High Strength Shaft Ball Bearing

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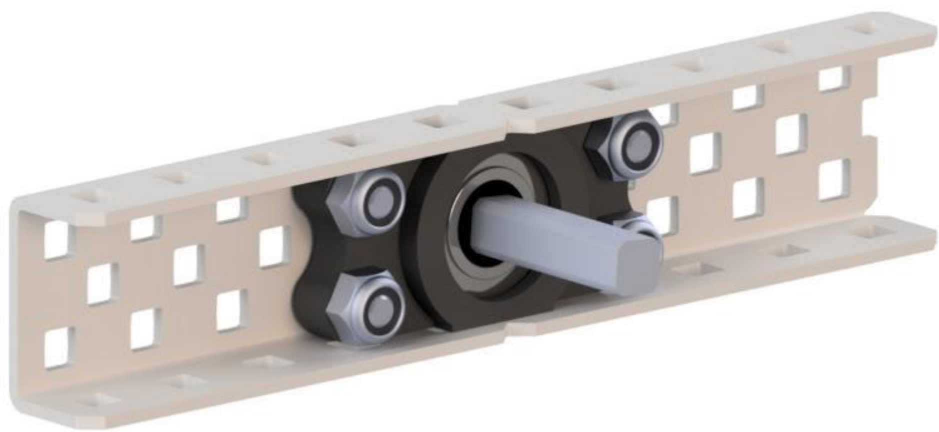


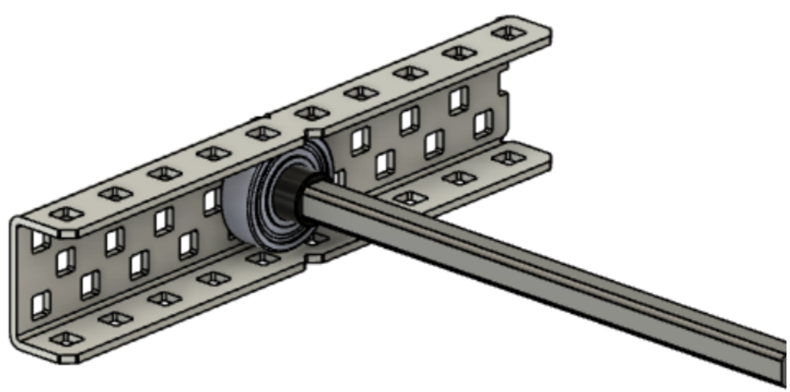
Introduction

The VEX Robotics Competition is a very fun and exciting game, and all someone has to do is go to the VEX Robotics Website to see many useful and well designed parts. As Vex Robotics continues as an ever evolving competition, it has become more and more important to make sure high quality and useful parts are being made accessible to ensure that competition is fun and challenging. However, knowledge and experience with VRC has made it so that in some cases, it is outdated parts that are holding the students back. One example of this is with joints and shafts. The power of the VEX V5 motors and students' use of them, as well as the high strength needed of a robot to compete in some games, have led many to design their robots with strength in mind. Vex high strength shafts are very strong and can survive incredibly heavy loads, making them very useful for designing tough and durable robots. However, their usefulness is limited by their bearings, which are clunky and high on friction. We experienced this firsthand last season, in the Vex Robotics 2020-2021 Season game, Change up. In that game, our robot had a high strength shaft used on its top roller that was spun at high speeds to launch the balls into the goals. We found that due to the high friction nature of the bearings, our motor used for the top roller was becoming warm, and the roller was not spinning nearly as fast as it should have been. This had an impact on our robot, and we were not able to resolve this issue without switching to Low Strength shafts. Due to our experiences with the bearings, we feel that a high strength ball bearing would be a step in the right direction. Ball bearings are very low friction, and often used in industrial and mechanical settings. Given these qualities, we believe that a ball bearing would be a good addition for our robot, and useful in many cases.

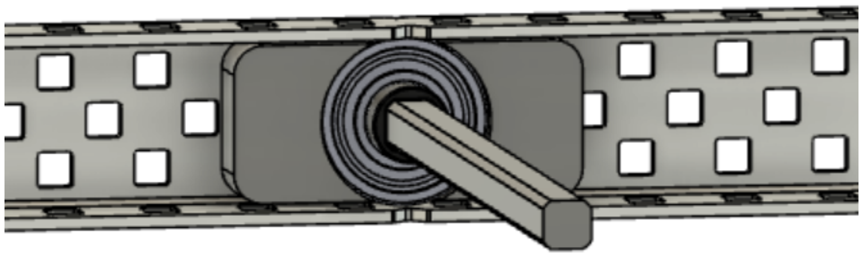
Design Process

The first thing we needed to do was find a ball bearing that would work with the shafts. From the CAD file of high strength shafts, the diameter of the circle that goes around the shafts is 0.3 inches. When looking on the VEX Robotics Website, we discovered that VEX sells ball bearings in their VEX PRO line of parts commonly used by FIRST Robotics teams. We found a ball bearing that had an inner diameter of 0.375”, and an outer diameter of 0.875”. This made it perfect for what we wanted to do with it, since the inner diameter is the same as the outer diameter of the HS Shaft spacers that rotate with the shaft, and the outer diameter is the perfect size to fit in the inside of a 2-wide c-channel. This allowed us to put the high strength shaft spacers into the ball bearing, which acted as an insert for the shaft to turn with the inner ring of the bearing. We decided to take inspiration from the existing High Strength bearing and the 4-post nut retainer for the design, as those seemed to have similar dimensions and design to what we needed. We also wanted something that would hold the bearing against the c-channel, so that it could not be pulled out sideways. After figuring out these general requirements, we set out to creating our part.

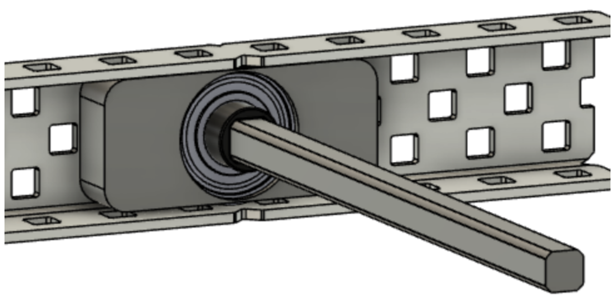
First, the CAD STEP file of the ball bearing we needed was downloaded from the vex robotics website. The ball bearing was imported into the education license version of Fusion 360, along with a 2-wide c-channel, HS Shaft, and HS Shaft spacer from a community made Fusion 360 VEX library, and the four were jointed together like so:



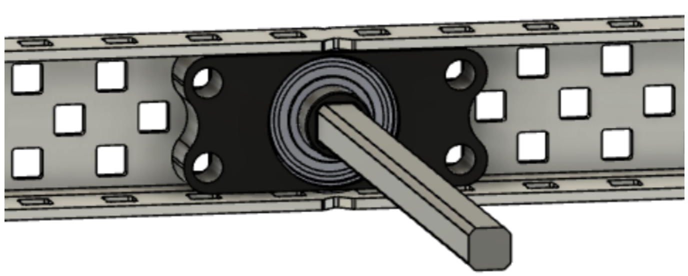
A sketch was then created on the face of the c-channel and extruded to 0.25 inches.



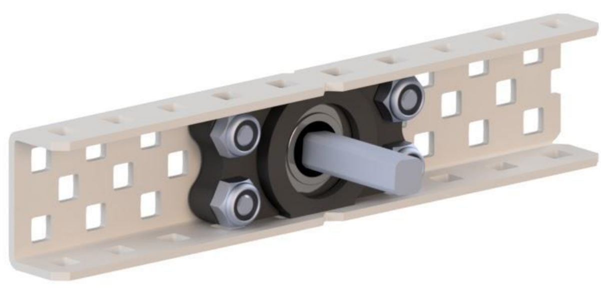
The face was extruded again to 0.375”, and a lip was created around the outer ring of the ball bearing to hold it in place.

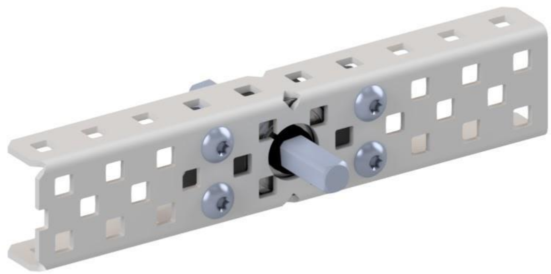


Then, the color of the part was changed for appearance, and holes for screws and to open up access to the other holes around it were made:

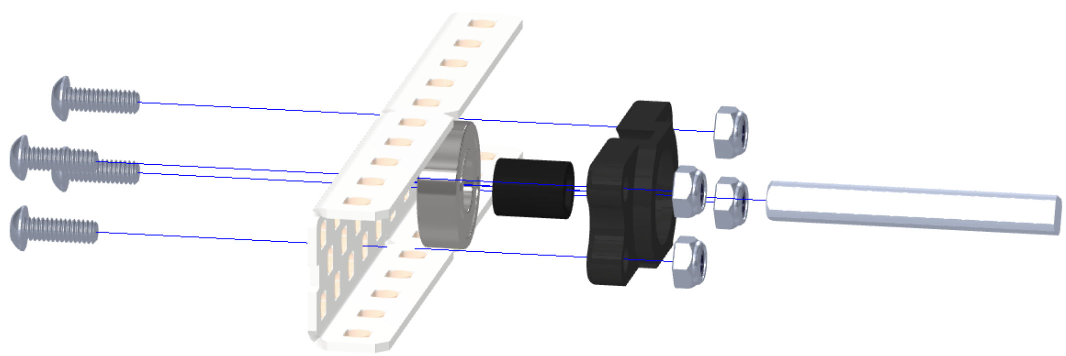


From there, the final step was extruding the rest of the bearing except the ring around the bearing to 0.25", to match the old bearing's dimensions better and to be more compact.
The part was then imported into Autodesk Inventor Professional 2022 and assembled and rendered there.
The final renders of the part from multiple angles are below:

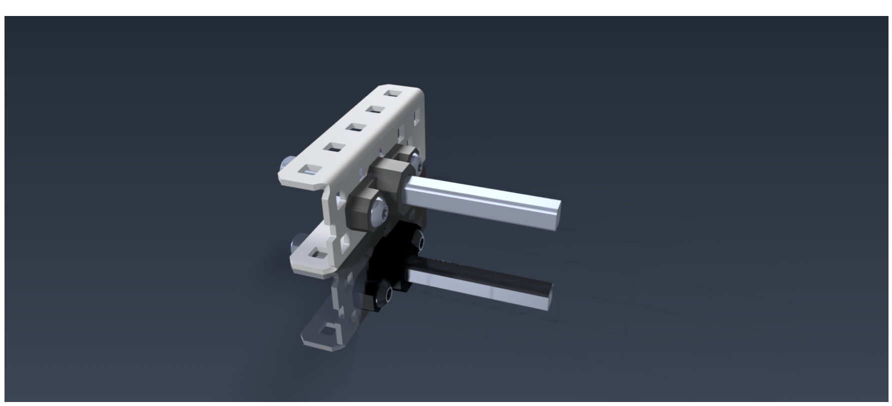




Here is an exploded view image showing an example of how the part can be assembled:



And, for reference, a normal HS Shaft bearing assembly:



The Ball bearing adapter assembly is slightly more complex, and a little larger in size. However, it is still relatively compact, and saves a lot of power loss due to friction from the motors. Because of these benefits, we believe that the small increase in size is worth it.