R&D

Problem Statement 0001: High-Strength Axles

VEX offers many parts, unfortunately many of the parts are not big enough to fit within the maximum dimensions. The high strength axles (HSA) have a maximum length of 12” while the maximum dimension for a VRC robot is 18”. This difference is problematic for teams because it restricts how useable certain parts are. We already have couplers, but for high torque situations like in cascade lifts, and powerful intake systems, HSA are needed, and there is currently no way to connect them. While the majority of the parts that VEX makes are very high-quality, the axle connectors in general are not perfect. For starters, you are unable to add extra friction or extra tension to either of the axles once they are in the connector. This may not sound like a problem, but in certain scenarios, such as a high gear ratio, the axle connectors that we currently have can fail and compromise the integrity of our robot.

Solution 0001: High-Strength Axle connector

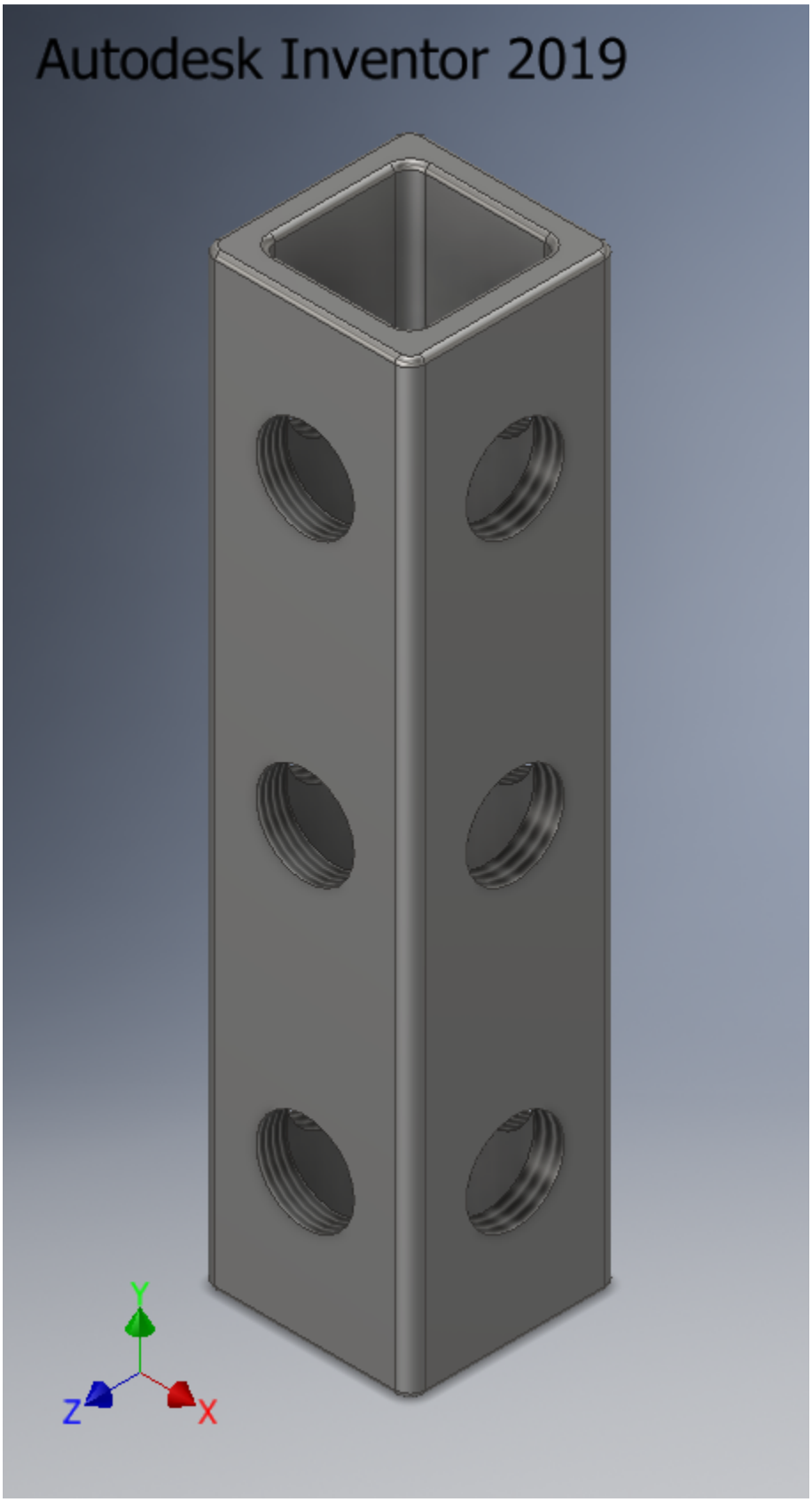
Before talking about what we designed, I want to point out some continuities that we made sure existed in our final product. We noticed that the axle connectors that already exist have a very sleek appearance. We also noticed that the V5 kit has certain geometrical patterns and shapes. We wanted to maintain these features so this piece fits in nicely with the rest of the VEX library. This is why we

finished our design with a very geometrical, sleek, metal material, to fit the classiness that the V5 kit brings. The design problems we had to solve were: how do we connect two HSAtogether while keeping the axles from moving, while keeping the design light and compact, all while adding versatility to the piece. When we designed a HSA connector, we addressed many challenges that situations for HSA create, and problems with the connectors for regular axles. As simple as the concept of an axle connector sounds, it takes a lot of work to innovate on it. After multiple hours of brainstorming, we decided on a few major features.

The first thing that we decided to add was screw holes in the connector. These screw holes had multiple benefits. The first benefit, was that it allowed additional tension to be placed on the axles to ensure that they wouldn't slip. This is important when considering high torque situations because if an axle slips, it is likely that your robot won't function. The second major benefit, was that the axle connector became much lighter. Not only were the screws highly beneficial in keeping the axles stable, they allowed for the axles to be placed anywhere in the connector rather than being forced to stay in the middle. One of the major problems of the previous design was that the axles must be centered in order for the connector to work properly. This is fixed by allowing the axles to be placed anywhere as long as one of the three screws is able to make contact with the axle, which provided much needed versatility to the piece. The inspiration for the idea came from the VEX shaft collar. We thought, that since VEX already produces a part with similar cut outs, it would be very easy to produce another part with identical features.

The second feature that we made sure that our product has, is a very compact frame. When using an axle connector, you want the connector to be as unnoticeable as possible. For this reason, we tested different sizes of connectors in order for us to determine the best size and shape. Following in the fashion of the VEX V5 kit, we made the frame a square so it fits the Geometrical theme, while still having the necessary support. We also reduced the size of the connector from its original 2.5 inches, to 1.5 inches. We were only able to reduce

the size because of the screw’s added stability. Due to the fact that HSA are such a vital parts in many large bases and intakes, it is paramount that they remain intact and tight at all times.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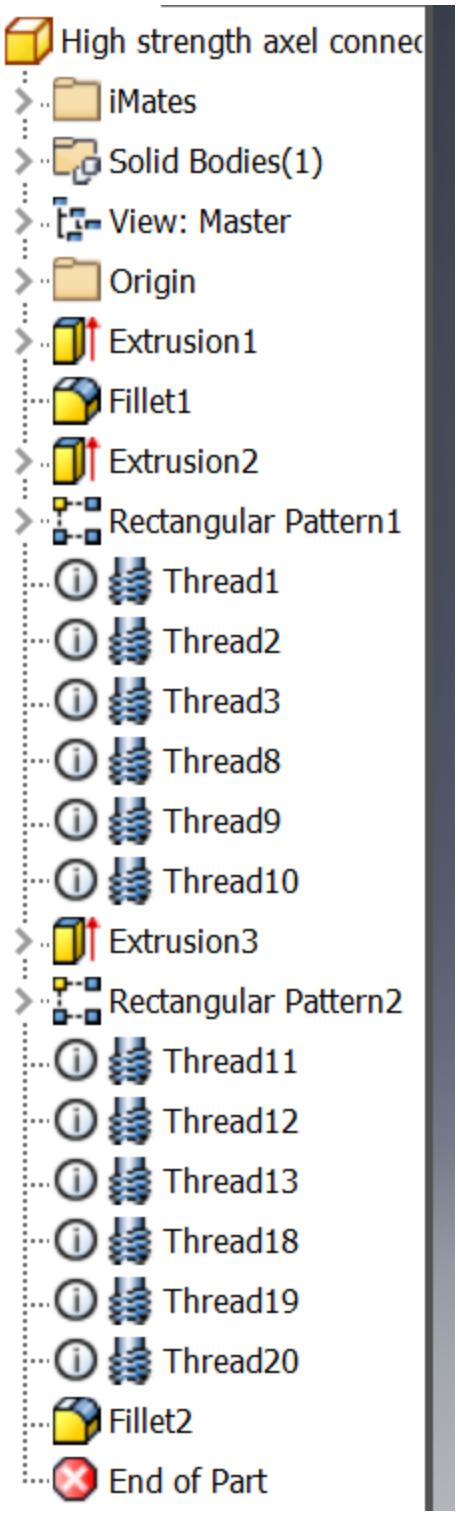
From the testing we have done, and concepts that have come to our minds, we don’t currently see a major issue with it. Our plan however, is to manufacturer these parts for our school’s VAIC team and have them tell us these problems. We all know that no design is perfect initially, but through continuous testing and rigorous scenarios, we hope to flush out as many of the inevitable flaws that is has. If we are able to get this product to more people and get their opinions, we could improve the product design and functionality at a much faster rate.

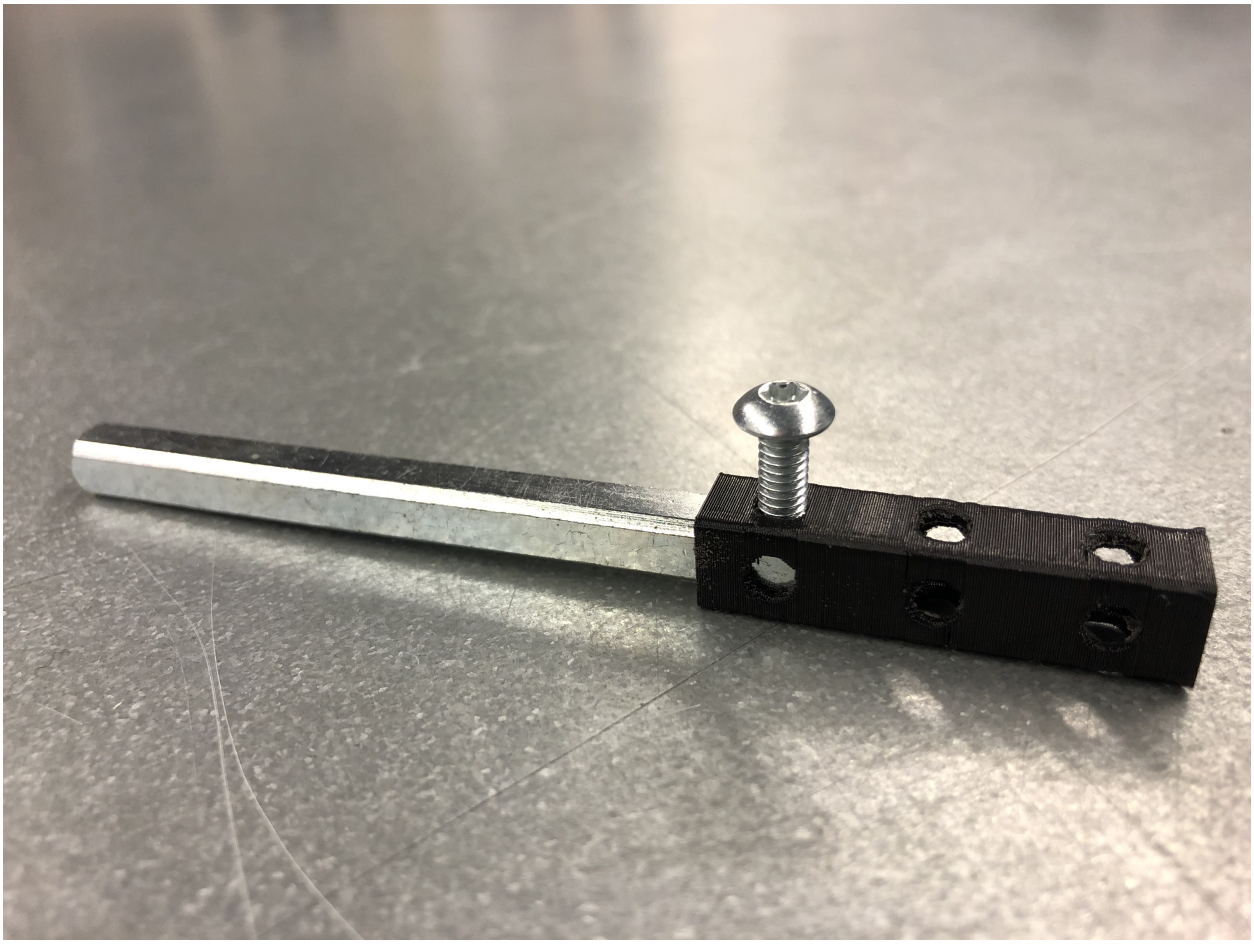
Takeaways

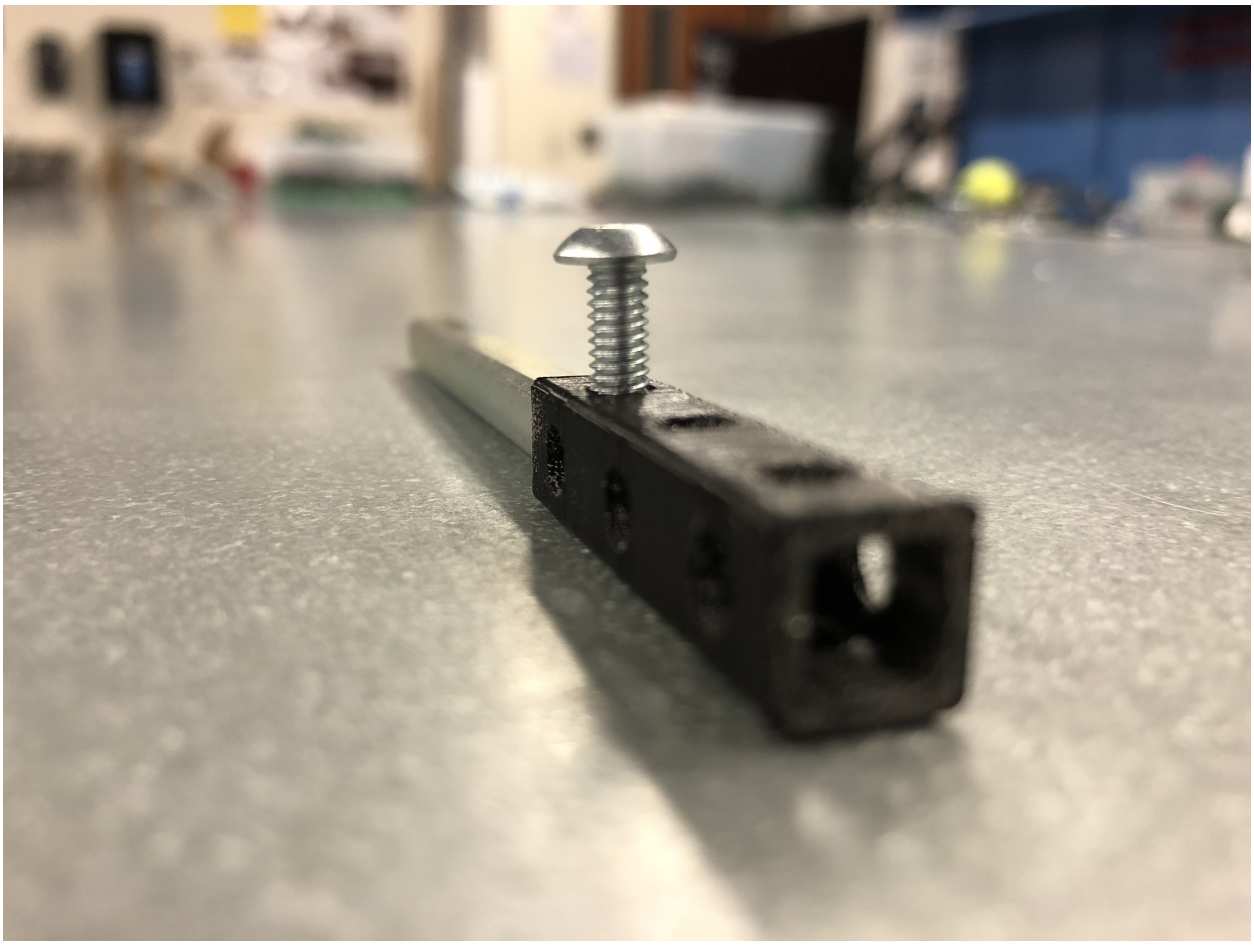
We am really glad that we were able to use Autodesk Inventor 2019 in order for me to make this part. We used many different operations, some of which are not commonly used (in high school level robotics) such as thread and iMates. This entire project has been a joy to experience because we are now able to see how professionals complete and document their work. We am also able to see the usefulness of 3-D modeling CAD software in the engineering and design process.

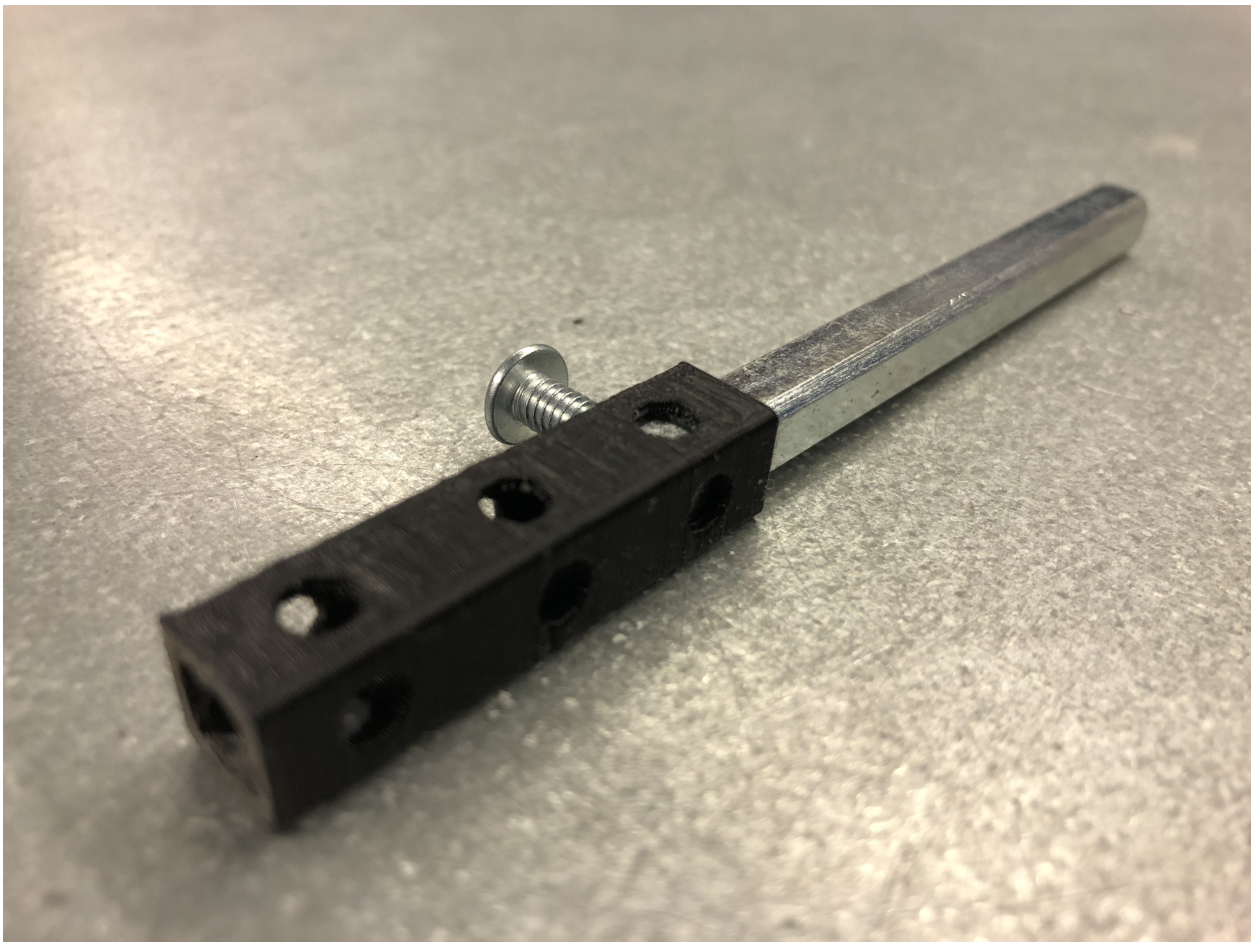


I’m Daniel Hanna, and am the 3-D designer in my team.I would like to be a mechanical engineer, and using a 3-D modeling software to create my ideas is a

very good way for me to test and visualize my final product before fabrication. On my VRC and VAIC team, I plan on using 3-D modeling much more because it will allow me to better document and better plant design. It's important to document and test what you're building, and if inventor can help me complete that process without physically building something, that would be a major benefit.







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