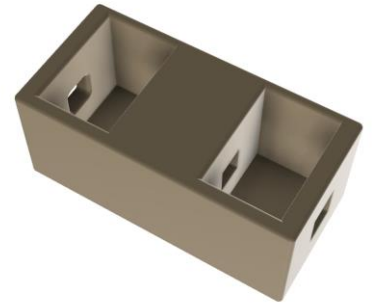


VEX IQ – 2019 / 2020

69639A – Notre Dame du Sault



Make It Real CAD Engineering Challenge

IQ Shaft Extender

Final Report

1) Introduction

We are team 69639A from Notre Dame du Sault in Sault Ste. Marie Ontario, Canada. This year, we are competing in the VEX IQ Middle School division.

While building our robot this year, we found that we did not have a metal shaft of the right length. All the shafts we had were too short. We did notice that if two shafts were connected, they would provide the right length we needed. We therefore went to the drawing board to design a new part to connect two metal shafts together.

We call the new part the “IQ Shaft Extender”.

2) Explanation of the New Part

There were several design criteria for the new part:

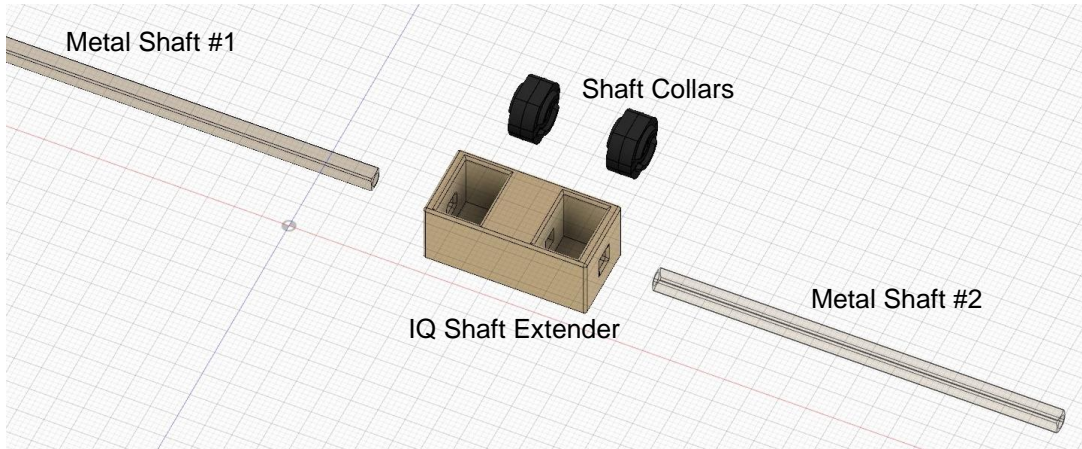
- It needed to be strong enough so it can handle rotation forces (torque)
- It needed to have a way to hold the metal shafts together so they don't come apart
- It needed to be long enough so the new “double shaft” does not bend at the joint
- It needed to be designed so no tools are required to make it work such as screw drivers or specialty tools

The part we designed is a rectangular box with a square slot through the length of the box that can accept the metal shafts to be connected. The part has two holes which can accept existing VEX IQ Shaft Collars. These Shaft Collars will hold the metal shafts in place so they do not pull apart. The centre of the new part is solid plastic (dense honeycomb pattern) which can transfer the rotation forces (torque) from one shaft to the next.

With our design, all of the design criteria were met.

The **IQ Shaft Extender** is used as follows:

- Step 1: Select which metals shafts you wish to combine
- Step 2: Insert two (2) collar shafts (existing VEX IQ parts) into the holes of the **IQ Shaft Extender**
- Step 3: Push the two metal shafts through the **IQ Shaft Extender** so that the shaft-collars grip the shaft and the joint is in the middle of the **IQ Shaft Extender**.



3) Software

We used Autodesk Fusion 360 for the design. We looked at all three software options and decided to go with Fusion 360 for the following reasons:

- Tinkercad looked a little too simple and we were not sure it would handle the requirements of our part
- Autodesk Inventor is an older program and looked more complicated to learn (less user-friendly)
- We wanted to use a program that is used in the professional design industry
- Fusion 360 was finally selected since it provided advanced modelling capabilities and was fairly easy to learn after watching a few online tutorials.

We downloaded a 30-day trial version of Fusion 360 2019 (version 2.0.7046) from the Autodesk website.

4) Design

With Fusion 360, we started by importing the shaft collars and metal shafts from the VEX IQ parts library (available online). We then started with a 14.50mm X 13.00mm square that we extruded to 30mm in length. The size was approximated so that the Shaft Collars would fit into the new part.

We then needed to remove the areas where the Shaft Collars would be inserted. We created cubes slightly larger than the Shaft Collars and then subtracted these cubes from the original component.

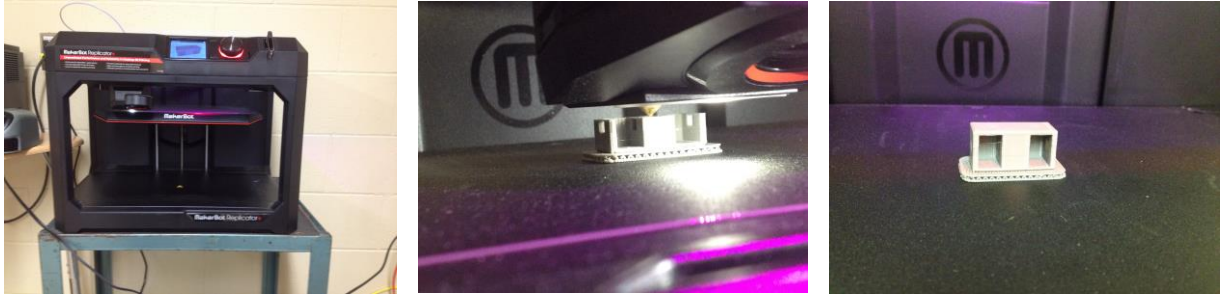
We also created a 3.257mm X 3.257mm cut-out to accept the metal shafts. The size of the shaft opening was selected to be slightly larger than the metal shafts to provide a tight fit. The metal shafts are 3.175mm (1/8")

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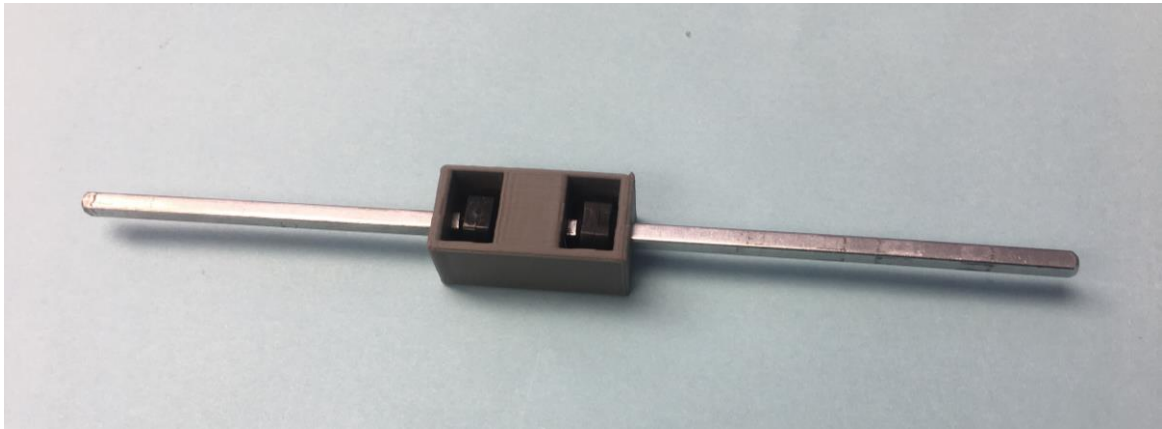
therefore we made the holes with approximately 0.04mm on either side of the shaft. We knew that this would be a trial-and-error based on the 3D printing machine that is used.

After we were happy with the geometry of the new part, we used the Chamfer function to round-out the edges so they were not sharp. The rounded edges also make it easier to insert the metal shafts into the **IQ Shaft Extender**.

We were able to 3D-Print the new part using a Makerbot Replicator+ 3D Printer at our school.



We tested the final part and it worked great !



5) Conclusion

In designing a new part, we learned that it is not too difficult to do. We learned how to use a new program (Fusion 360) and the design process required from start to finish.

We were also surprised how easy it was to create a new part and have it printed on a 3D printer. The design process for a new part is very similar to the design process for our robot. We make a list of design criteria, we come up with solutions, we build, then we test.

In the future, we would likely use this design process to come up with new parts that can be used in the VEX U competition which allows 3D printed parts. The skills we learned might also be valuable in our future careers. The software we chose to work with is an industry standard program.