# Team 687A

CAMS High School

# 3d Printable Airless Wheel for VEX

Make It Real CAD Engineering Challenge
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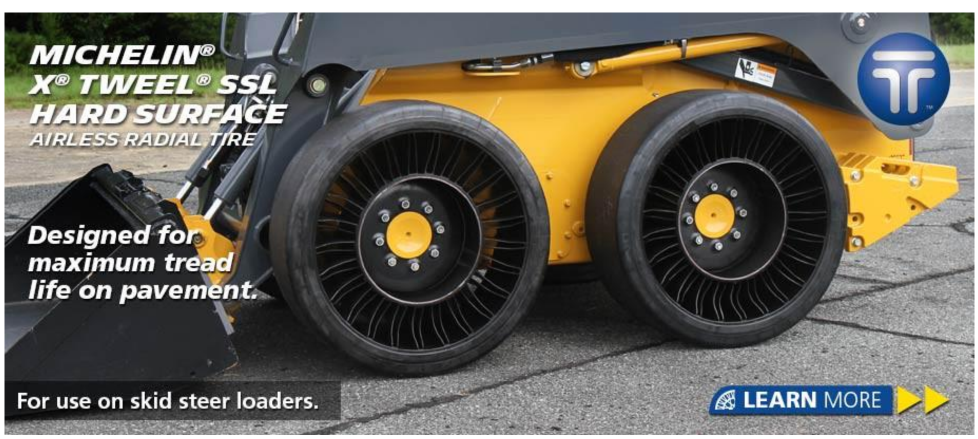
## Introduction

This year, as our team was designing our robot for the Turning Point game, we saw that the game involved climbing over bumps, and could involve harsh impacts on our drivetrain. Some kind of suspension could help us climb the platforms, smooth out forces on axles, and reduce vibrations that loosen bolts and disrupt gyroscope sensors. There are no practical ways to build a suspension with VEX parts, so we decided to create our own solution.

When we brainstormed ideas, we thought of airless tires. They are a new technology that uses compressible spokes instead of air to absorb shock. They sounded perfect for us because they are simple and compact, and can be easily made from cheap materials like plastic.




An example of Michelin airless tires in use on a loader

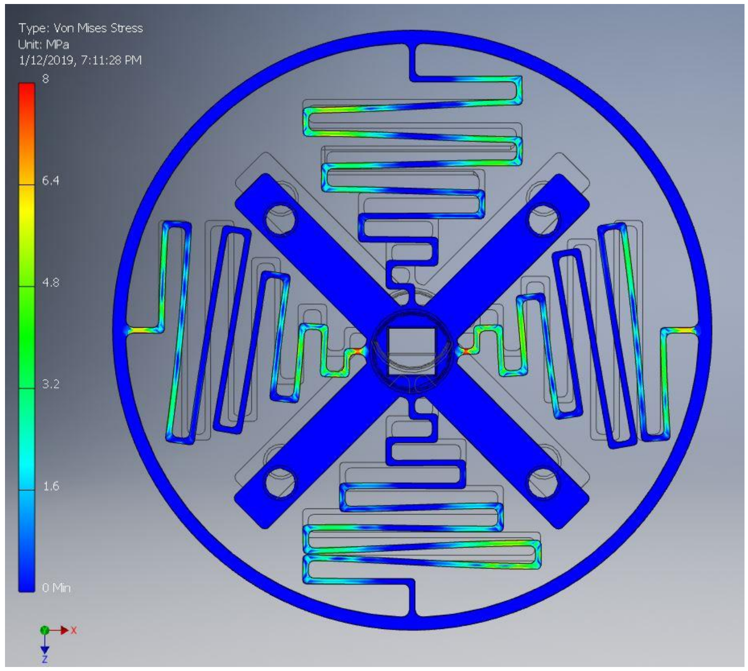
## Functionality

Our unique design has a central hub, flexible spokes, and an outer rim all made from one piece of plastic. When load is placed on it, the zigzag-shaped spokes can flex to absorb shock. Four thicker supports were added to prevent the spokes from compressing too far and breaking. The wheel is designed to be identical to standard 4” rims, and uses existing 4” standard or high traction tires. It is compatible with high strength axles, or standard axles with standard square or free spinning inserts. Four holes 1” from the center allow the wheel to be bolted to a gear, structural metal, another wheel, a turret bearing, or any other part.

Side View

## How We Made It

We measured dimensions of existing wheels, axles, tires, and gears to ensure compatibility with existing parts. We researched how thick our spokes needed to be to give us just the right amount of flexibility when printed with PLA plastic. We also made sure it would 3d print without any problems. Autodesk Inventor Professional 2019 (release 2019.0.2) was used to model our wheel. After we modeled it, we used stress analysis in Inventor to make sure it would perform the way we intended. We assembled the wheel with inserts and a standard tire to see how it would look in real use.



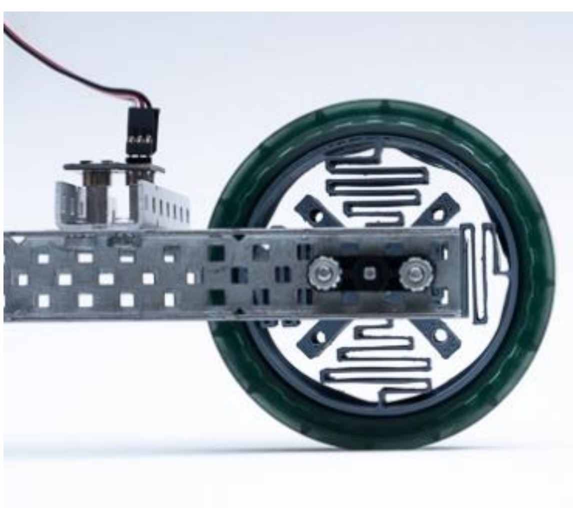

Stress analysis

Assembly With Insert and Standard Tire

## 3D Printing

The part was 3d printed and we tested its capabilities. It turned out flexible and springy as intended. It seemed to absorb forces pretty well, and the springs showed no signs of breaking. While the springs were flexible, the outer rim and inner hub were very solid. Overall, it worked exactly as we had expected.

We mounted it on a test robot to test it in real conditions. It was a huge improvement, especially when driving on rough surfaces.



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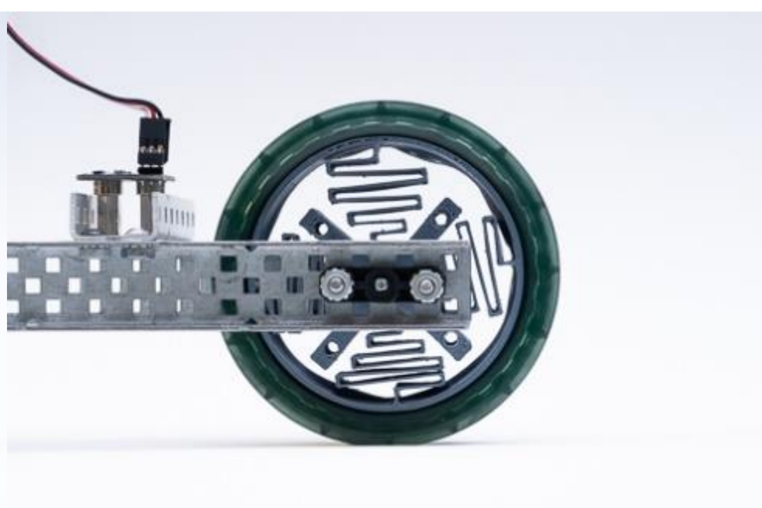

Under load

## Conclusion

While designing this part, we learned about several engineering principles like elasticity and tolerances. More importantly, we learned skills in Inventor that will help us beyond just one wheel. Being able to CAD our robot will help us move through the design process faster than physically rebuilding the robot whenever we have a new idea. Being able to find potential issues before we build will save us a lot of time. We will also use Inventor for other robotics projects at school. Some of us are interested in careers in engineering, and learning Inventor will help prepare us for our futures.

Oblique View