

# **Retractable Boundary Launcher** **(ReBouncer)**

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## What Is It?

The ReBouncer is a mechanism used to utilize the maximum robot expansion dimensions by launching a hook right up to the maximum boundaries and then pulling it back in.

## What robot can it be used on?

The ReBouncer requires no other specially built parts; it simply needs to be mounted onto any structure that can fit it. It can then be attached to the robot using smaller plates between the axles and motors, and be used as an active subsystem.

## How Is It Used?

The ReBouncer is powered with two motors: one 100 RPM motor for the Controller, and one 200 RPM motor for the Reel. These two mechanisms operate independently. The ReBouncer starts in a loaded position, with the Hook sitting in the ReBouncer's launch area. The Controller (which consists of a Reloader and a Blocker) turns clockwise, its Reloader setting loose a rubber band that launches the Hook forward. Once the Hook is launched, the Controller turns counterclockwise again, the Blocker moving in front of the Reel. The Reel proceeds to turn counterclockwise, pulling in the Hook. At the end of the match, the ReBouncer can be quickly reset.

In the 2021-2022 VEX Game Manual, it says that the maximum point-to-point expansion limit is 38 inches (see image 1). The ReBouncer rope can be readjusted to fit any expansion rule for each year.

## Design Software

The software that was used to design this creation was **Autodesk Fusion 360** (Education License).

- The **Sketch** tool was used to create the basic two-dimensional frame of the ReBouncer.

EXAMPLE: [See image 2.](#)

- The **Extrude** tool was used to create three dimensional objects from sketches.

EXAMPLE: This works off of the previous example. As can be seen in the image, the basic shape of a frame is being extruded 60 millimeters above the sketch. [See image 3.](#)

- The **Offset Face** tool was used to create extensions of faces that couldn't be created with other tools.

EXAMPLE: The Offset Face tool's complex mechanics assisted with the creation of the Band Clip, which needed to have thicker walls. [See image 4.](#)

- The **Loft** tool was used to create unique connections between faces that couldn't be made with other tools.

EXAMPLE: When the Reel was created, a unique cone-like end was required to keep the rope on the reel when the ReBouncer pulled in the Hook. A Loft was used to achieve the creation of this shape. [See image 5.](#)

- The **Move/Copy** tool was crucial to line up the holes with the motor holes in the Frame.

EXAMPLE: [See image 6.](#)

- The **Circular Pattern** tool was often used to reproduce the same shape around the same center.

EXAMPLE: When the hook was designed, a single barb-like shape was sketched out and extruded; the Circular Pattern tool was then used to duplicate the shape 4 times around the screw hole. [See image 7.](#)

## Lessons Learned

### **Lesson #1: Make sketches before designing complex parts**

While creating the ReBouncer, many different sketches were made with measurements. These rough sketches were vital to ensuring the CAD's accuracy and effectiveness, and also helped the 3D printer run properly.

A couple of draft sketches drawn in the Robotics Engineering Notebook are attached. See images 6, 7.

**FUTURE IN ROBOTICS:** Draft sketches, in the future, will assist in creating robot parts with perfectly accurate holes and measurements, reducing the risk of creating a part that is too short or too long, which will waste time/resources.

**FUTURE IN ENGINEERING CAREER:** In the engineering world, draft sketches will be incredibly important for me. They'll help reinforce the fact that I created a part on my own and create a reference for me during design.

### **Lesson #2: Calibrate a 3D printer perfectly before using it**

The Frame took 4 attempts to print, taking over 40 hours to complete. This was because there were many struggles with the calibration of the 3D printer being used. Eventually, it was discovered that using a different slicer fixed all problems.

**FUTURE IN ROBOTICS:** In the future, this lesson will definitely help with prototyping; it will take fewer attempts to arrive at a desired prototype because there will be fewer interruptions by hardware misuse. This will be useful for both VRC, using the Vex Parts Library, and if I participate in VEX U, where I am permitted to use 3D printed parts.

**FUTURE IN ENGINEERING CAREER:** Engineering sometimes also requires digital fabrication to prototype complex and intricate parts.

### Lesson #3: CAD is essential to designing important mechanisms

Designing the ReBouncer would have been an impossible task had I not first used Fusion 360 to design it. This is because I didn't have solid parts to work with; I first had to sketch them out and then create them myself, finally 3D printing them and using them.

**FUTURE IN ENGINEERING CAREER:** As an engineer, one often needs to work without tangible mediums. In other words, I'll have to design my own parts to make use additive manufacturing instead of subtractive manufacturing, increasing the possibilities of what I can accomplish within my chosen branch of engineering.

**<SG2> Robot expansion is limited once the Match begins.** Per <G4>, at the beginning of a *Match*, each *Robot* must be smaller than a volume of 18" (457.2 mm) long by 18" (457.2 mm) wide by 18" (457.2 mm) tall. Once the *Match* begins, *Robots* may expand, but no horizontal dimension can exceed 36" (914.4 mm) at any point during the *Match*. See Figure 22.

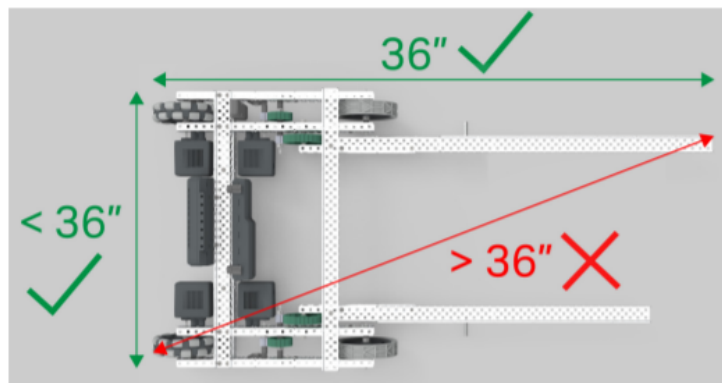
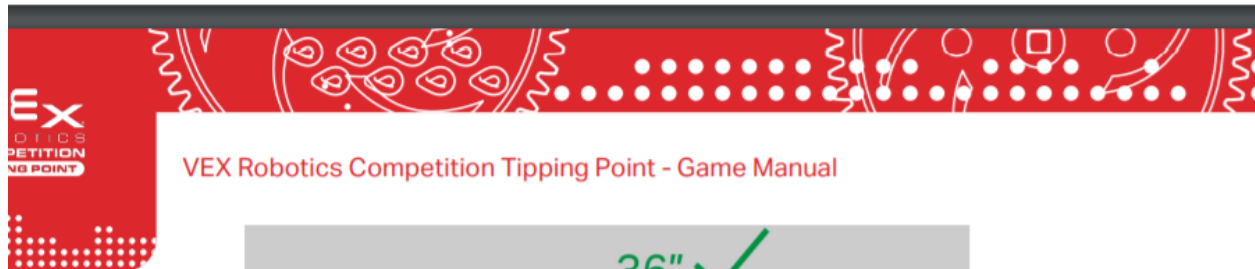


Figure 22: Examples of Legal and Illegal "point-to-point" expansions.

Because the robot above has a "point-to-point" measurement greater than 36", it would not pass inspection.

Image 1: Specific Game Rule 2 in the Version 2.3 VEX 2021 - 2022 Game Manual.

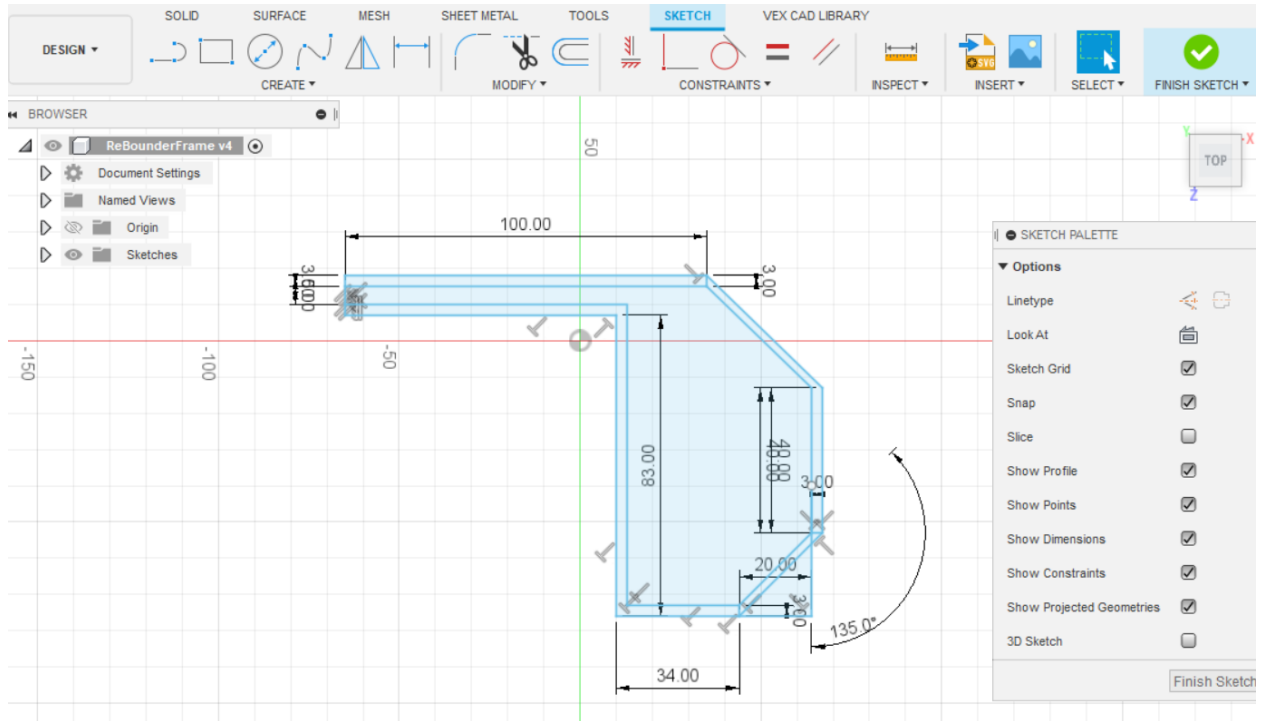


Image 2: A basic Sketch utilization while making the Frame.

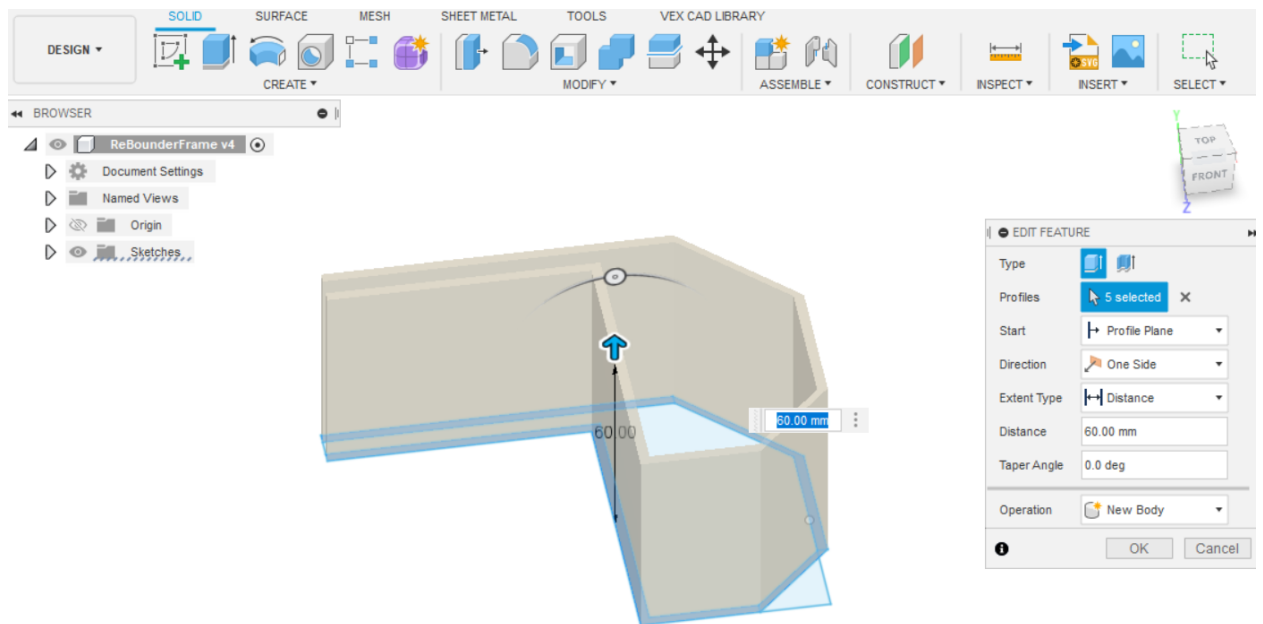
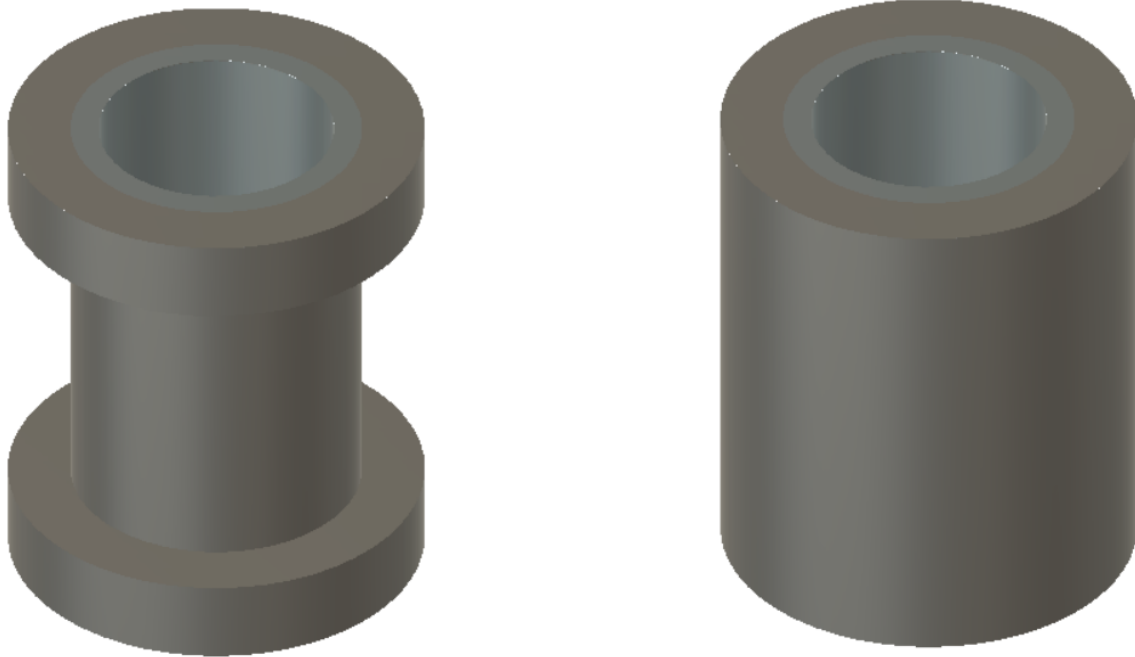
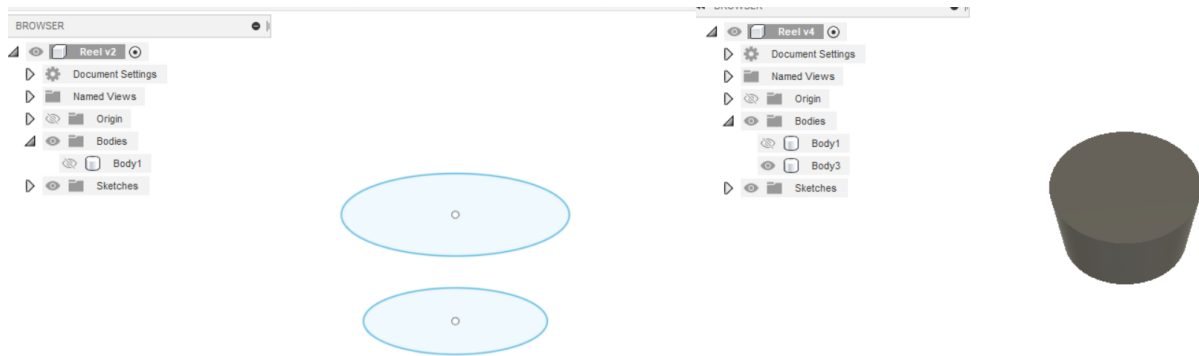


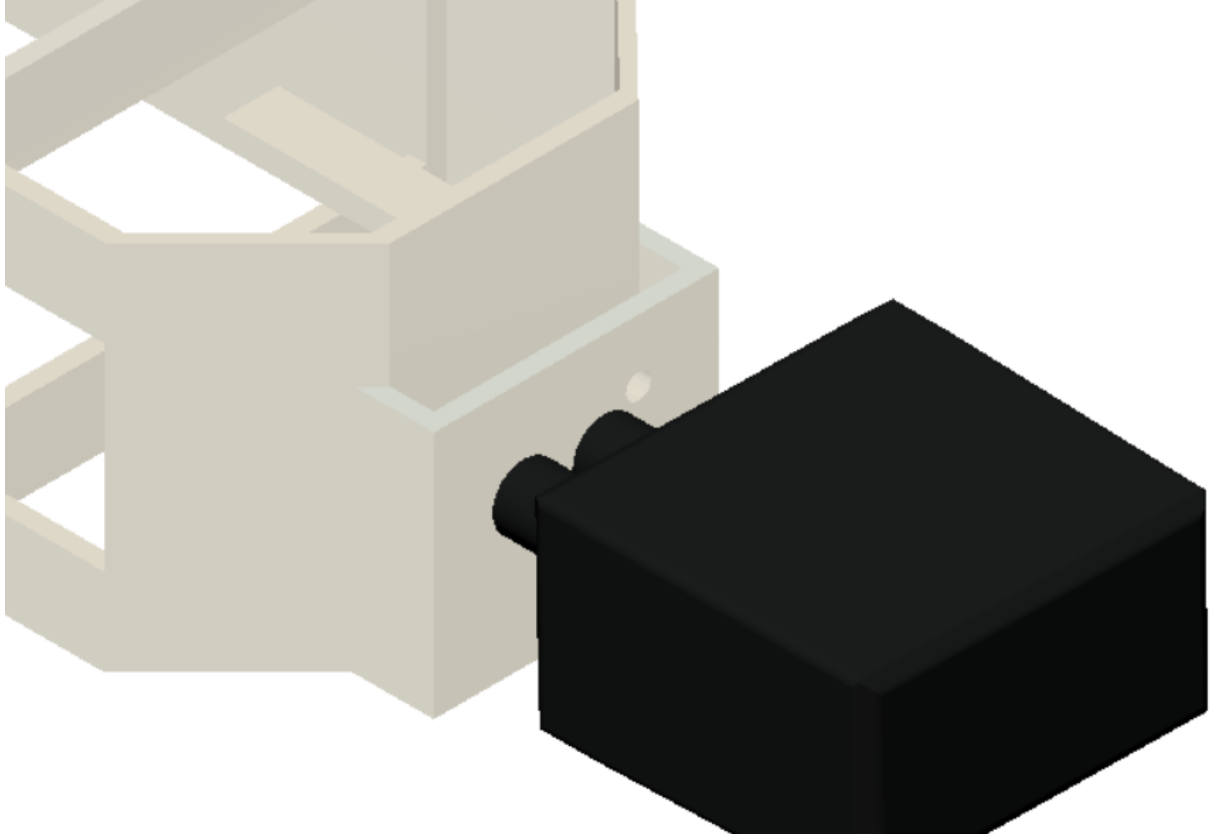
Image 3: The Extrusion tool was employed to make a structure from the Sketch.



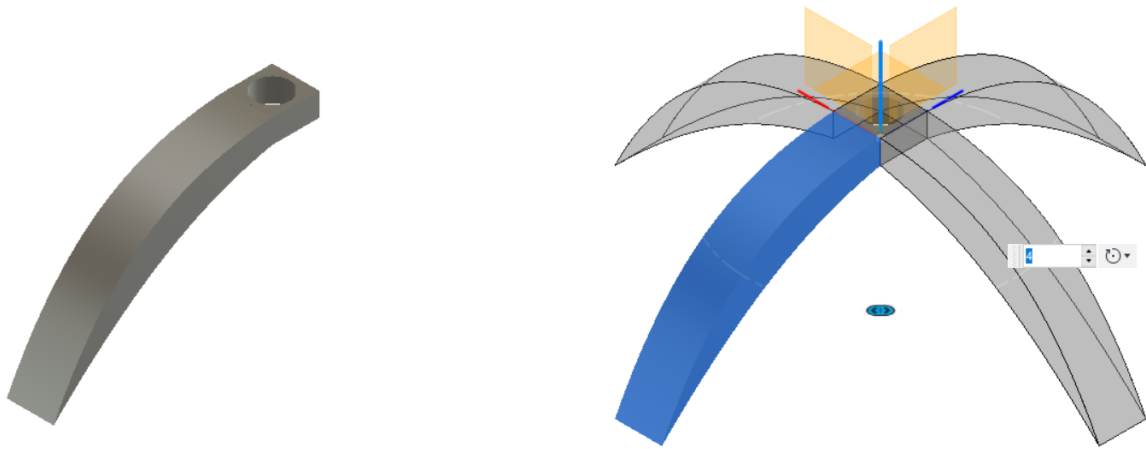
*Image 4: The Offset tool being used to widen the Band Clip's walls.*



*Image 5: The Loft tool being used to create the Reel.*



*Image 6: The Move/Copy tool being used to line up motors with the Frame.*



*Image 7: The Circular Pattern tool being used to duplicate the Hook's barbs.*





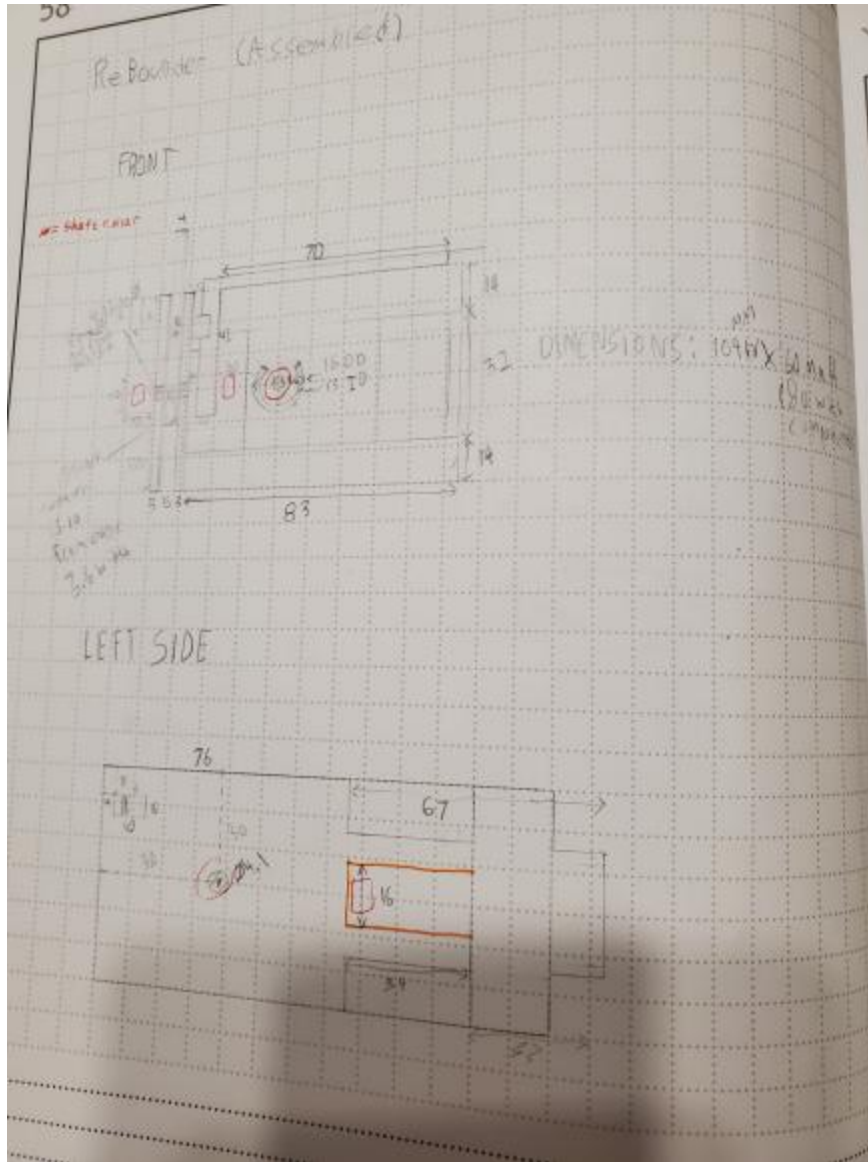
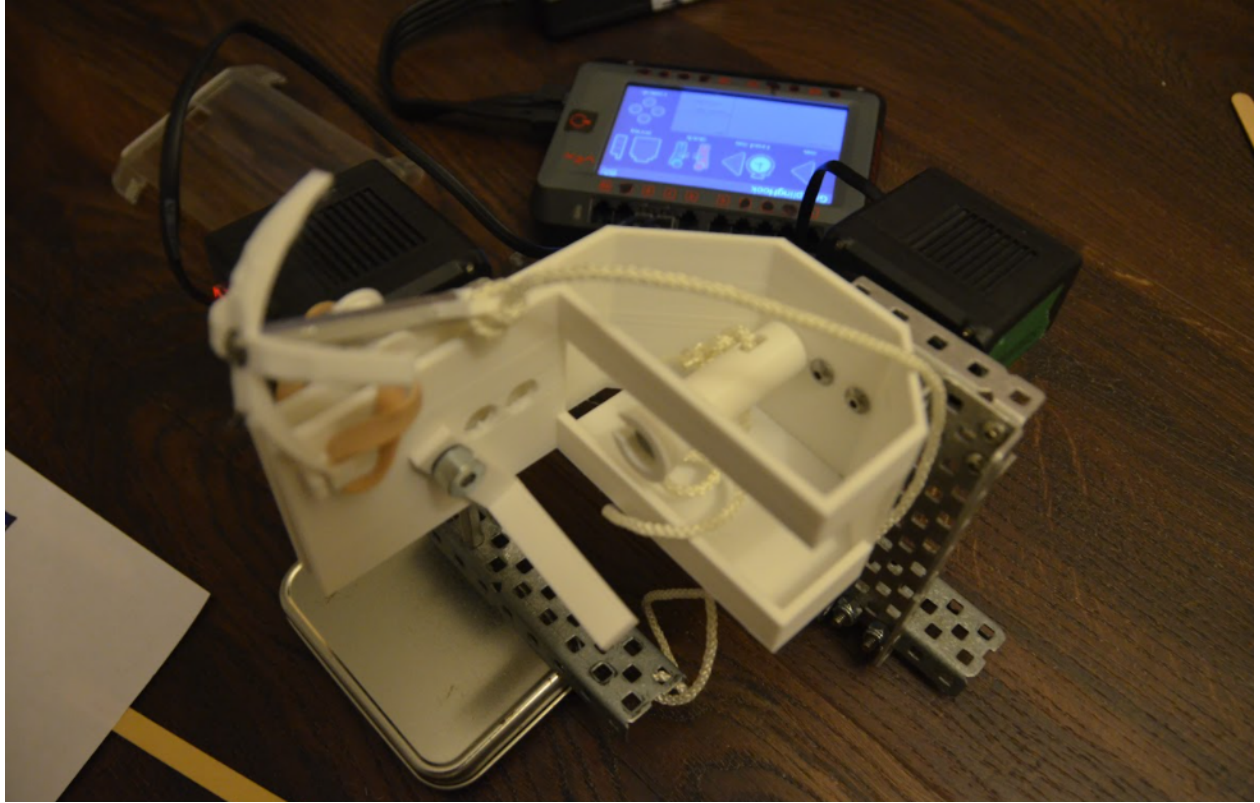


Image 9: The front and side view sketches of the ReBouncer.



*Image 10: A top view of the assembled ReBouncer without the Hook.*



*Image 11: The Assembled ReBouncer with the Hook.*