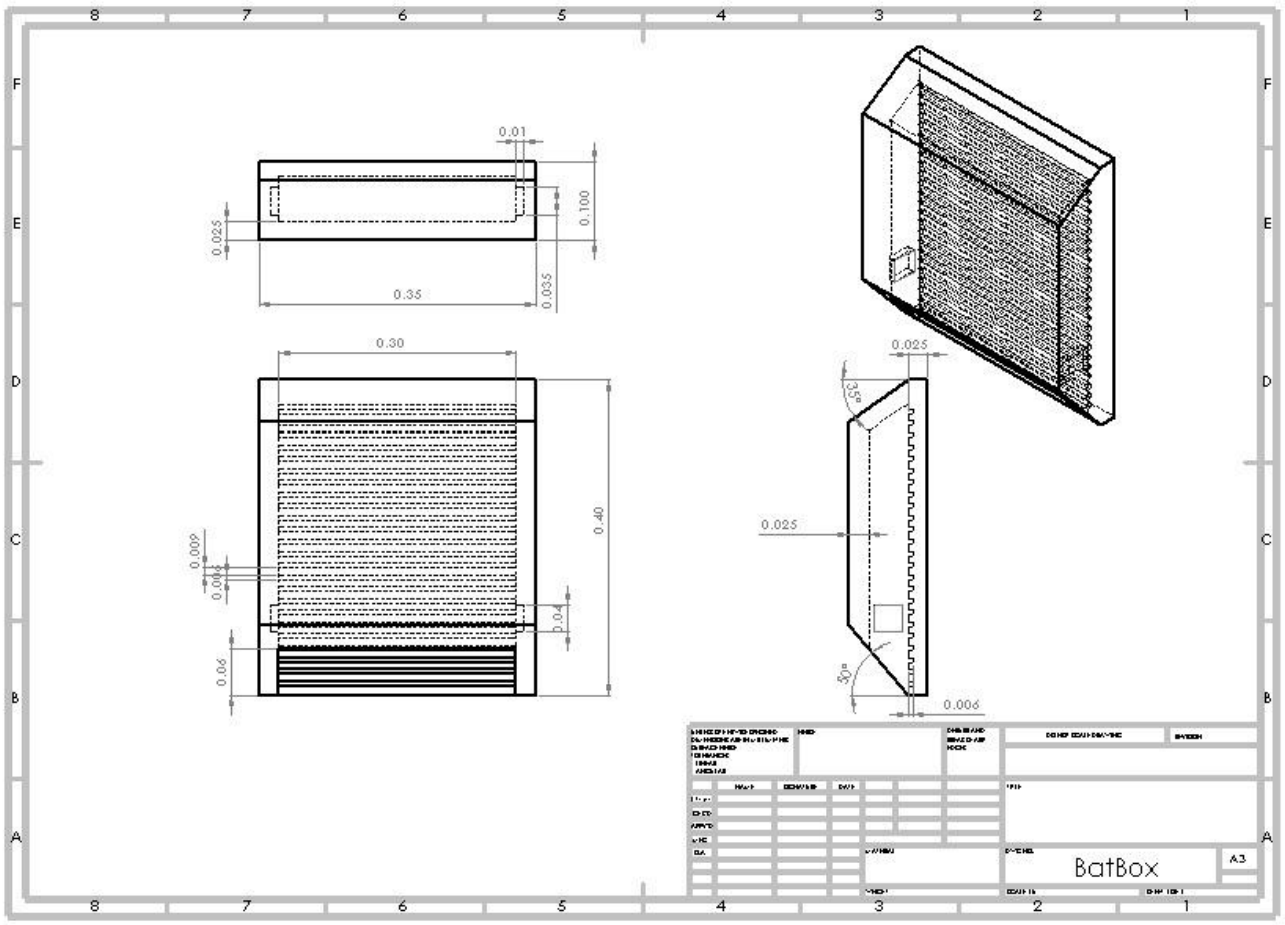
2.5 David Whitehead



This design is similar to other designs presented by the group, but it changes the method in which the bats roost in the nest. Using hanging dowels, multiple vertical tiers can be added, allowing more dense populations. The roof would hinge open to allow for easier maintenance. The slanted roof and ¾ inch cedar panels keep the bats safe from the elements, and ventilation slits cut into the sides provide airflow and prevent the bats from overheating on hot summer days, as well as preventing predators from being able to get in. An impact sensor and a small box to house the electrical components it relies on would sit at the bottom of the landing platform, to count the number of bats visiting the box. The bottom remains open, allowing the bats droppings to fall out, and to facilitate entry. The back panel is ridged, to let bats land easier and climb up to where the dowels hang.

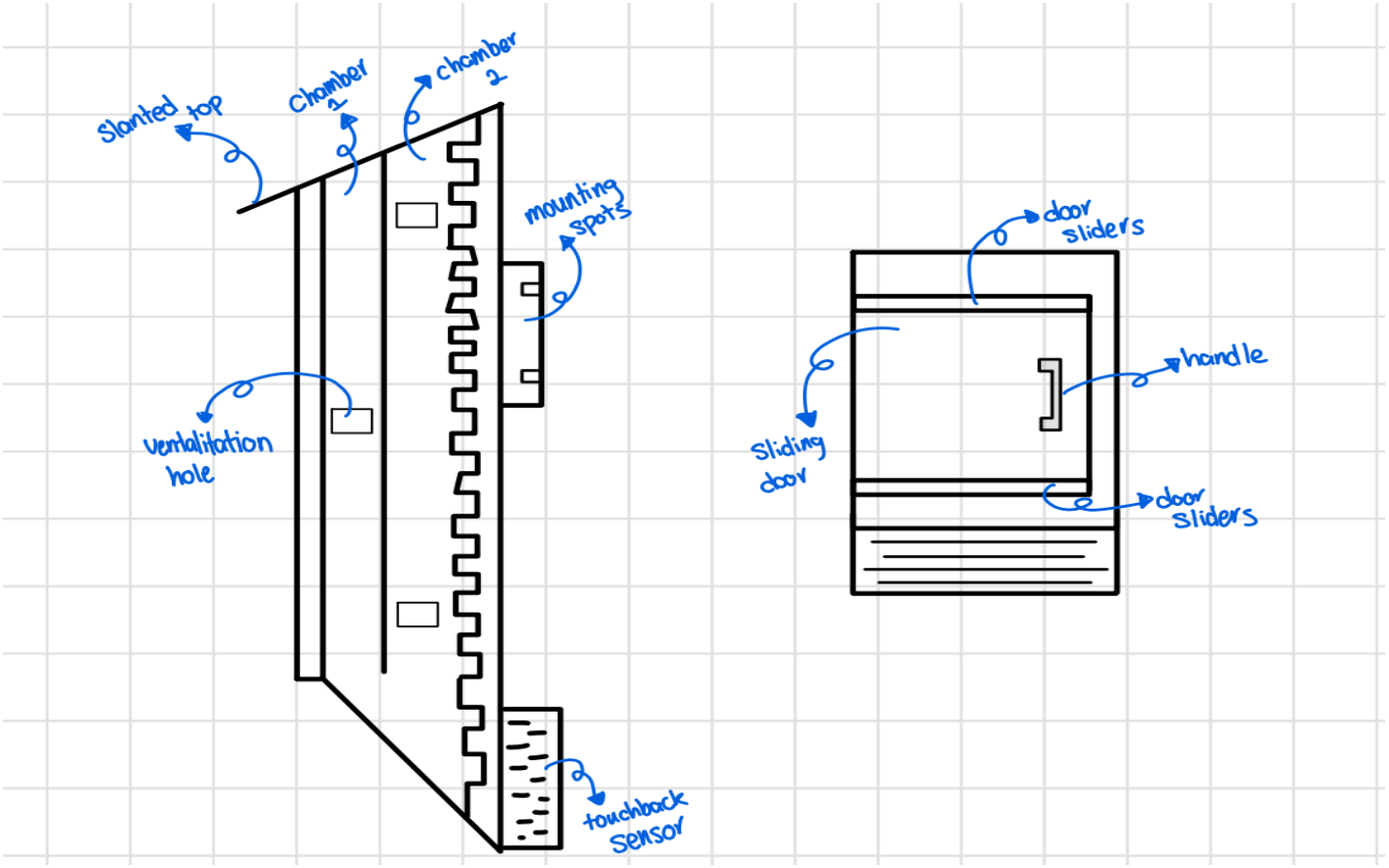
3. Three Global Concepts

3.1 Concept 1:



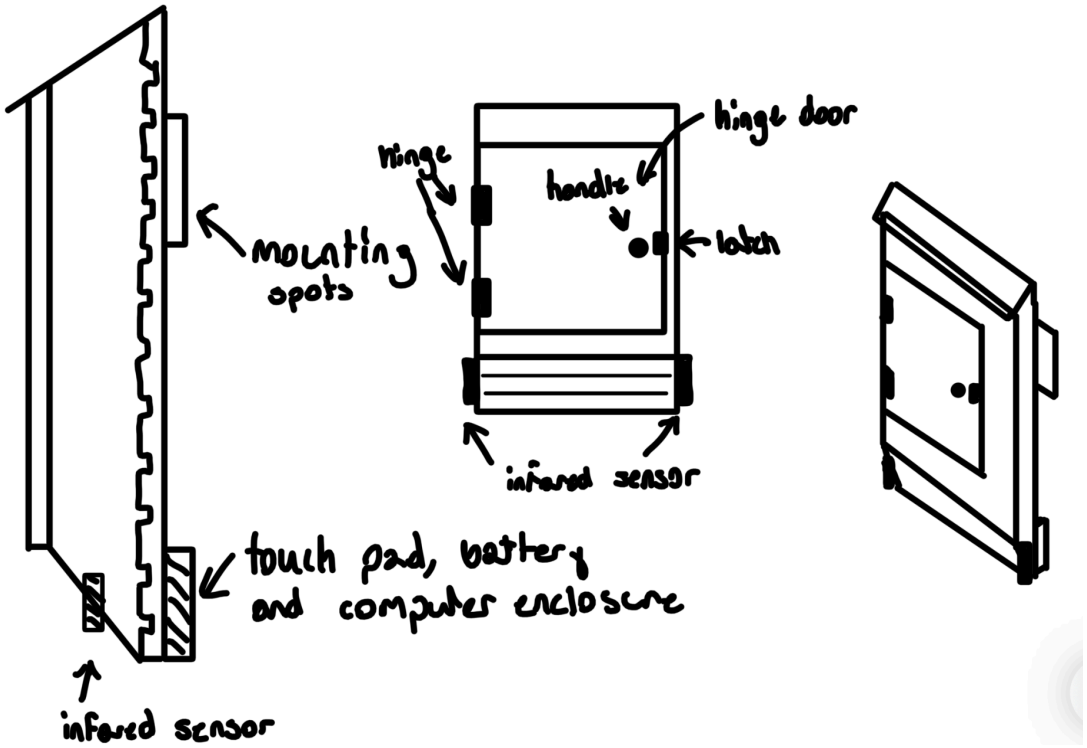
For Global Concept 1, we take a one-chamber concept and adapt it to an infrared laser counting method. The box keeps the dimensions of 35cm x 40 cm x 10 cm and adds on a 3.5 cm x 3.5 cm box cutout on either side for where the laser would be placed. This concept will have roof shingles overtop for weather protection, along with a slanted top to let snow and rain slide off. This box will use cedar and 2.5 cm thick walls painted black for insulation. The box will also have 0.6cm deep and 0.6cm wide grooves spaced out by 0.9cm for the bats to use to climb inside the box. Lastly, the box will have a hinged door that can be used to easily clean up the box.

3.2 Concept 2:



This concept was developed based on ideas gathered from the team members' designs, which include the touchpad back sensor, ventilation holes, slanted roof, mounting spots, sliding doors, and two chambers. The touchpad back sensor keeps count of the bats entering the bat box by detecting vibrations. When a bat lands, the sensor registers it as one entry. The ventilation holes ensure that the bats can stay cool and receive fresh air while being small enough to prevent predators from entering the bat box. Mounting spots are used in the design to secure attachment to trees, walls, or other surfaces, making installation easier. The sliding door allows for easy cleaning of the bat box chambers when required. However, we realised that sliding doors can jam, which has prompted us to consider the use of a hinged door instead. Lastly, the slanted roof design helps prevent the piling of debris, allowing items like leaves, rainwater, and snow to slide off, which protects the structural integrity of the box and minimises wood deterioration.

3.3 Concept 3:



This concept pulls from multiple of the team members' designs. It incorporates both an infrared laser counting system (which uses an infrared laser and a sensor on the other side to detect when the laser is broken by a bat passing through) and a touchpad sensor (to detect and count when a bat lands on the landing pad). Using both these systems simultaneously ensures a more accurate count of the number of bats using the box. The design incorporates mounting areas similar to the design used in Jonathan's concept to make sure the box is easily installed on walls or trees. Also pulling from other team members' designs, a door with a hinge and latch (to keep the door closed) allows the box to be more easily cleaned and maintained. The box uses a 1 chamber design made of cedar wood, as well as a slanted roof to allow rain and snow to slide off and not pile on top.

3.4 Concept Design Matrix

	Global Design 1	Global Design 2	Global Design 3
Specification	Laser & Infrared Sensor	Sliding Door	Hinge Door & Touchpad Back Sensor
Importance	2 - however it's not in our budget	2 - not as convenient as a hinge door	3 - convenient & reliable

Legend:

3 - very important 2 - important 1- not important

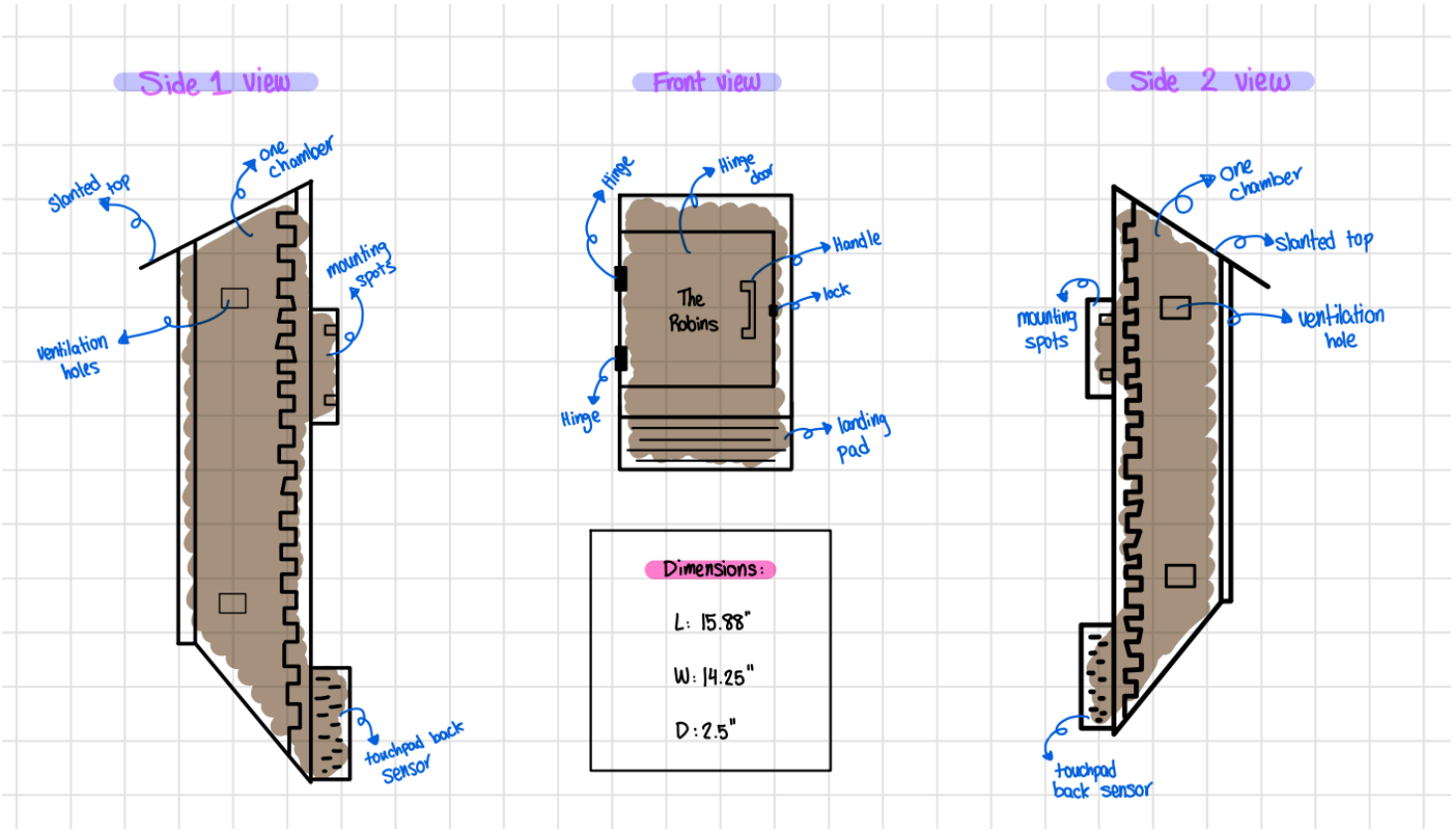
4. Finalised Bat Box Design for our Team

Our finalised design incorporates a blend of ideas from our three global concepts. The dimensions of the bat box are: length is 15.88 inches, width is 14.25 inches, and depth is 2.5 inches. It will be constructed from cedar wood and will have a dark brown tint to mimic the appearance of a tree, which is known to attract bats.

The design features a single chamber, a slanted top, and two ventilation holes on each side of the box. Additionally, it includes a touchpad back sensor, mounting spots for secure attachment, and a hinged door with a lock to prevent unexpected openings. The landing pad is designed with textured engravings, allowing the bats to latch onto the wood with ease.

These elements have been selected from the three global concepts we have developed, as well as contributions from the team members' personal designs.

Below is the finalised sketch of our bat box, showcasing all the features we plan to incorporate into our prototype.



5. Conclusion and Recommendations

The objective of this deliverable was to design a bat box that counted the number of bats that go inside the bat box. We analysed each team member's design and compared the design features to the design criteria until there was an agreed-upon final design. The final design chosen was the third global design which includes one chamber, a touchpad back sensor, a hinge door with a lock, a slanted roof, mounting spots, holes for ventilation, and a dark brown tint. This is the best option because it is easy to set up for non-engineers. It's very easy to clean and requires very little maintenance, and it is also a very safe and comfortable environment for the bats.

6. Future Work

Our future work consists of having a meeting with the client to discuss the proposed design thoroughly. During this meeting, we will address any lingering questions to refine the design further and proceed with making the prototype.