This part is being submitted for team 899A, Alluminators. I made this part based on an experience I had. Earlier this season, when our team hadn’t quite decided on a design yet, I proposed and prototyped a design involving lifting multiple blocks between two sets of wheels, then, when the stack was high enough and the robot was in the right place, a bar could be shoved into the blocks in order to remove them from the grasp of the wheels. This prototype was incredibly hard to make, as the rack and pinion system I had available was difficult to work and design around, and our team inevitably went on to other designs. I never forgot the difficulty there was in getting all the components to line up correctly, not roll, and attach sturdily to the robot’s frame all at the same time. In order to mitigate the difficulty of design that is the pre-existing rack and pinion system, I thought of the Advanced Ease of Use Rack and Pinion System (AEURPS). With far more attaching points built in, this custom rack is designed to make linear actuation more easily integrated into a robot design. Its square also shape ensures it does not roll in its holder, unlike some other designs, such as the one I made originally.

In a standard robot, this component would be installed to assist in the construction of manipulators moving in linear directions. The example given in the pictures is a shoving device for moving stacks of blocks. It would have the holder bolted onto the frame, with a motor attached to it, powering a standard high-strength gear (the pinion), to more easily control the linear motion of the attachment. For extra stability, more holders can be attached without pinions, to ensure that the part does not shake.

In order to make the components, I used Inventor 2018, the version I initially learned how to do CADD on. I also used the 2013 Inventor VEX Kit of Parts (KOP) (Imperial), for reference on the dimensions I should use. In the parts editor, I started by using the dimensions and shapes from C-channels in order to create a contained shape that would fit in with the current system. From there I proceeded to add the modifications. I started by removing a portion of the top and adding the teeth to the inside, even checking with an assembly that the high-strength gears fit in properly. I then made the decision to remove a portion of the bottom half of the component. This was done in order to improve accessibility to the bottom plate of the rack, in a way that allows for easier attachment of nuts to the bolts, even at the cost of reducing side coverage to a slight extent. From there, I placed the rack in an assembly with a high-strength gear, constraining them so that the gear would properly mesh with the rack’s teeth, then I proceeded to create the holder in place, so that its dimensions would ensure the proper encompassing of three of the four sides of the rack and the proper placement of holes above the rack corresponding to the distances the gears axes would be at, in increments of 0.5” (the standard shift from hole to hole). After a few minor modifications (such as the subsequent removal of the adaptability of the complete part) and providing the new parts with their materials and appearance, I created a new assembly for the purpose of creating animations.

Using a similar set-up to before, I instead constrained the parts to each other with parameters, and proceeded to animate those parameters in Inventor Studio to create the animations you see on the page. I made sure to introduce more parts in from the KOP over time to create better and better impressions of the purpose of the device. A third assembly, containing only the new parts, was also created and animated, so that a full library would not need to be provided to view the file and/or watch the animations. Over time, I also rendered high quality images of all the parts used, in order to be inserted into the challenge entry.

What I learned from doing this project was that 3D CADD modeling can be a useful and powerful tool for planning and brainstorming in a variety of situations, including but not limited to a robotics team. The ability to create a visual representation of ideas in such a quick and precise manner proves very useful for communication, rapid design iteration and keeping a history of design changes. This is demonstrated in the fact I was given the honor of 3D modeling our team’s robot, so that further planning and development could be done from it. I have already become an Autodesk Inventor Certified User and an AutoCAD certified user, and plan to continue using 3D design software in the future, for all the reasons listed above. With my career path being Engineer, I am highly likely to use 3D design software again, to making quick, precise portrayals of design concepts easy to create, as well as for every reason above.