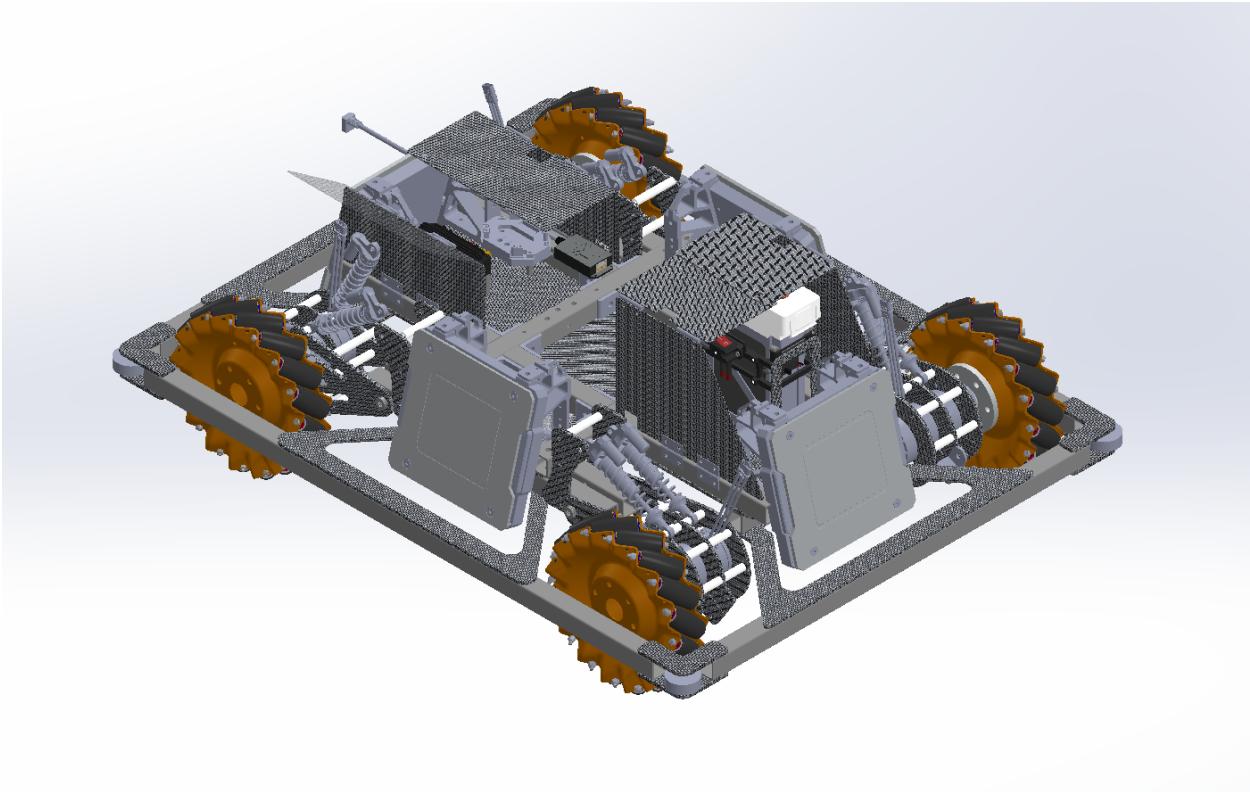
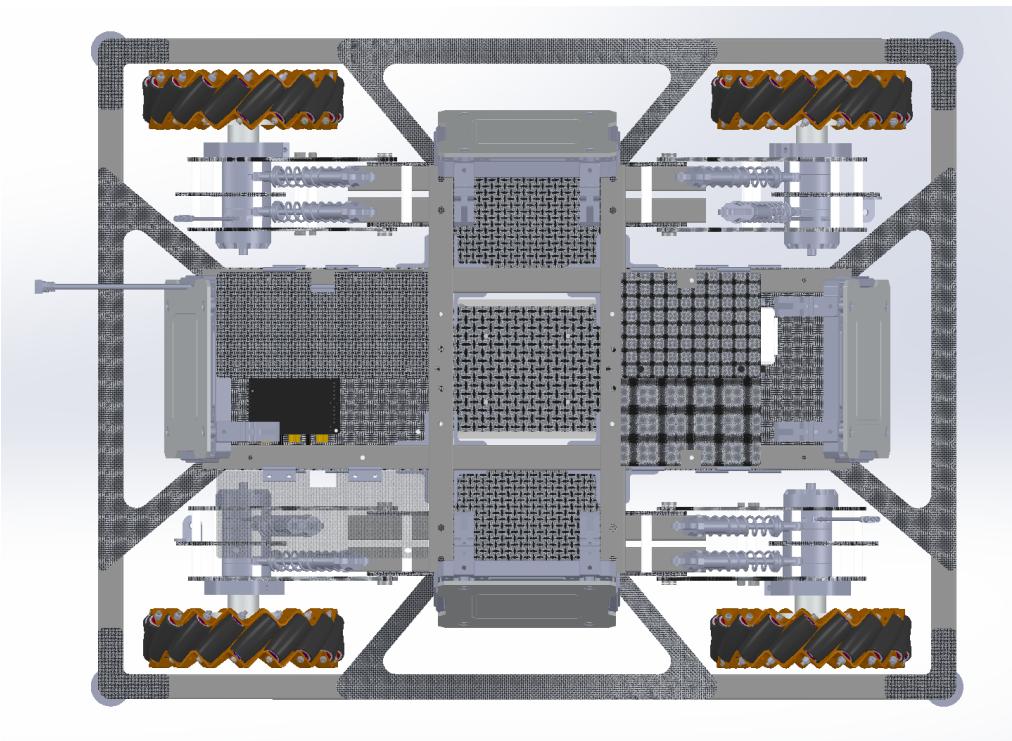


Infantry Protector Design v2

Written By: Roger Nguyen



(isometric view)



(top view and bottom views)

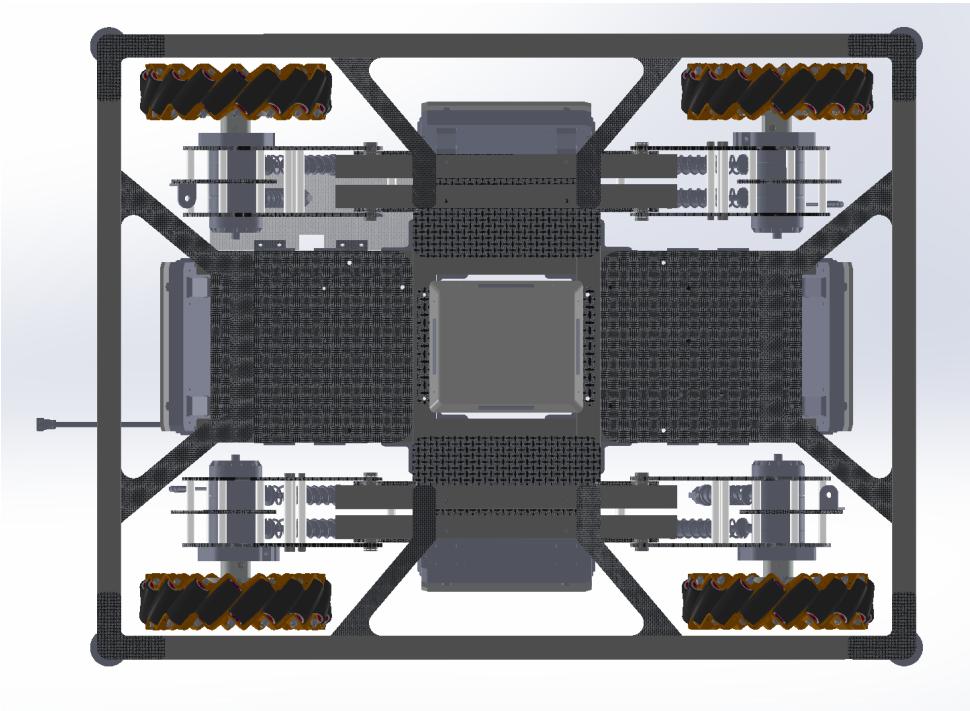


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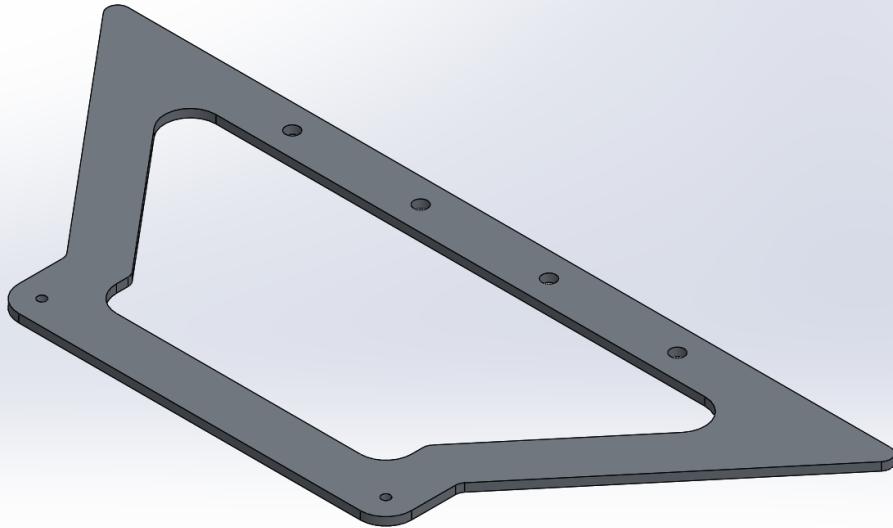
[1] Abstract

This is the redesign of the Infantry Protector; the initial design can be viewed in this [document](#). The role of the protector is to protect the infantry and the field from collisions. The materials used for the prototype will be acrylic which is used for the mounting brackets (the actual design will use carbon fiber), aluminum square tubing which is used for the protector itself and mounting block, and rollers which will be at the corners. The important changes in the redesign is the mount bracket, which was changed to be in a trapezoidal shape.

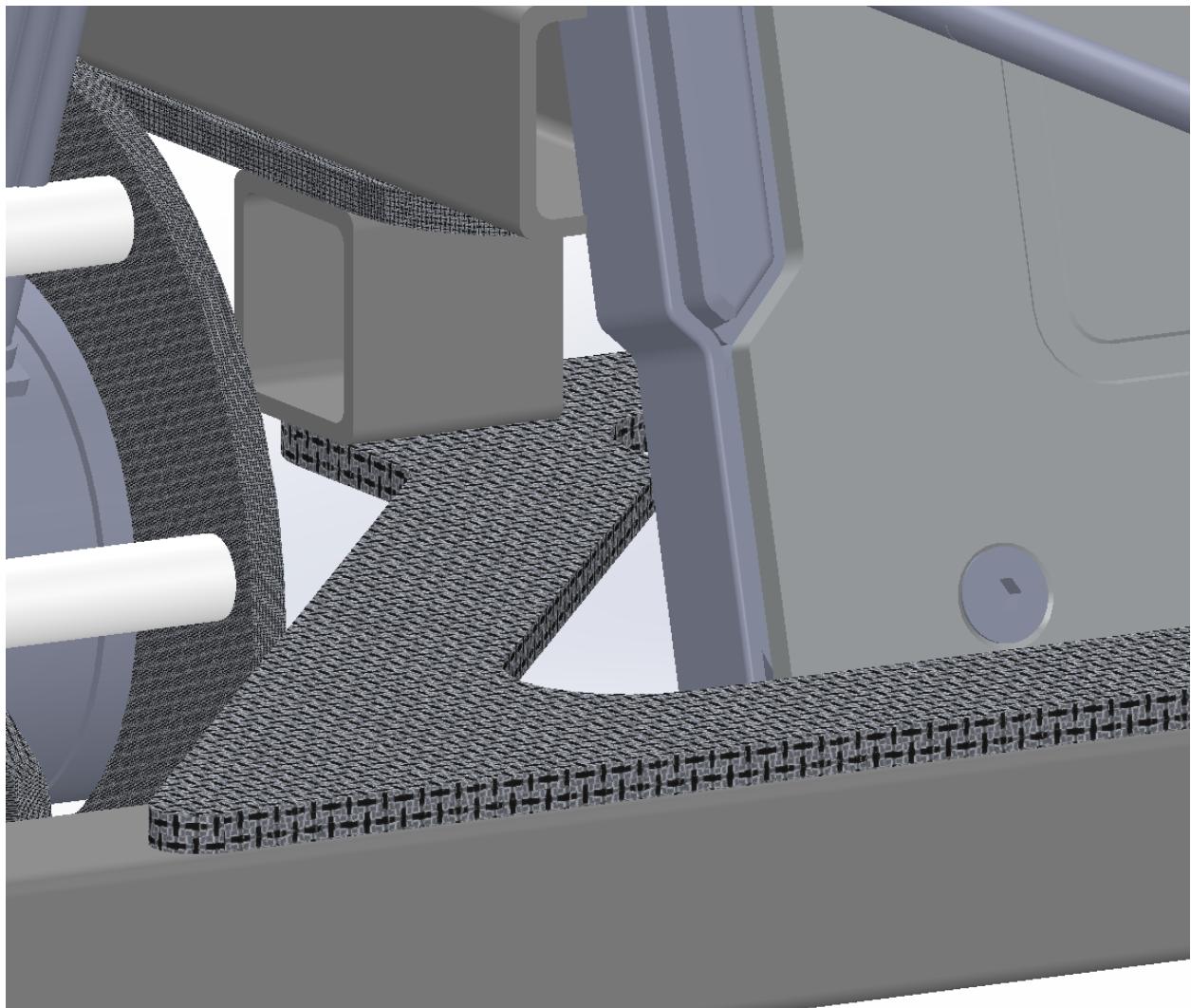
[2] Parts

The parts do not yet include holes, which will be added later.

[2.1] Front, Back Mounting Bracket

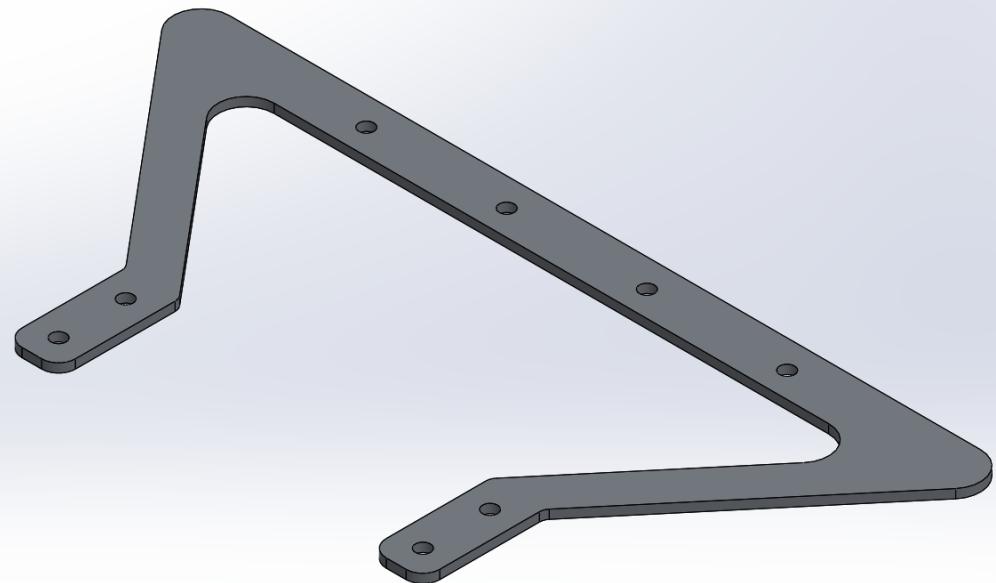


- This is the mounting bracket for the front and back of the chassis in an isometric view. The shape was changed to be trapezoidal to make the bracket stronger and less likely to yield during collisions compared to the first design.
- This mounting bracket uses M5 screws to mount onto the square tubing and M3 screws to mount onto the mounting block and subsequently, the chassis.

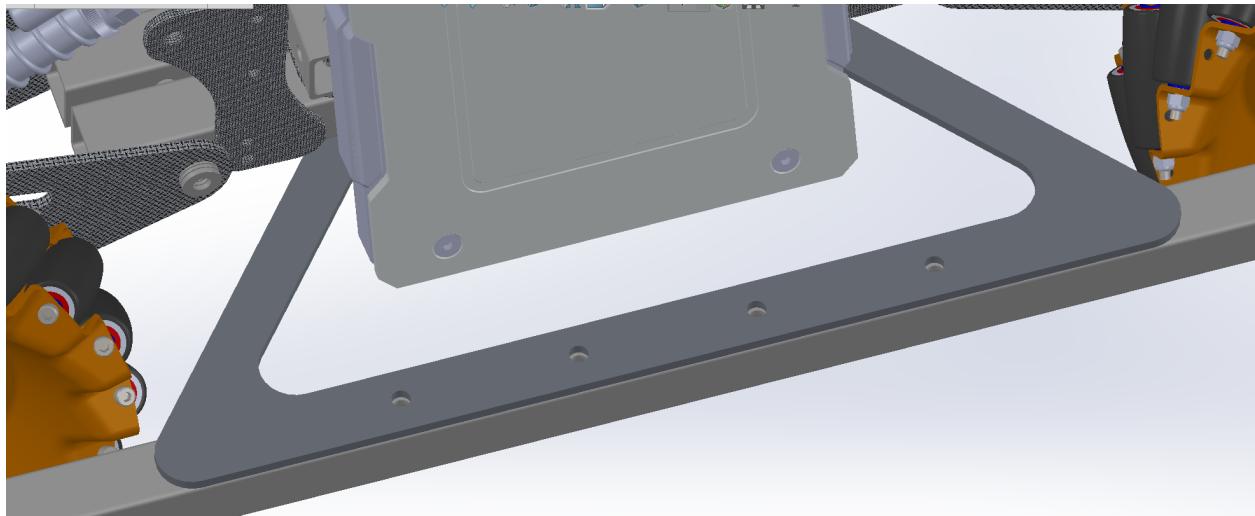


- The front, back mounting bracket will be attached to the chassis via a mounting block. This same mounting bracket will be attached to the square tubing as seen in the image above.

[2.2] Rear Mounting Bracket

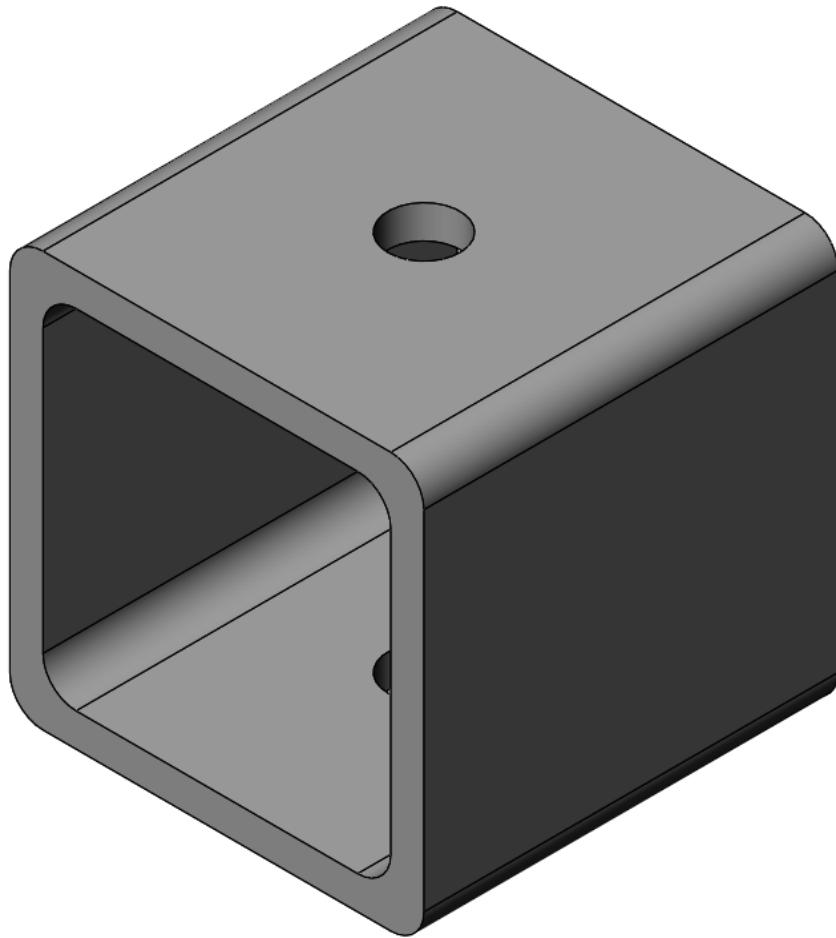


- A prominent distinction between the rear and front, back mounting brackets is that the rear isn't a complete trapezoidal shape. Since the robot's collisions will mostly occur at the front and back, the complete trapezoidal shape is not necessary.
- This mounting uses M5 screws to mount onto the chassis and square tubing.

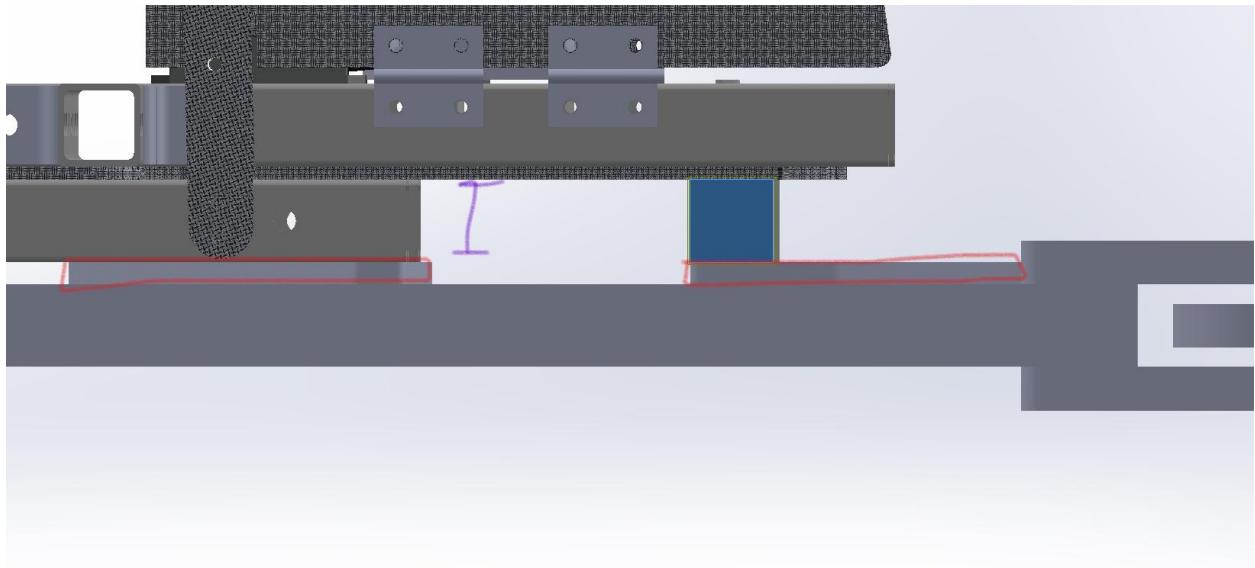


- Unlike the front, back mounting bracket, a mounting block is not needed since there is square tubing to mount under. Similarly to the other mounting bracket, it will attach to the square tubing on the top surface.

[2.3] Mounting Block

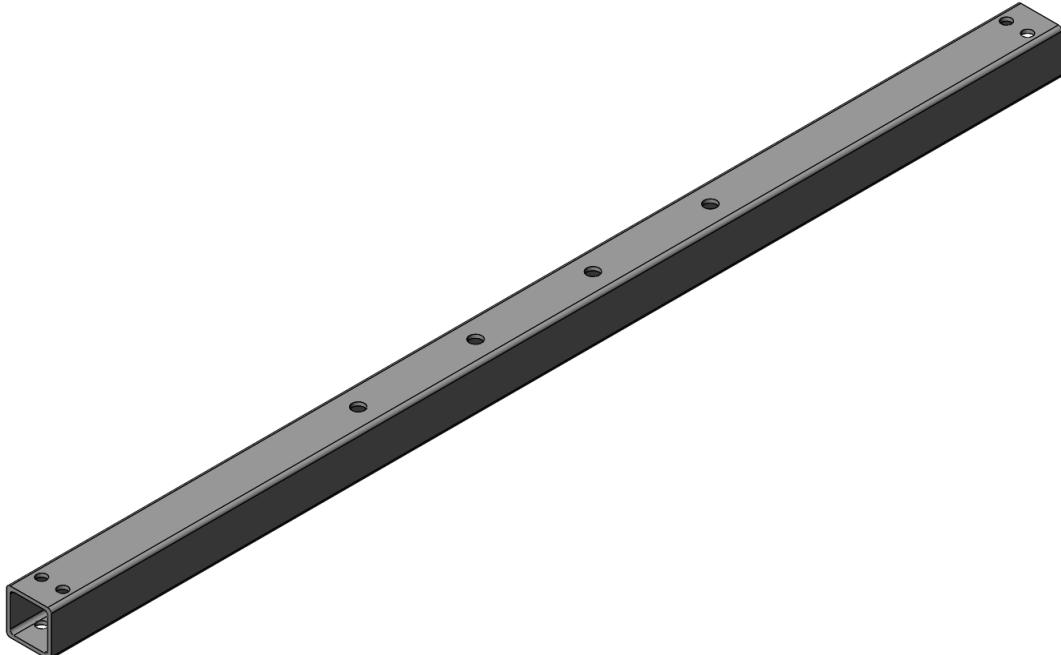


- The mounting block is used because otherwise the mounting brackets would be at different heights. The mounting block uses a pre-existing hole on the chassis to attach to, so no extra holes will be needed on the chassis.

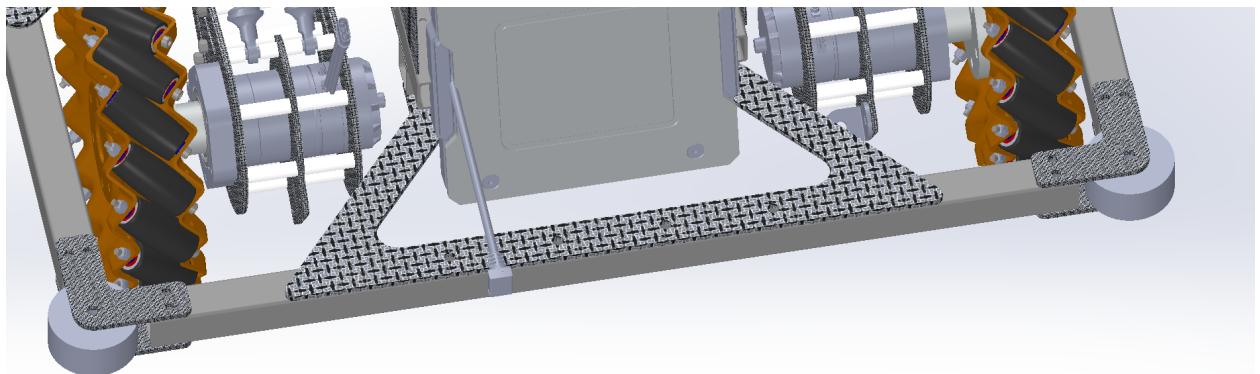


- On the rear sides of the chassis, there is square tubing underneath to support the suspension. The absence of this square tubing in the front and the back causes an uneven level for the mounting brackets to attach to the chassis (the purple dimension). The inclusion of the mounting block (highlighted in blue) allows the mounting brackets to be on the same level (red).

[2.4] Square Tubing

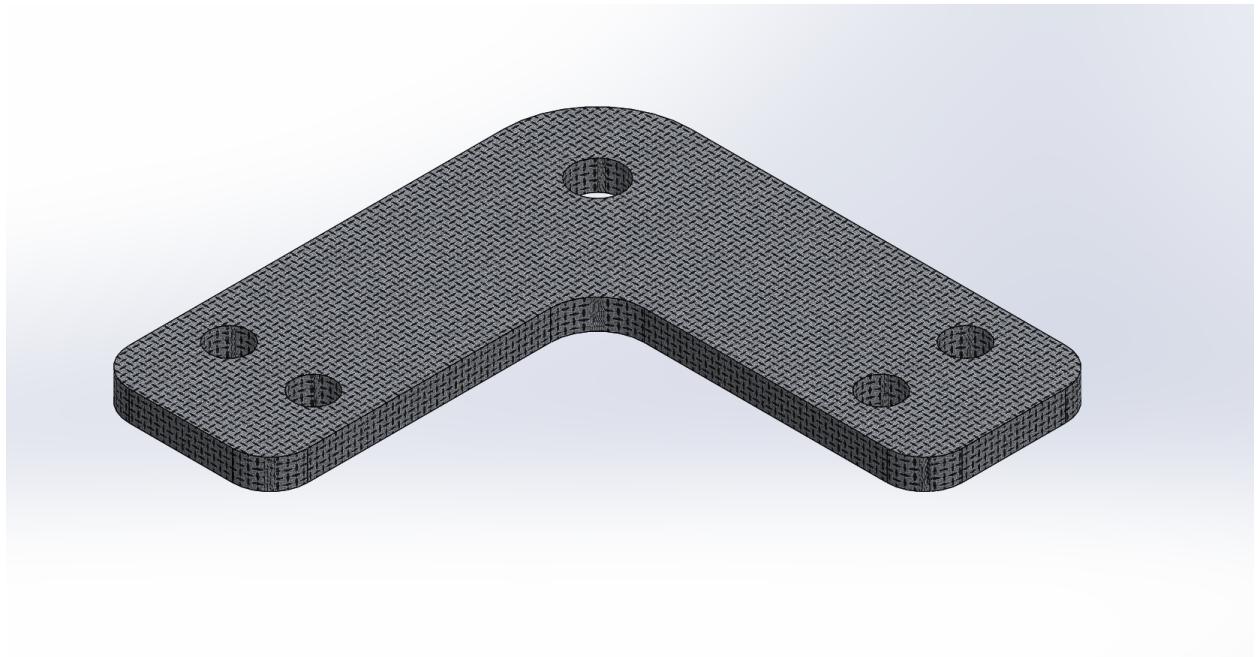


- The square tubing used will be the same used in the chassis, which is 3/4" in side length.

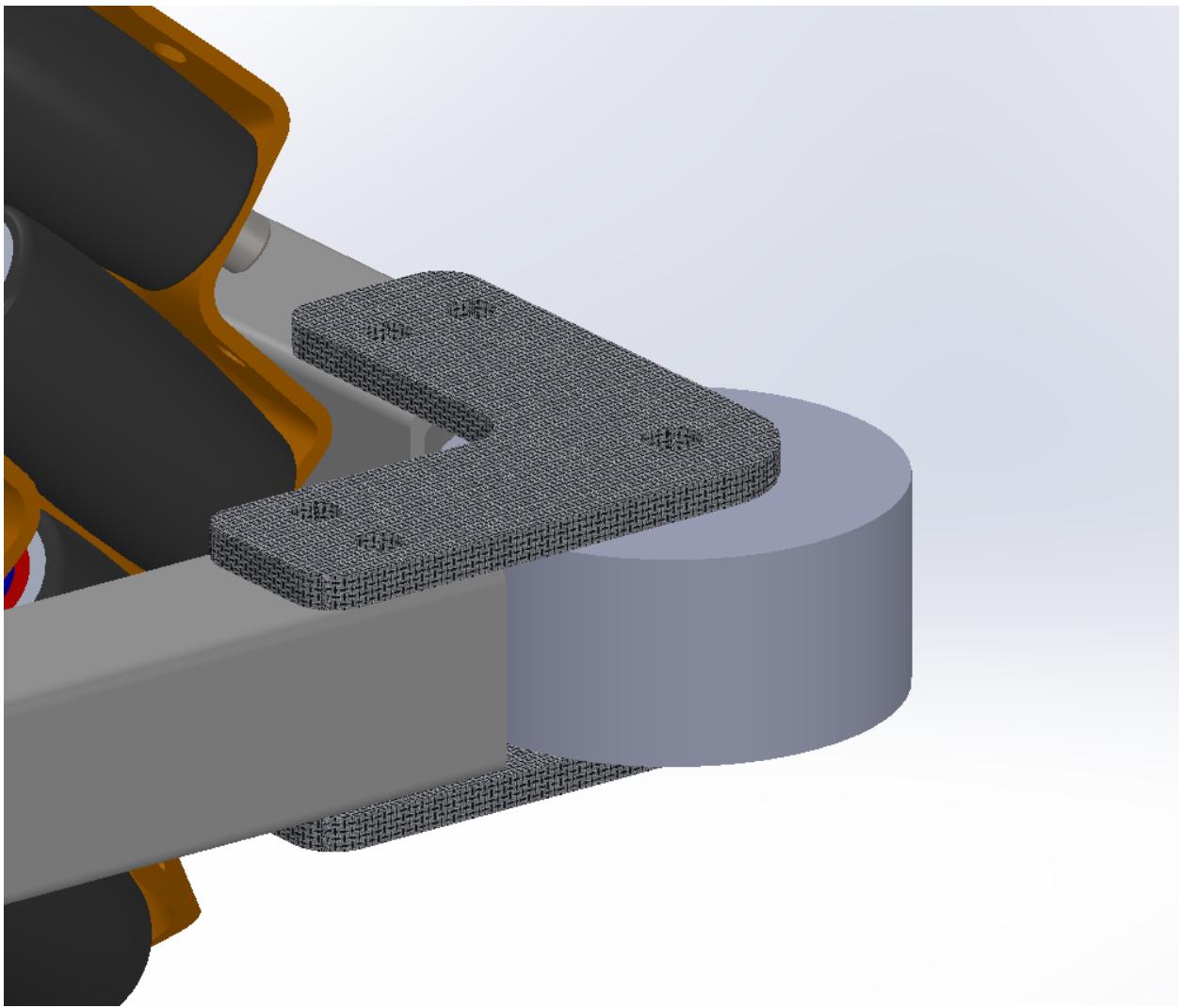


- As mentioned above, the square tubing will be attached to the mounting bracket and at the corners, the square tubing will be attached to the roller mounting brackets that will hold the roller.

[2.5] Roller Mounting Bracket



- The roller mounting bracket—as mentioned above—will be used to attach the rollers to the protector. This is an isometric view. The roller uses four M4 screws to mount onto the square tubing and a M5 screw to mount onto the roller. FEA shows that the bracket will yield when faced with a worst-scenario collision ([document](#)).



- The roller will be connected to the bracket via a M5 screw that will be through both brackets.

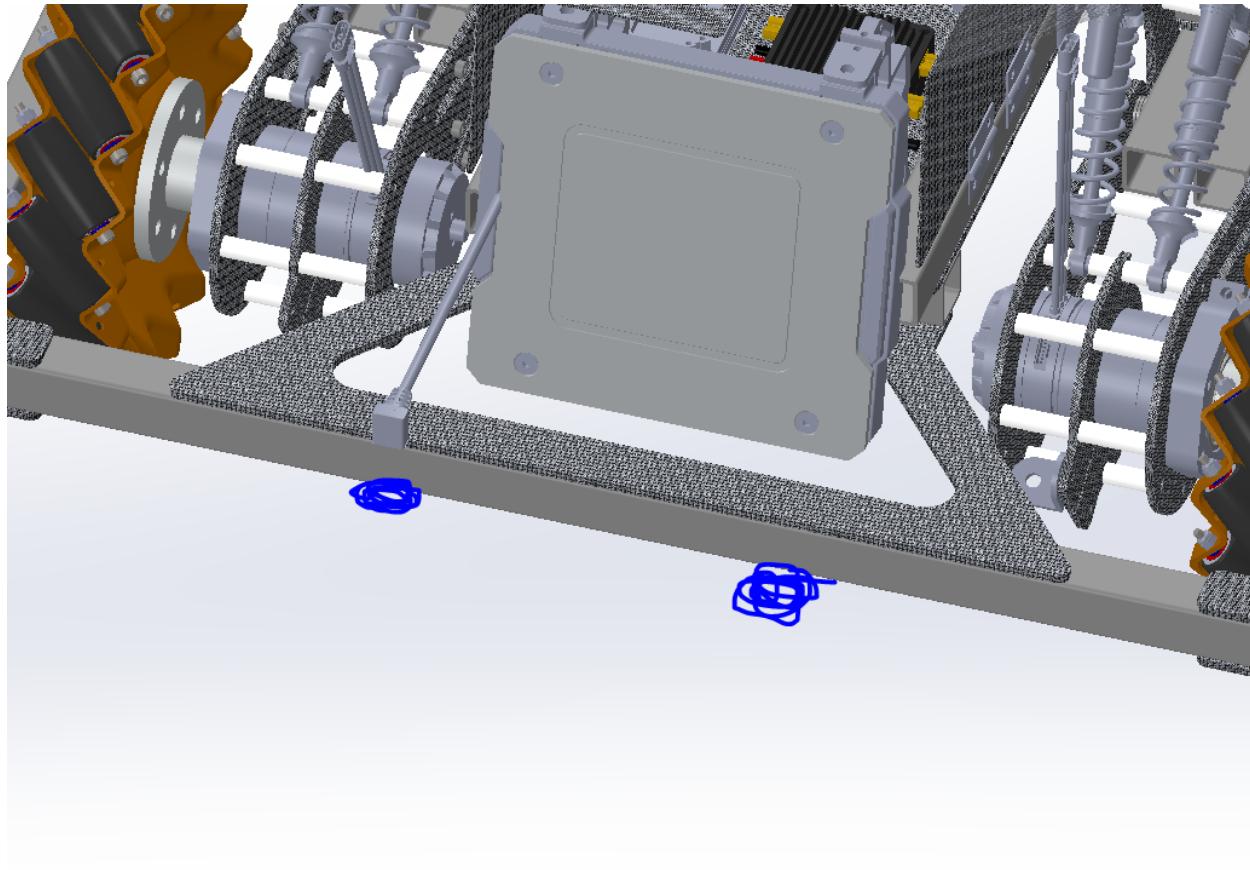
[3] Other Details

[3.1] Roller Type

- <https://www.mcmaster.com/rubber-wheels/rubber-wheels-7/for-axle-diameter~7-32/>
 - I plan on using M5 screws which are approximately 0.19685 inches which is smaller than the axle diameter (0.21875 inches). I plan on drilling the inner diameter of the rubber wheel and creating a clearance hole, to allow rotation.
 - The wheel hub length is exactly the same as the square tubing height, which will not allow the roller to translate.
 - The price of each wheel is 2.20\$ which is 8.80\$ for all four corners.
-

[4] Re-Design Considerations for Protector

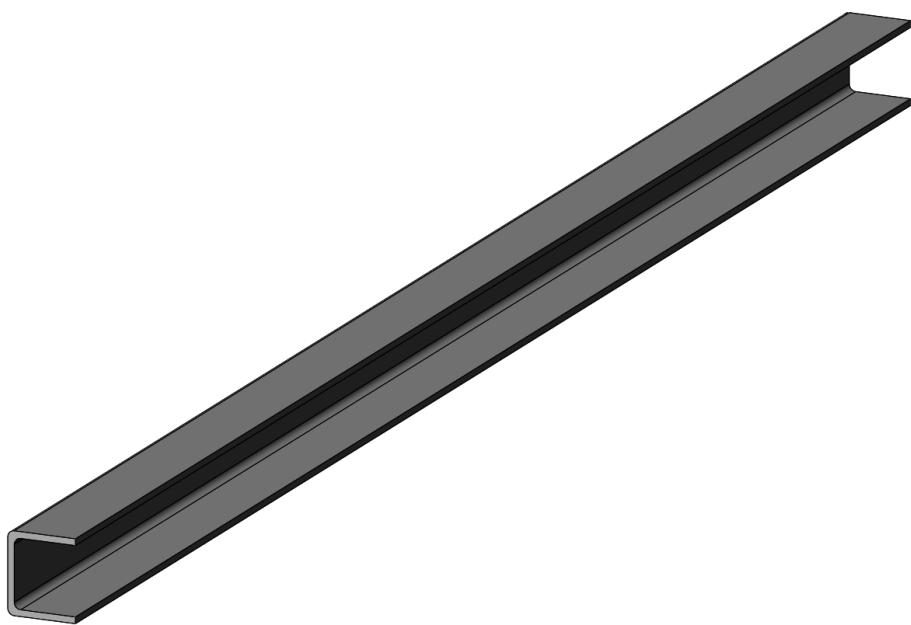
[4.1] Extra Rollers on the Front and Back for Ramps



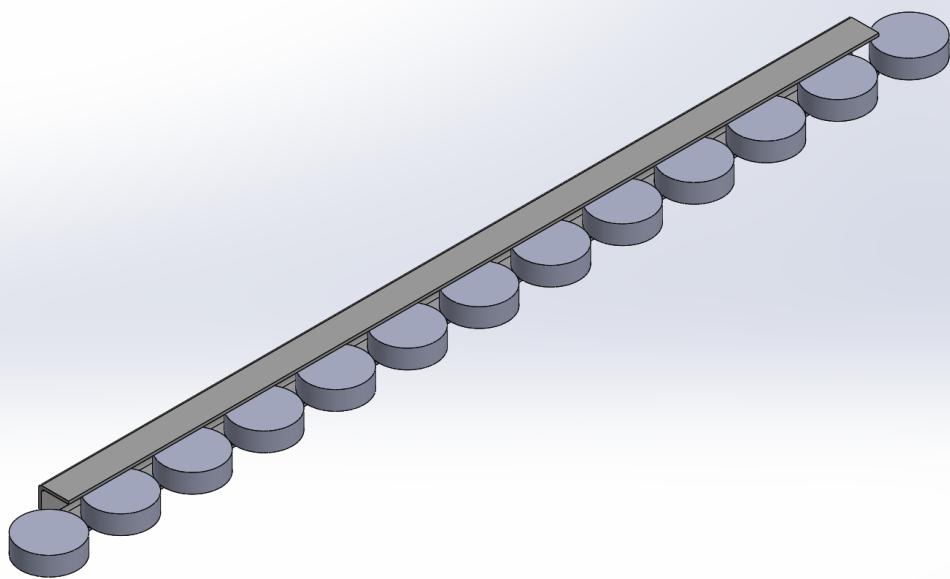
- In order to further protect the chassis when it is going up and down ramps, extra rollers could be added to the front and backsides of the protector (the blue circles indicate where the rollers could potentially be). They would be connected to the underside of the square tubing.

[4.2] Rolling Barrier

- <http://ijlemr.com/papers/volume2-issue2/19-IJLEMR-22053.pdf>
- https://www.researchgate.net/publication/324759555_Rolling_BARRIERS_Emerging_Concept_to_Reduce_Road_Accidents_An_Indian_Perspective
- The two papers linked above describe a better way to protect the chassis using the idea of covering the barrier/protector with rollers. This would require much more work in terms of manufacturing and cost.

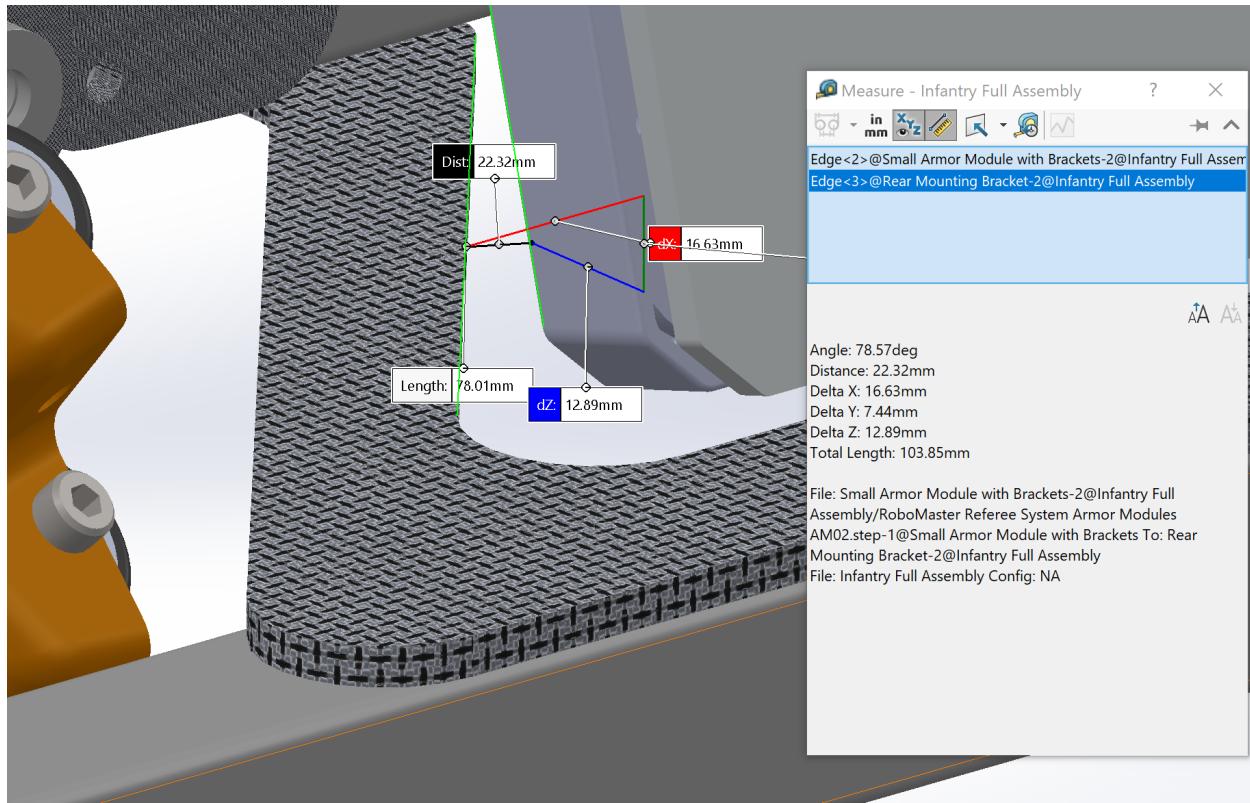


- The square tubing would need to be cut so one side is open to allow the rollers to be on the outside of the chassis.

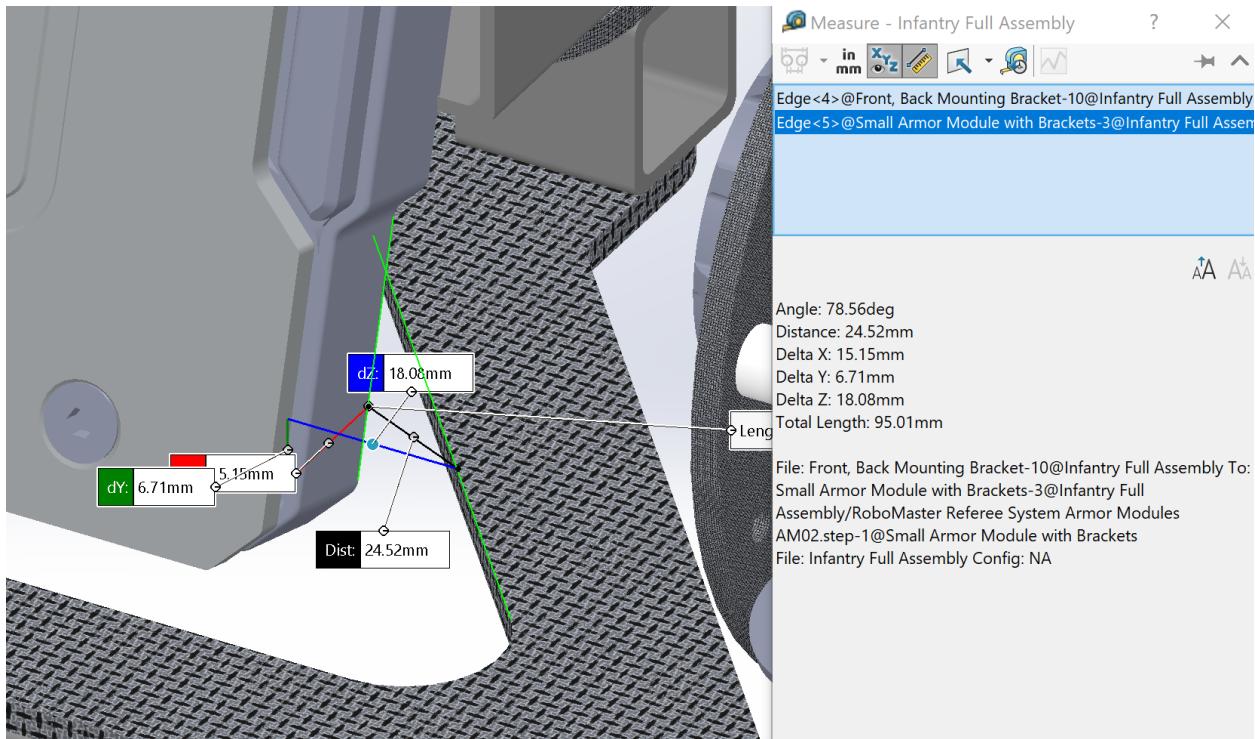


- The rolling barrier idea would only work if a much smaller roller is used, so it could fit inside the square tubing. The number of rollers required would also drive the cost of the protector to be much higher.

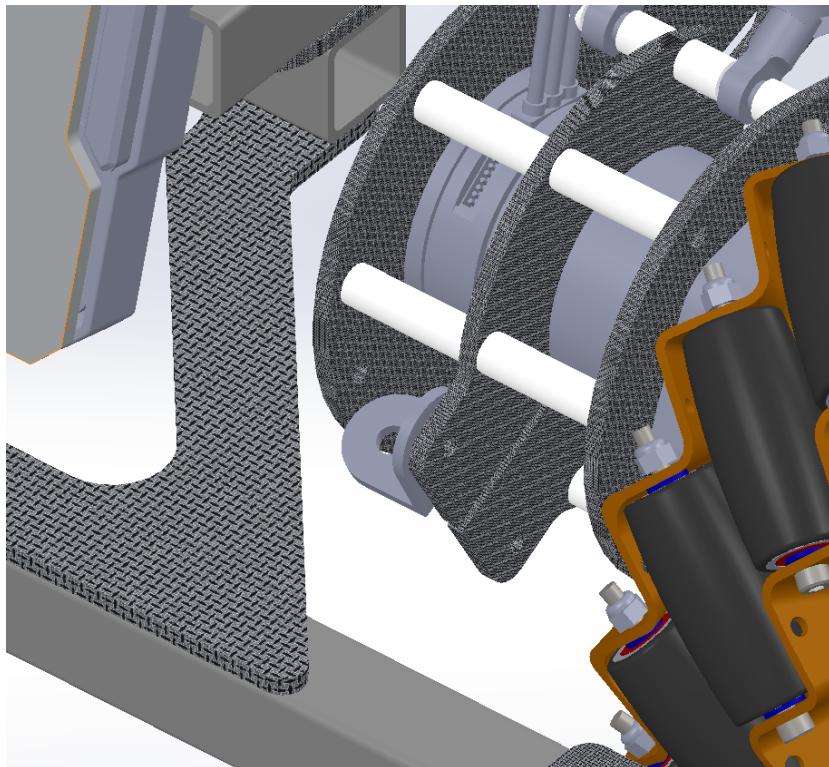
[4.3] Bracket Interference

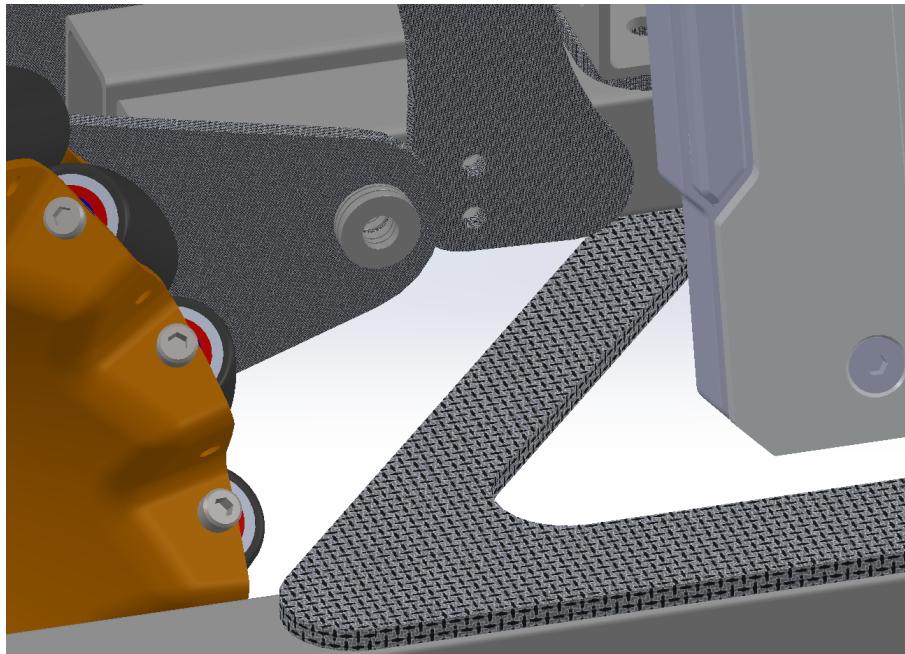


- The distance between the rear bracket and the small armor module is 22.32 mm. This distance could be too small and the angle will need to be adjusted.



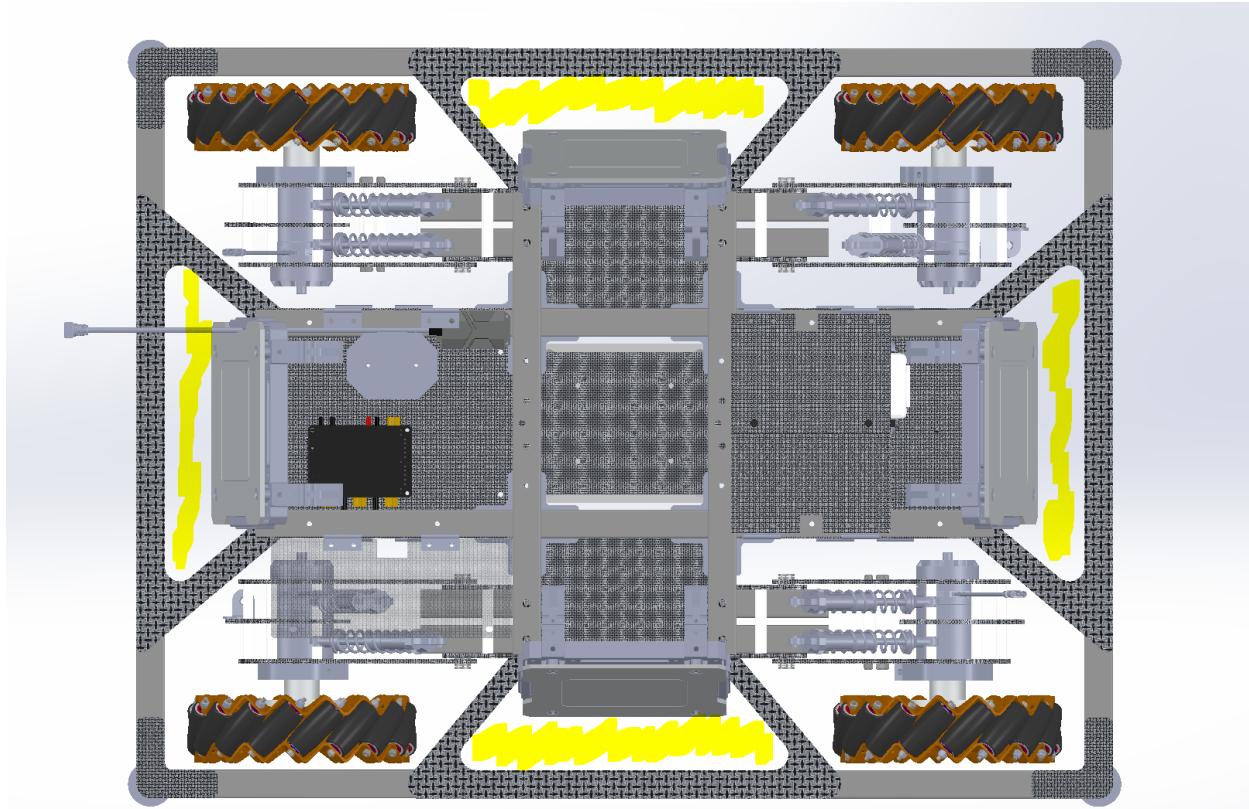
- Similarly, the front, back mounting bracket is 24.52 mm away from the small armor module.





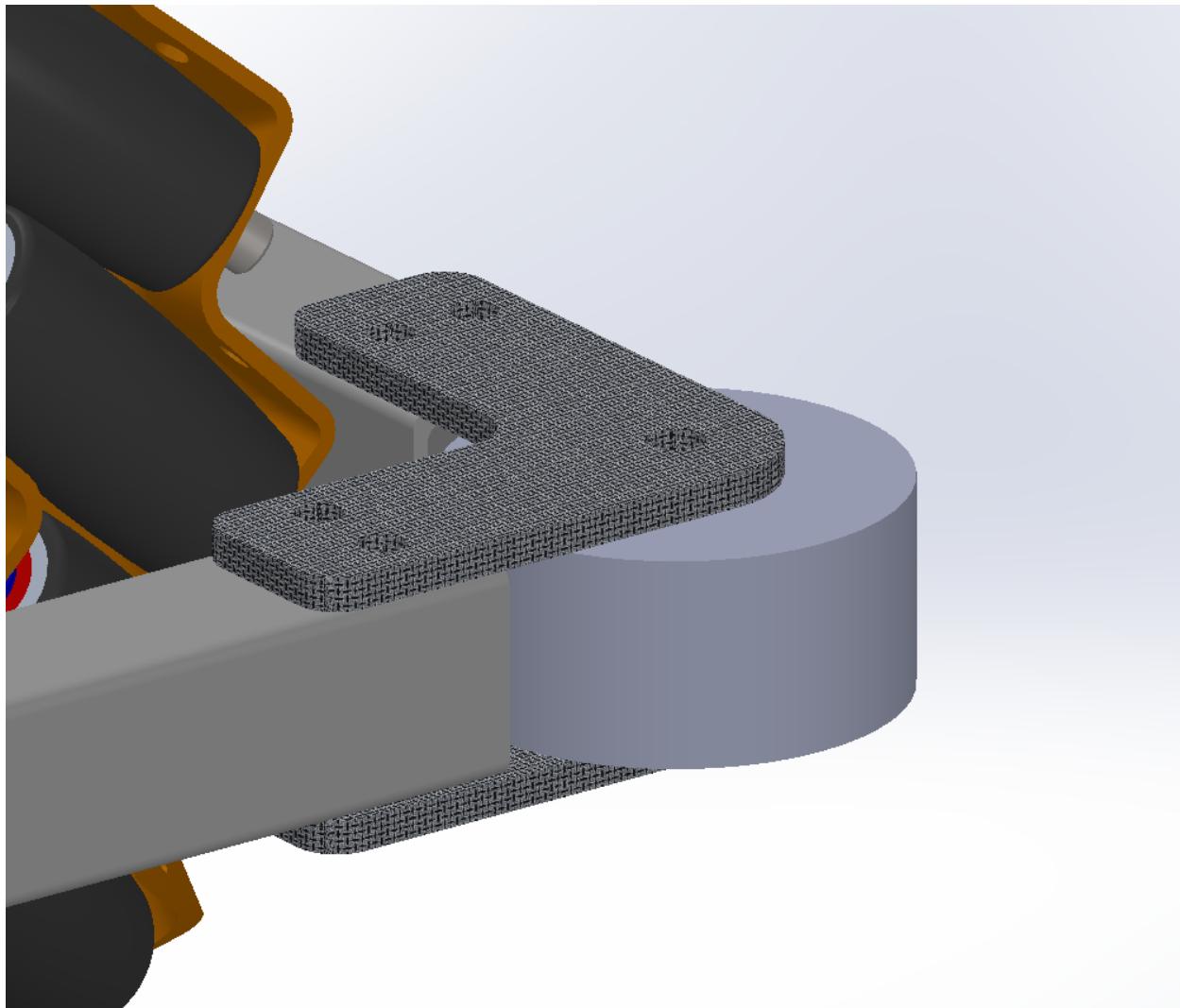
- There could be interference between the bracket and the suspension system as shown in the images above.

[4.4] Bracket Alternate Design



- In order to further strengthen the mounting brackets, the space (colored in yellow) could be filled with material.

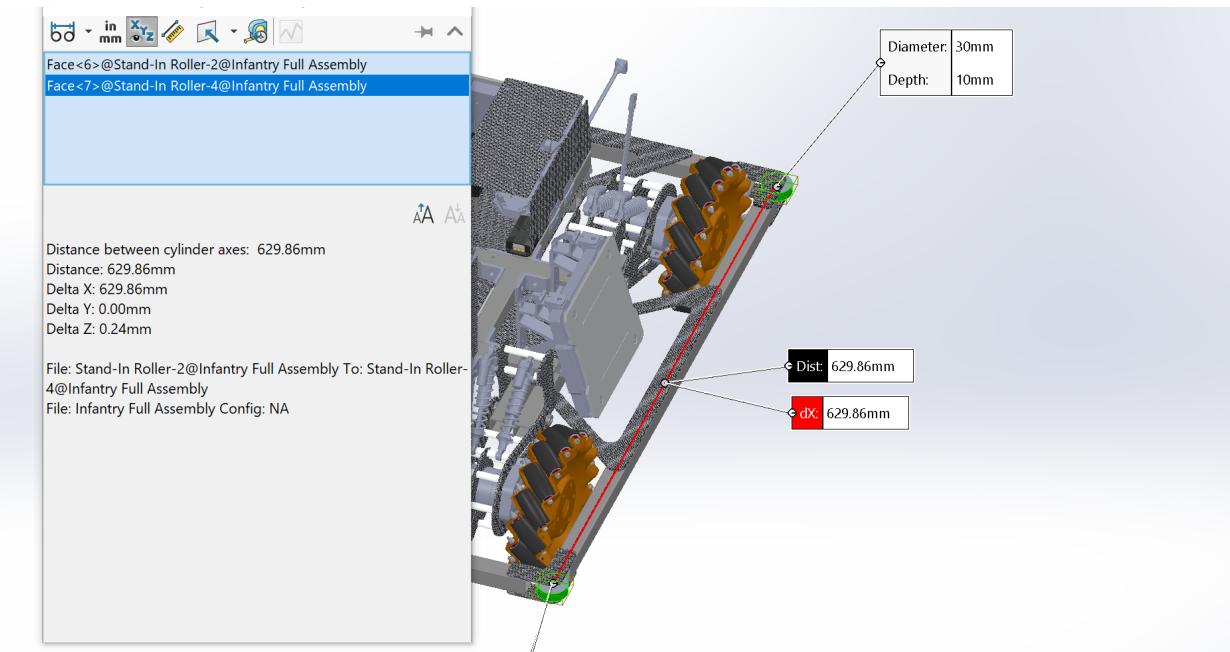
[4.5] Roller Bracket Alternate Design



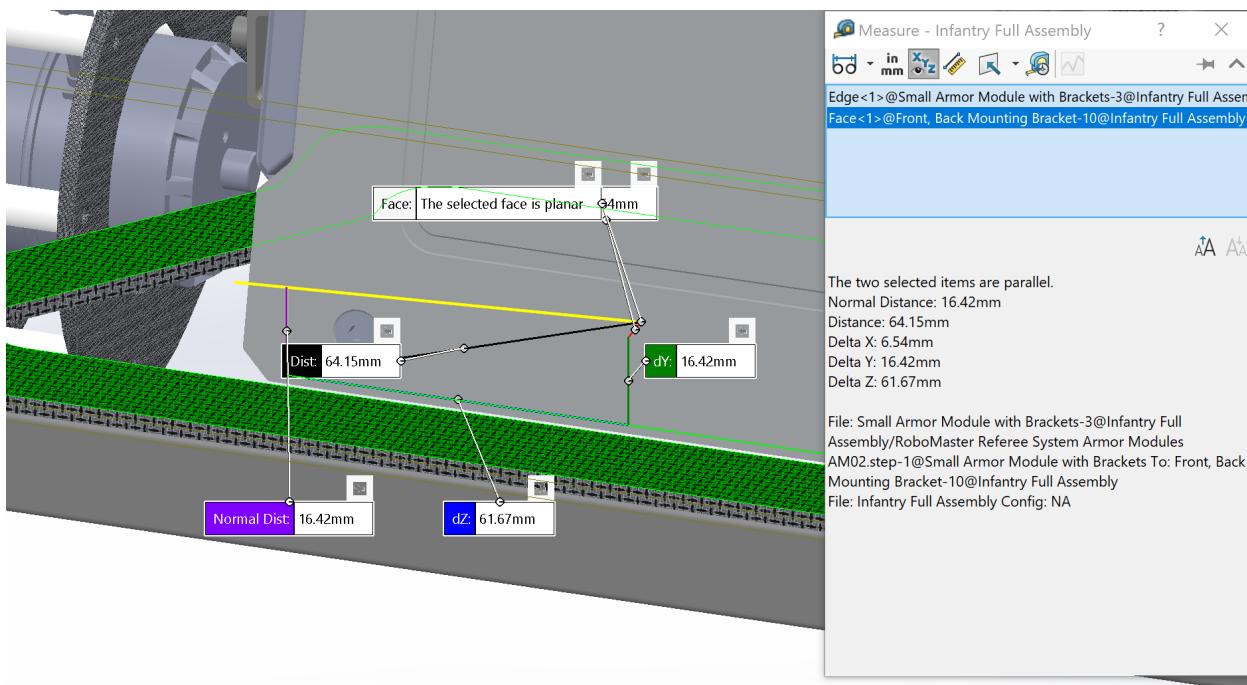
- The bracket should be re-designed to make it stronger since the roller is what faces the blunt force during a collision.

[5] Re-Design Considerations for Chassis

[5.1] Size



- The current infantry design with the protector is over the LWH constraint of 600mm*500mm*800mm (the units will not be included in the rest of the commentary). The current dimensions are 630*481*H, where H is still undetermined because the turret CAD is not fully complete. Without the protector, the dimensions are 580*435*H. With the current chassis model, the length constraint is over 30 mm. **The protector was designed to be as small as possible. There is approximately 5mm distance between the wheels and the square tubing. The chassis needs to be redesigned to be at least 30 mm smaller in length.**



- **The armor module needs to be moved higher.** Currently, the square tubing is above the lowest part of the armor module by 16.42 mm.

[5.2] Hole Locations

- Currently, the holes on the mounting bracket use pre-existing holes to attach to the chassis. The problem with this is that if the protector ever needs to be removed, then screws interlocking multiple components will need to be removed. **In order to make it easier for the protector to be removed and mounted, new holes on the chassis should be made.**

[6] References

- 2020 Shanghai Jiatong University Infantry