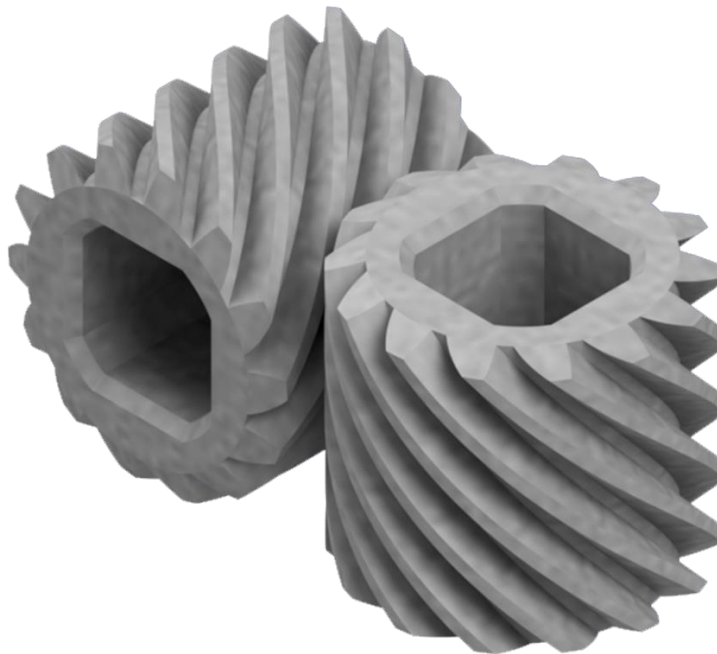


HELICAL GEAR SYSTEM

Presented by QVEX



JANUARY 18, 2022

VEX ROBOTICS "MAKE IT REAL" CAD ENGINEERING CHALLENGE
[Sponsored by Autodesk]

Summary

We, The Queen’s VEX U Robotics Team have designed a new helical gear system using Autodesk Inventor Professional 2022. Our system is compatible with existing VEX high strength shafts and is operable in two configurations: parallel or at a 90 degree to one another. This allows for high-power torque transfer between perpendicular axels or around bends. These two applications give the helical gear ample utility when building space constrained VEX robots.

Contents

Summary	1
Introduction	2
About Helical Gears.....	3
How it works	3
Manufacturing	4
Applications.....	4
Conclusion.....	4

Introduction

The VEX community continues to evolve with exceptional improvement in hardware and software over the years. With such passion from the community to continue to go above and beyond, it is important that the hardware supports such endeavours. For instance, the VEX community shows a growing interest in mechanical innovations that yield a competitive edge. Mechanisms such as holonomic drives and transmissions show wonderful opportunity, but due to restricted hardware, these ambitions are difficult to implement. For this reason, we, the Queen's VEX U Robotics Team have designed a helical gear intended for use in VEX systems.

Helical gears are like standard spur gears; however, their teeth are angled respective to the gear face. This allows for either perpendicular or parallel power transfer depending on their configuration. Helical gears are used by the automotive industry, in space constrained assemblies, such as transmissions. By providing helical gears to the VEX community, teams would be able to do more with the size-limit by taking advantage of the component's compactness and versatility.

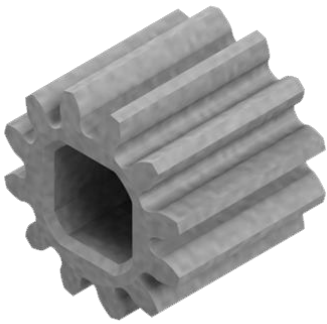


Figure 1: Standard VEX 12 tooth spur gear



Figure 2: Standard VEX 24 tooth bevel gear

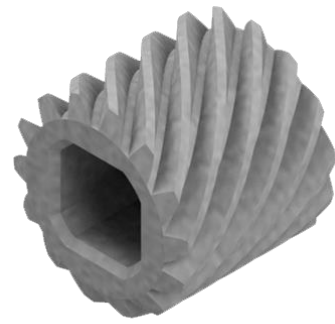


Figure 3: QVEX 14 tooth helical gear

About Helical Gears

How it works

Helical gears are cylindrical gears whose teeth are not parallel to the axis of rotation. The angled teeth form a helix around the body of the gear in the range of 15 – 45 degrees. This allows for pressure to be distributed evenly along the transverse and normal plane, resulting in the gears to withstand more stress than the conventional spur gear. This allows the gears to distribute its load among a greater surface area, significantly increasing the performance under high loads. During operation, the contact of two helical gears starts at one end of the tooth and gradually moves along the tooth, causing the system to have a smoother operation with reduced shock load and backlash. This makes helical gears perfect for high-speed applications due to how smooth the gears spin.

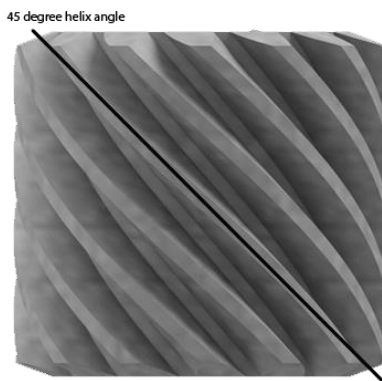


Figure 4: Helical gear with 45° helix angle

Helical gears can transfer force perpendicularly like a beveled gear, or in the same axis, thus making it a very versatile gear. The one drawback of a helical gear is that it will impose an axial load on the shaft requiring the use of shaft collars to constrain the gear. The gear is designed to work seamlessly with standard VEX High-Strength Shaft and Low-Strength Shaft adapters and on the 0.5" spacing of VEX C-Channel.

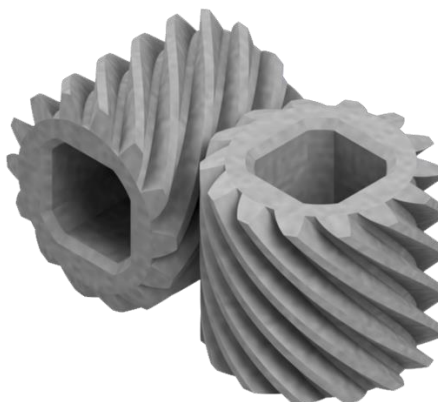


Figure 5: A perpendicular helical gear configuration

Manufacturing

We, plan to construct our gears using 3D printing. Due to the roughness between layers of FDM 3D printed parts, the gears would have to be printed with ABS plastic and require an acetone bath to smooth them. Another option would be to make use of an SLA printer, which would offer superior smoothness between layers. The gears could also be made of steel in a similar fashion to the VEX high-strength 12 tooth gears. Unfortunately, we do not have the tools necessary to manufacture with this method.

Applications

Due to COVID-19, our team has not had the resources to test this product yet. However, we are optimistic about the opportunities it will provide for innovation when designing compact VEX assemblies. Specifically, the team takes a keen interest in swerve drives due to their ability to move in every direction while maintaining full power, and the advantages they provide during autonomous operation. However, VEX provides few options for perpendicular power transfer causing us to create bulky mechanisms that are not ideal for competition. We believe that the addition of the helical gear in the VEX product line, will be of substantial use to us and other teams.

Conclusion

We are excited to see the types of innovations that will arise with the introduction of the helical gear to the VEX product line. We know the community is always eager to try new hardware and believe that the helical gear will be key to designing more sophisticated and efficient robots in VEX. The experience we gained learning about this gear and its applications in automation industry are invaluable and we hope to allow more teams to benefit from this part. We are excited to see what the greater VEX community can create using our system.