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<u>CAD a Subsystem Challenge</u>

Our team, 8838B, from Orchard Hills Middle School, has decided to create a CAD design of an entirely new part. We named it the Variable Angle C-Channel Joint. This joint allows easy connection of 2 wide C-Channels of any length at angles ranging from 0 to 180 degrees. This would allow beams to be placed at angles other than the standard 90 or 180 degree angle which will open up unlimited possibilities in constructing innovative designs incorporating diagonally placed beams. Instead of the standard, rectangle shaped robot(mostly because of the chassis), making a triangle shaped chassis and other unique subsystems could be more plausible.

Besides creating more unique subsystems, the piece can be used to make attaching pieces more elegantly. For instance, the beam on punchers to launch balls have to be placed at an upward angle. Using this, creating the 20-50 angle slant is much more space efficient and is much simpler than how traditional punchers are mounted. In addition, using three c-channels and three of the variable angle c-channel joints will be a perfect triangle bracing on lifts, flywheels, or object manipulators. By attaching the c-channels and the created parts together, I can easily create a triangle and attach it between two beams to create a strong and neat triangle bracing. As one can see, this part can not only allow for more innovative designs, but also open a new realm of polygonal robot designs.

I used Autodesk Inventor to CAD our Make It Real CAD challenge. The model is the **Autodesk Inventor Professional 2019 64 bit build 136**. To CAD my design, I first measured the dimensions of a c-channel to establish the correct dimensions of our joint. Next, I used the line function to draw the basic shape in which the c-channel will rest in. I then extruded the drawing to make it 3D (see Figure 1 at the bottom of the page). Next, to create the rotation column, I used our knowledge of angles and diameter, to create one that was the perfect size for the shaft collars. Speaking of which, the shaft collar is how it locks the angle one wants the beams to be apart. On one half of the joint, a cylinder is drawn attached to the edge of the joint (see Figure 2 at the bottom of the page). The cylinder contains a square hole which fits an axle perfectly. The other partnering half of the joint will have two cylinders mounted on the edges to complement the other half (see Figure 3 at the bottom of the page). Both of the cylinders were drawn based on the diameter of the shaft collar and extruded to create the 3D form. I constrained the two shaft collars (note: the Vex parts seen in the CAD were inserted from the Vex parts library) to the two cylinders so that they are directly attached (if I move this half of the joint, the shaft collar will move with it). When the two halves are combined using the constraint function (see Figure 4 on the bottom of the page), only the side with the shaft collar can be rotated. Once rotated to the desired position, tightening the shaft collar will lock the angle in place. Finally, in order to help make the drawing more clear, I used the appearance function to change the colors of the CAD to highlight different parts of my design. This is how my design works and how I used our CAD platform to draw this design.

By designing the Variable Angle C-channel Joint, I hope to expand the possibilities in robotics by allowing easy positioning of c-channels at oblique angles and thereby creating the opportunity for infinitely more unique robot designs. During this process, I learned the important aspects and beauty of Computer-Aided Design. Using the computer software to draw lines and shapes and projecting 2D pictures into 3D structures makes designs more precise and accurate. CAD also helps me experiment with how changes in the structure of one small part can potentially change the way the robot functions. One can create anything as long as one has the patience and passion. The 3D scale imagery allows me to see my ideas on a 3D scale so that I can evaluate the advantages and flaws. In the future of competitive robotics, I will be able to sketch out a robot that my team and I selected and it will serve as a blueprint for the actual robot construction. Furthermore, the lesson I learned from CADing is to look at things from a different perspective. One view of the robot may look perfect but from another angle, some flaws can appear or it could look surprisingly different from what one anticipated it would look like. Using CADing software enables me to easily view an object from different angles and allows me to see things from different perspectives. I can apply this to life beyond robotics. For example, there are always different viewpoints in any argument or discussion. In order to fairly judge, I need to be able to appreciate all the different sides of the discussion. Having this skill will certainly help me in anything I choose in the future.

Pictures Below in chronological order

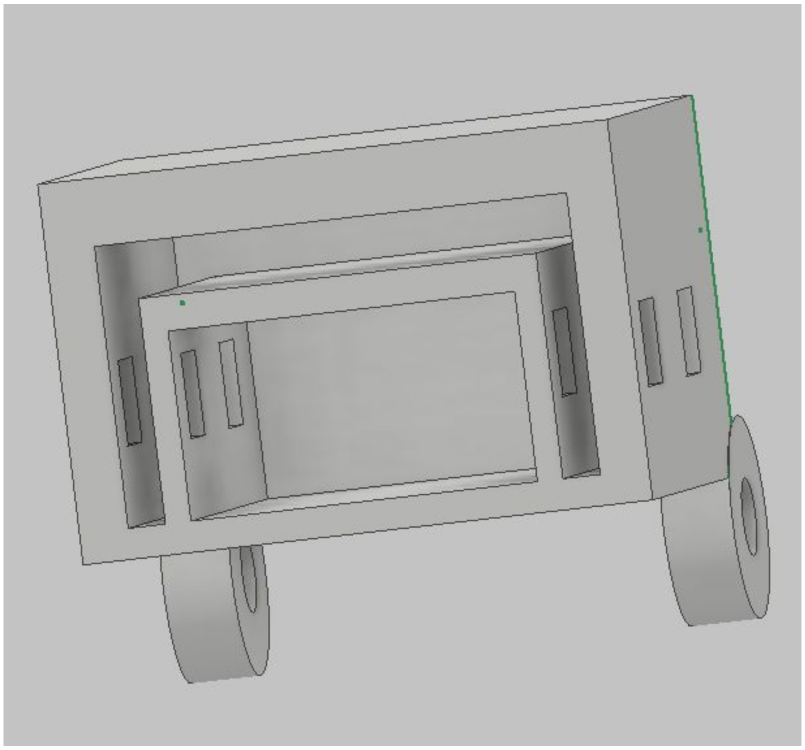

Figure 1

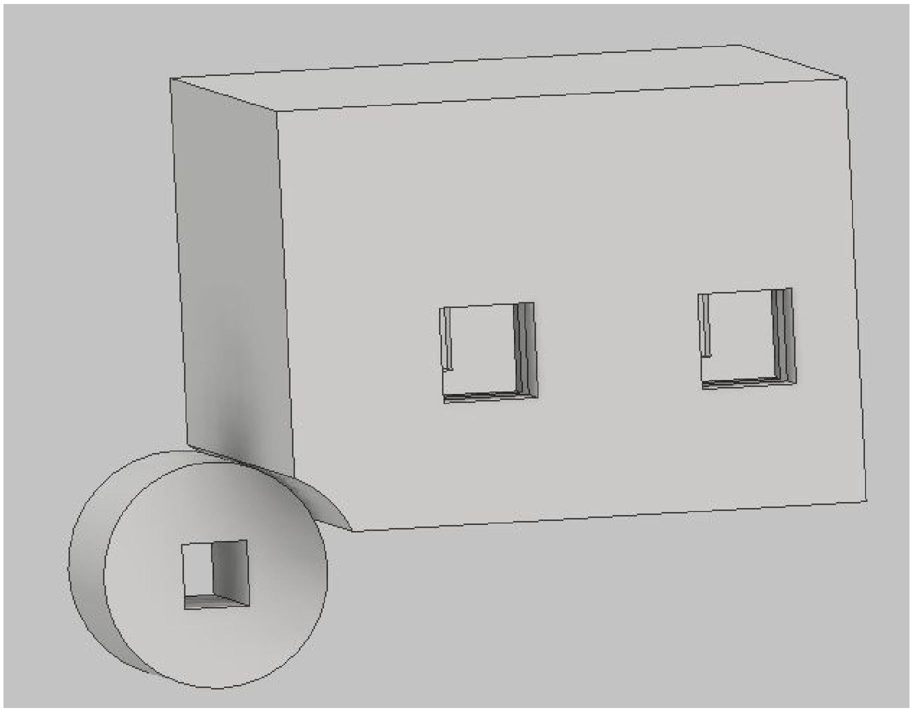

Figure 2

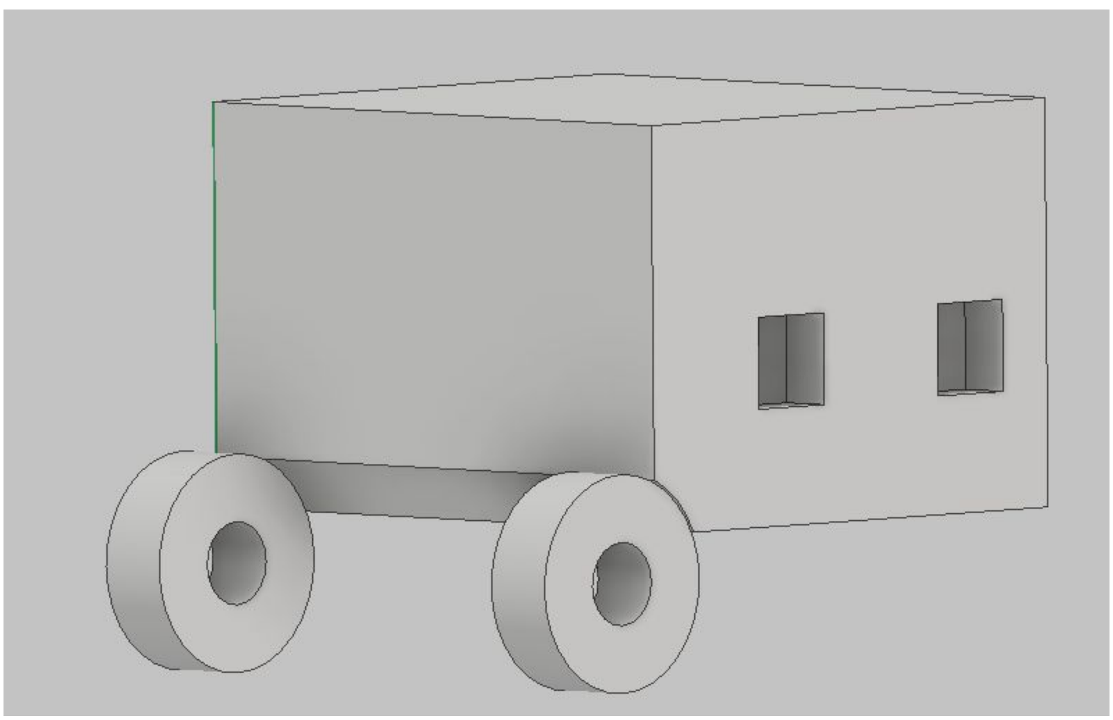

Figure 3

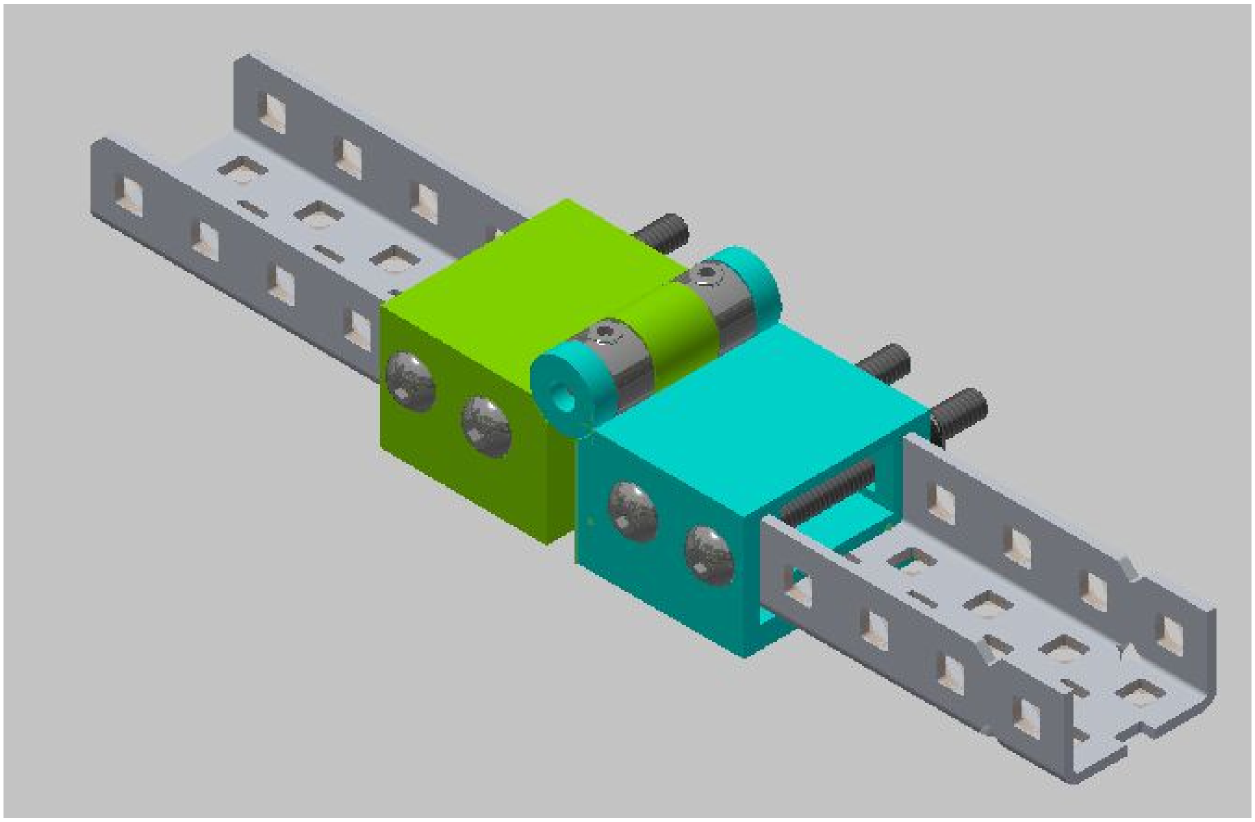

Figure 4