Improved Battery Holder

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I. Introduction

Throughout our experience working in the VEX Robotics environment, all of our Fryeburg Academy teams have had our fair share of encounters with self-caused problems that –with some planning and changes– allowed for a new and improved robot ready for competition. However, one particular problem we ran into was not a part designed by us, rather a part designed by VEX. We have identified a negative consensus among members of the team regarding the use of the VEX V5 Battery Clips, as multiple instances of functional failure have occurred both in preparations for and during competitions. As a result, members of the robotics team had to be extra cautious around the battery clips. Taking into account that almost every single team has to deal with these parts, we believe that there should be an improved method of battery storage. Taking these factors into consideration, we decided to approach this challenge with a goal of improving on the current clips.

II. Design Process / Functionality

Before we started designing, we took some time to consider the current issues with the battery clips to better understand what we need to improve upon. After some time testing around, the major problems we identified were as follows:

- Some clips slightly miss the slot they are designed to snap into.
- The function sometimes failed and made it easy for batteries to come loose and fall off during a match.
- Replacing the batteries involves applying some pressure to the clips which can end in accidental damage if this pressure is built.

We had found one of these major problems very recently after team 20005B almost lost control of their robot during the final matches due to the battery falling off of its clips. Head of team 20005B, Marcos Barrionuevo, adds: *"The dangers presented by these barely functional clips presented itself abruptly to me when after a sudden impact I ended up driving the entire match with my battery dragging along the ground. I was lucky enough to barely prevent a disastrous unplugging, but it became abundantly clear to me that the method of battery storage had to be changed to ensure future success."* We noticed this similar occurrence on other robots during competitions and realised it's not just an isolated problem, it's a global problem. After gathering the list of major problems, we set out to brainstorm the first concepts of the new battery holder design. The first designs we documented somewhat reflected what the finalized design would soon become, keeping some of the ideas we thought of originally and tossing others we thought were unnecessary or too over complicated for what we were trying to achieve. We felt that the multitude of components favored complexity over functionality *(See Figure 1 below)*.

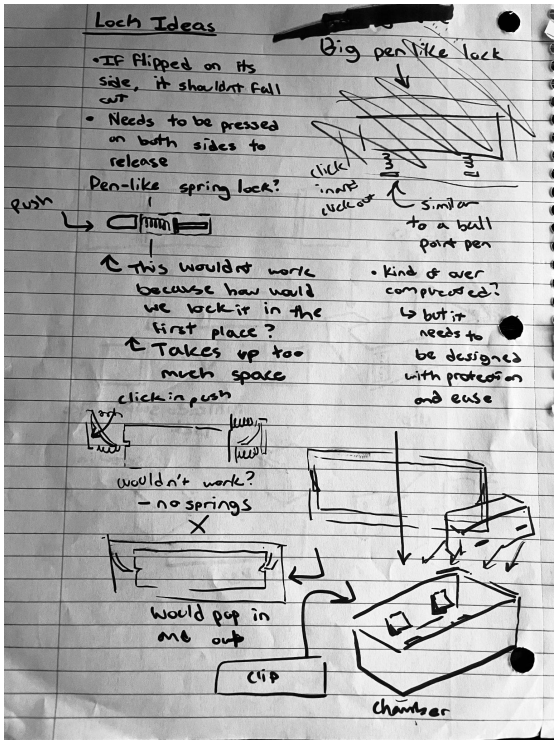


Figure 1 (left side): Originally, we had planned to have some sort of bendable, "spring lock" mechanism. We scrapped this idea because of its overcomplexity and potential for damage.

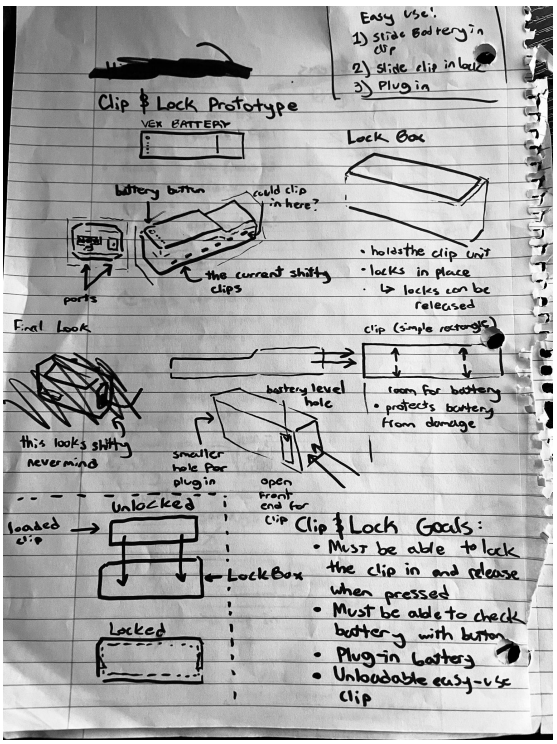


Figure 2 (right side): This was the second iteration of our design. This design kept consistency and ended up being very similar to the final design.

The small components featured in Figure 1. would be a hassle to implement and had higher odds of breaking. We decided to shift our vision over towards the second iteration of our design *(See Figure 2 above).* In this design, we had a storage unit consisting of a top and bottom half which would be responsible for holding the battery. While we did have a method of storage, we still struggled to find a way to mount it to the robot. It took a couple more iterations before we settled on the final design *(See Figure 3 below).*

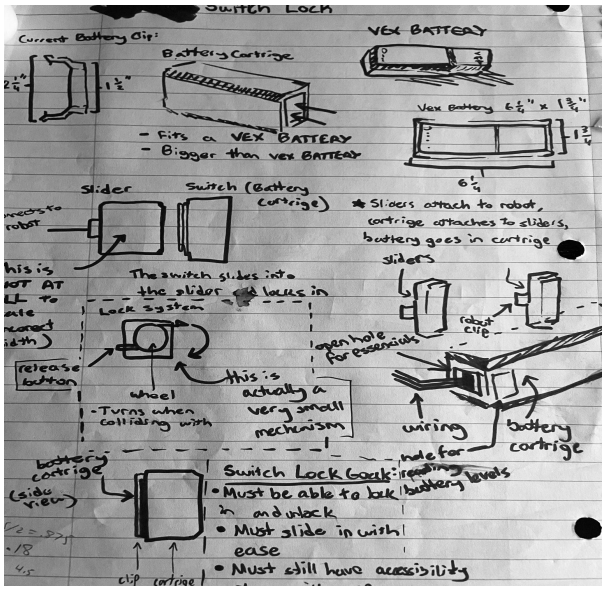
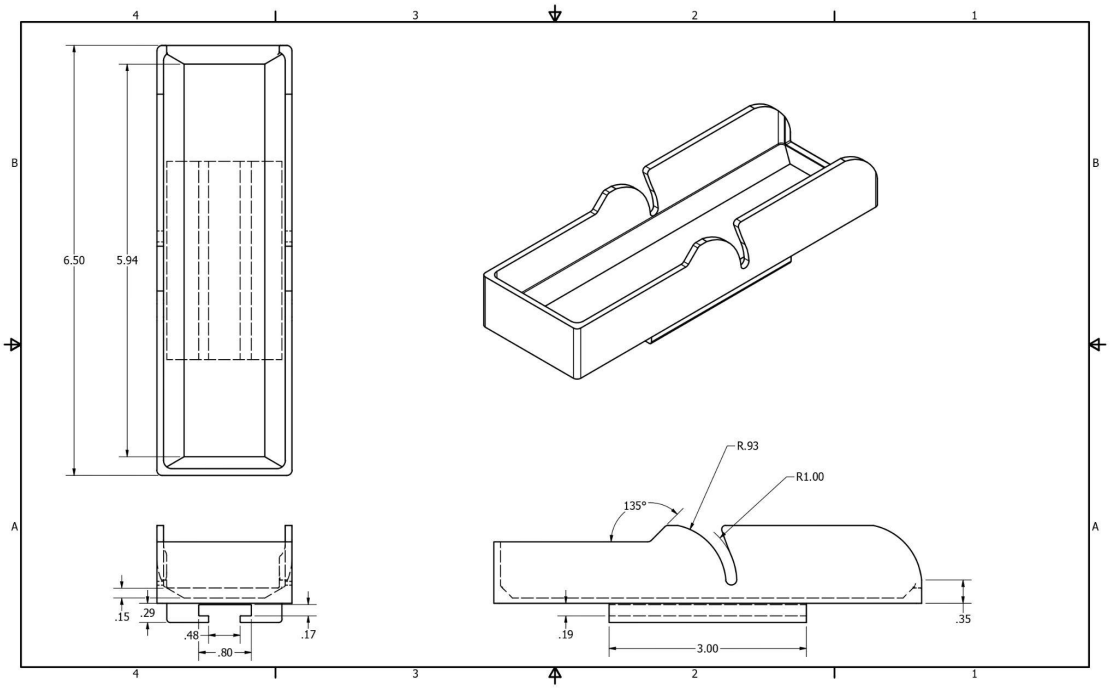


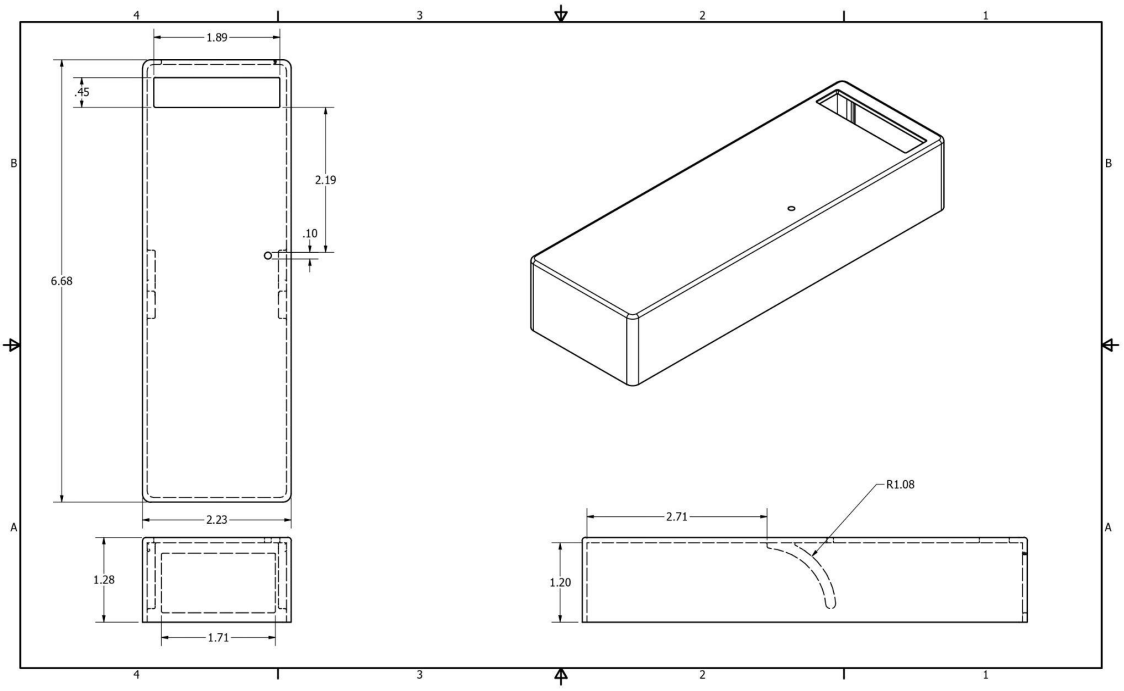
Figure 3 (left)
The design in Figure 3 was the most influential to the final design of the battery holder, as it introduced the rail system. This system used small clips with rails that would mount to the robot for the battery cartridge to slide on.

For designing the parts, we decided to use Autodesk Inventor Professional 2021. We took advantage of the many tools the program provides including:

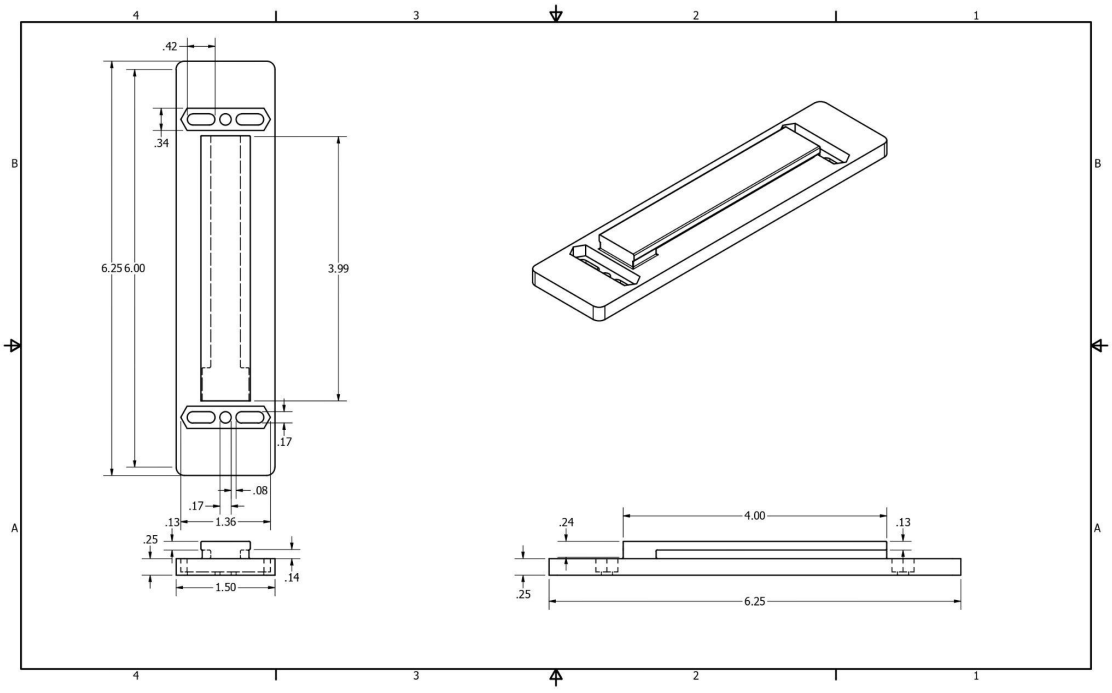
- Sketches
- Extrusions
- Fillets
- Geometry Projections
- Lines, arcs, and circles
- Measurements
- Planes



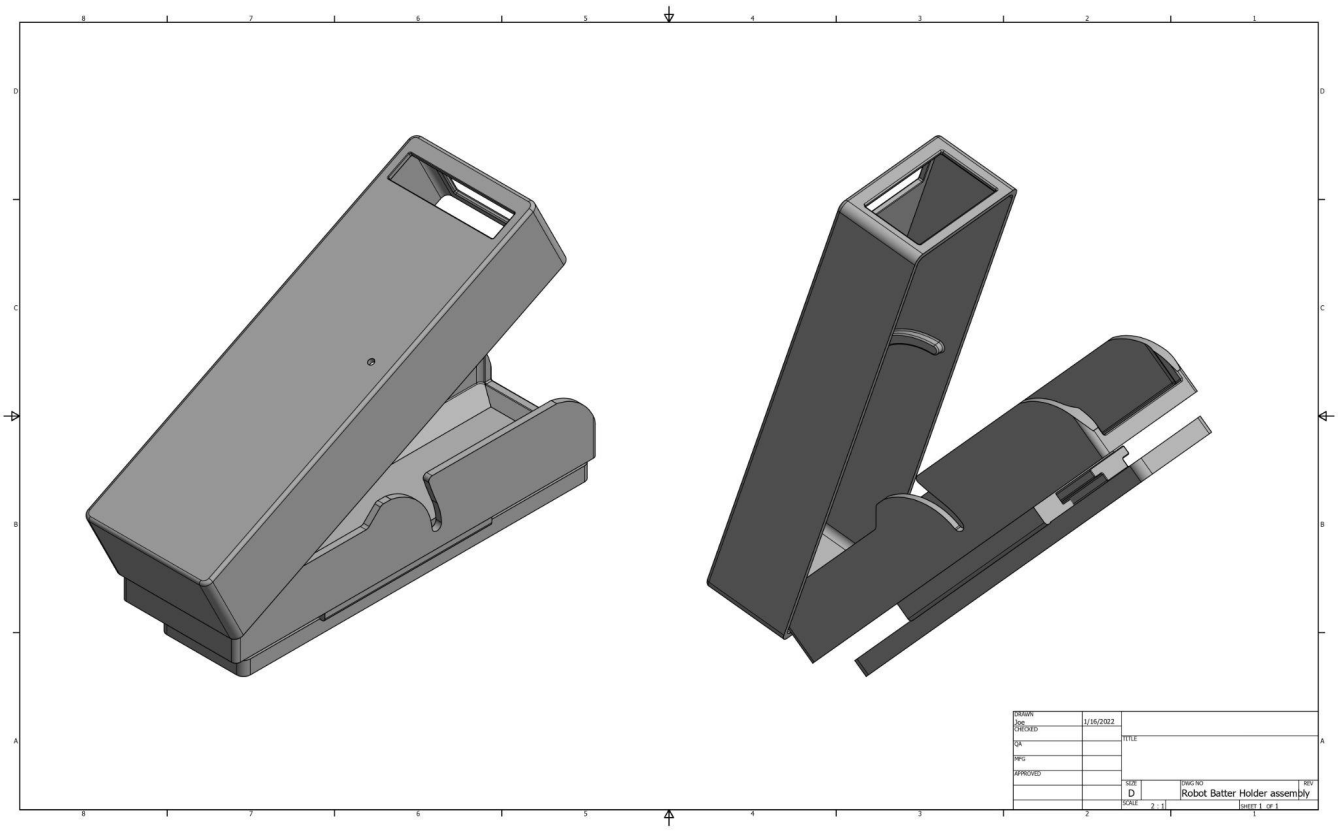
Bottom Half (above) - The bottom half of the shell is constructed to closely replicate the shape of the battery to allow for a tight fit, whilst allowing enough breathing room to easily slide in. The sides of the bottom half are cut to act as a slot for the top shell to lock in place. On the bottom face of the shell is a groove designed to fit on the railing.



Top Half (above) - The top half of the shell is larger than its counterpart. This allows the top shell to move at an angle to slide the curved extrusion inside of the slot.



Rail attachment (above) - Learning from the previous accounts of damage to a clip based battery attachment, we opted to create a rail to hold the shell from falling off. The groove on the bottom half of the shell slides on the rail until it reaches its end point.



Full Assembly (above)
In this diagram, the top shell is aligned properly with the bottom half, as if the two parts were to come together. The bottom half of the holder allows the battery to be slid in easily and also permits the rail to fit within the groove.

III. Conclusion

The current VEX V5 Battery Clips have demonstrated functional failure in both preparations for and during competitions. Over the duration we spent improving upon the clips, we gained experience collectively on the design process, including drafting, assembling, and frequent trial and error. As the designer of the battery holder, I had only tinkered around with Autodesk Inventor occasionally prior to designing the part. I not only utilized my previous knowledge on the program, but I also learned a great deal about other features which will later help me in a future engineering field.