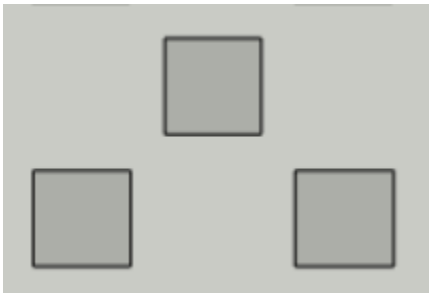
The Lift Brace

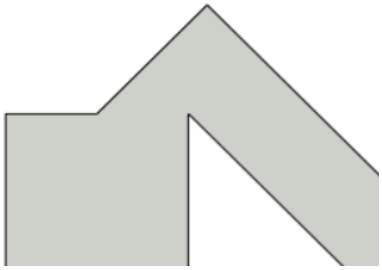
By Murad Malik on 393W at Legacy Magnet Academy

I was in a robotics tournament with my alliance's robot and was against 2 other robots. This match was our first of the day. As I drive towards the yellow goal a yard from my robot, I notice something peculiar. Something important. Something that could change the outcome of the match. My lift was loose and was jangling about during the most important 30 seconds of this match. I think nothing of it, and pick up the goal. Or at least, I try. The goal comes up, but not nearly far enough. The goal dangles, inches from the platform, inhibited only by loose screws. As the match comes to a close, it was clear what the game-affecting problem was. Four loose screws. The screws will always come loose, as there is no additional pressure or locking keeping them in place. These screws lost us the match and netted us a slightly broken robot. After the tournament, I look online and find nothing but temporary and ineffective solutions.

Until now. Using my Fusion 360 skills, I created a lift brace that could have saved us the match. It has the side geometry of a right triangle, which helps with stability and strength. The hypotenuse ensures that the lift bean will always be straight, and absorbs some vibration from the robot, the #1 enemy of tight screws. Primarily, I used the sketch, extrude, and rectangular pattern tools. I first created a rough sketch with the sketching tool to tweak length values. Then, I extruded the sketch into a body, settling on a 10 hole by 10 hole (around 6 inches per side) size. I used the Pythagorean theorem to calculate the length of the hypotenuse. Next, I used the sketching tool and a model of a c-channel to create one set of holes (see right, FIgure 1), and



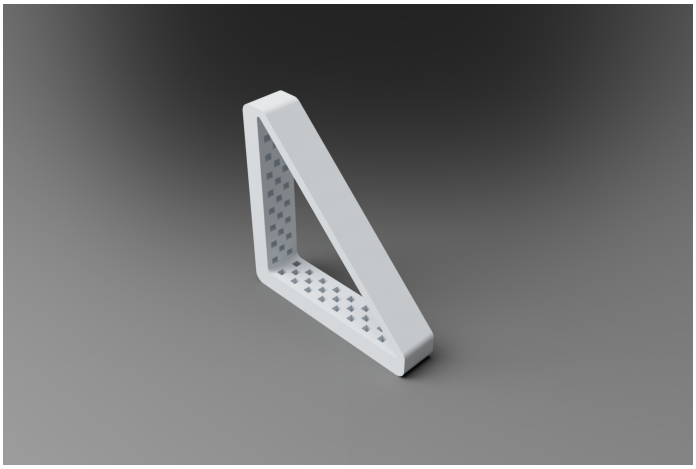
(Figure 1)



(Figure 2)

the rectangular pattern tool with the features setting to make the rest of the holes. I repeated this on the other side of the brace. There was a ledge on the corners of the model (see left, figure 2), which didn't provide lots of contact and stability between the hypotenuse and the sides. So, I cut off the top slightly and filled in the hole(see right, Figure 3). This provides lots of adhesion and strength between the hypotenuse and the sides. Finally, I filleted the sides of everything for a safer edge for teams and slightly higher tolerances for screws. The final product meets all of my design criteria, it braces the lift, absorbs some vibration for the screws, and fits nearly all lift types.

(Figure 3)



To use the lift brace, simply attach it to your lift and chassis beams with screws and bolts (preferably nylocks). The brace fits standard vex c-channel holes and mimics a 2x10 c channel on both sides. With this part, a lift can be secured tightly without fail with only 4 screws. This part can be integrated onto most robots with ease, as the small yet sturdy design of the Lift Brace can fit virtually anywhere

I have some experience in CAD, using snapCAD in 2018 and 2019 and Fusion 360 for 2020 to today. For this challenge, I used Fusion 360 V2.0.10806. I challenged myself to use commands and practices I was unfamiliar with such as the rectangular pattern command and copying geometry. However, there were many things I could have done better. I could have used the line tool in the sketching workspace for the hypotenuse of the triangle. I also felt like I took the longer path modeling the brace. Instead of making the whole sketch (minus the filleted edges) in 2d, I made the edges, then made the hypotenuse on top of the edges. This makes for a slightly worse product, but the holes on the base were fully accessible with the method I used. If I made the model in 2d, then extruded, the product would have been cleaner, easier to plan, and taken less time to make. This knowledge will help me make models faster, more serviceable, and with less effort. CAD can be used in many different applications, and I believe that it is valuable to learn these skills early in this digital age.

Our model went through two iterations before it became what it is today. The first iteration was a slim, small brace only intended for small 90 degree connections, such as a claw to a lift, or a ring intake backing to a chassis. I sketched this idea out on paper before something occurred to me. I realized that this small idea could have solved one of our biggest problems. I redesigned the brace for stability and lifts. I made it taller, wider, and emphasized strength in this design. I made sure that the brace was easy to use and compatible with every lift type I could think of, as having it only useful for one robot would defeat the purpose of making the brace in the first place. Finally, the brace has been finished. It is a part that is reusable, practical, and solves a problem every team is too familiar with.