2 Wide Bearing Flat

VRC High School - “Make It Real” CAD Engineering
Online Challenge Sponsored by Autodesk

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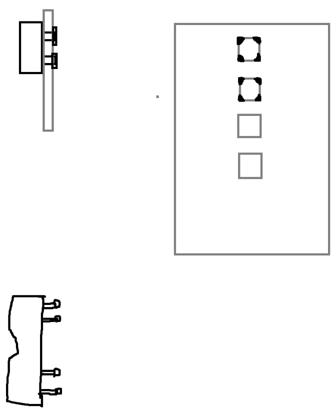
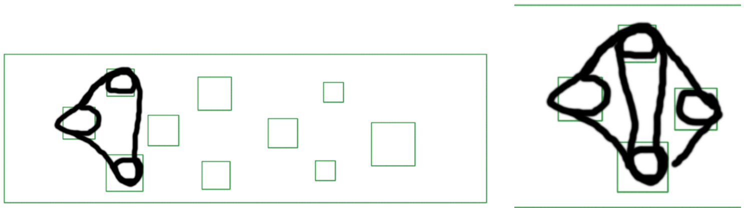
With this year’s VRC High School - “Make It Real” CAD Engineering Online Challenge we looked at issues or improvements that could be taken as inspiration for these CAD challenges. One problem that we ran into repeatedly while building was the spacing for bearing flats. When designing a robot figuring out the spacing between subsystems can be difficult yet important. For example, this year’s Tipping Point has a variety of game elements in which you need multiple subsystems coherently working together to achieve. However spacing them can be difficult as locations of screws, nuts, and bearings may interfere, thus compromising desired positions of subsystems. While moving things around does solve these issues at times, it's not always a solution and is usually inefficient or time-consuming.

We started off with various designs and brainstormed an ideal shape for the bearing flat that would be able to fit in a 2 wide space while still being sturdy.



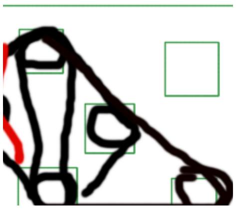
Two bearing flats in the side view and one in the back view. The rectangular gray piece is a plate.

This bearing flat was one of the prototypes we made. This design uses a similar concept to the nut retainer. The studs on the bottom of each bearing flat are made longer for less slop. On the ends of the studs flat are little studs that extrude outward. To insert these bearing flats, we would use a slightly flexible material to bend the studs inward. After bending, the studs would spring out and the studs would lock in place. Finally, a screw would be added to secure the bearing.



The green represents a 2 wide c-channel with the holes. On the c-channel is a prototype bearing. On the right is a 4 hole variant.

With this prototype, the bearing would have 3 holes or 4 instead of 2. While this might seem counter-intuitive, two holes are meant to be held with screws to stay structurally sound. The last hole is where the shaft can pass through. We eliminated one of the holes on the straight line to create a bearing that can fit on a width of 2 and a half holes. The bearing has the same appearance as a regular one, but is fitted with the third hole on the middle hole for the 2 wide c-channel.



The bearing prototype but with the four holes being arranged in a right triangle shape.

Our previous design failed in that it could not be fitted on 3 and 5 wide c-channels, as they did not have middle holes. But with our new design, the holes would be arranged such that the holes could be in any c-channel. This design has the fourth hole aligned to another hole on the bigger c-channels. The bearing flat also retains the same ability to be used on 2 wide c-channels. We also knew that regular bearing flats have studs that stick out from the bottom to lock into the holes and so we included this feature to all the holes except the middle, so if a bigger c-channel was used, the studs wouldn't push up on the c-channel as there are no middle holes.

After having the basic blueprints drawn out, we started to CAD. The bearing is modeled in Autodesk Fusion 360. To create this part, we opened a sketch and constructed the outline of the bearing shape. We then extruded the outline into a 3D model. Using the circle tool in the sketch, we cut four holes into the bearing. To find the spacings of all of the holes, we used the three hole bearing flat as a reference. We then used the filet tool to round off the rectangle on the corners. To allow the shafts to go through, we cut a circle in the middle of the square. Afterward, we used the pattern tool to repeat the studs on all three holes. We did not add the studs on the center hole so the bearing could work concurrently with both 2 and 3 hole c-channels. On the bottom and top of the bearing, there are intrusions. We used the extrude cut to cut out and form the intrusions.

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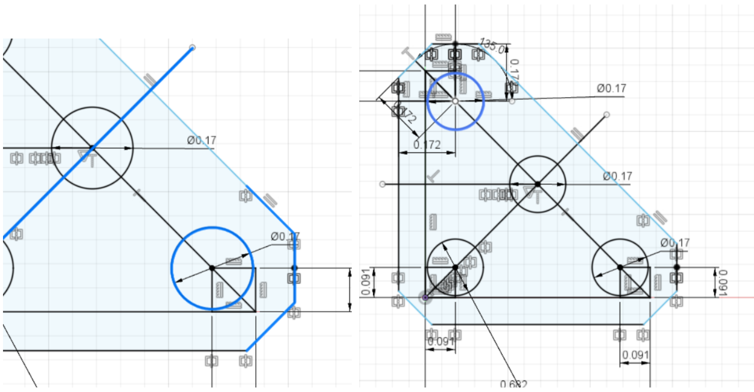

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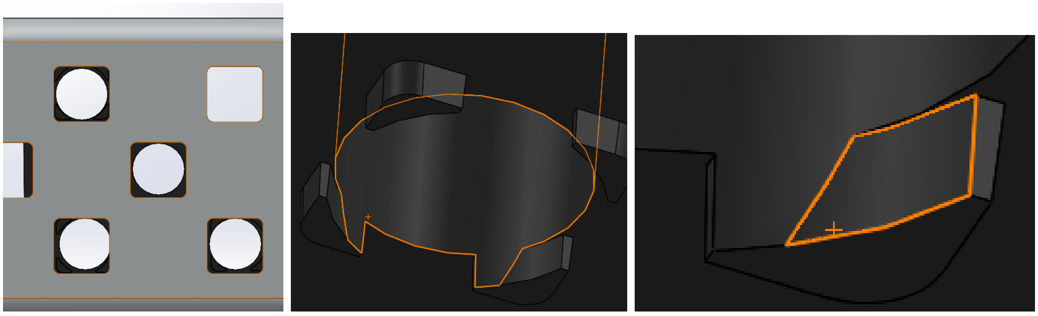
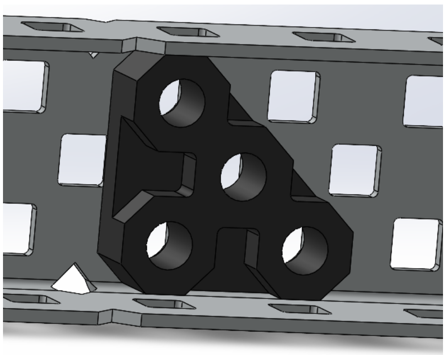
First sketches of initial 4 hole bearing

With this iteration of the bearing, we had the rough space and model complete. However, during the many design additions, we altered the spacing of the holes which was evident when we tested it and mated to the c-channels. Along with this issue, we also had the studs located at the bottom of the bearing flat that had a dimension error.



The bearings problems and errors showing misalignment and imperfections in studs

After cleaning up the model reducing its imperfections and blemishes we once again mated it to a channel to make sure it fits perfectly. This time, we made sure to align the holes properly and fix the studs by accurately measuring out the radius and distances. This solved the issue of the spacing thus fixing the studs to be in the hole. We noticed it covered other holes which would cause problems in tight spaces. However, with everything else finalized we came to the realization we were almost complete with the 4 hole bearing flat.



After completing this project we learned to use Fusion 360 and all the tools it offered and designed a component. When making the final design we cut materials from under the bearing similar to a classic bearing flat as well as making sure the bearing flat aligned to a channel. The CADding process was done precisely and accurately as we wanted the 4 holes bearing to closely resemble a 3 hole bearing flat in its general design. We learned many things through each iteration, fine-tuning the design, and finally ending up with a perfected and complete 4 hole bearing that achieved our goal of fitting a 2x2 space. We are happy with the final product of our bearing flat. If this were to be implemented, we would be able to have many more options when building the year's robot.