# CAD ENGINEER 6627A

Screw Joint

**6627A:** Screw Joint

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# >>>> THE PLANNING

**DESIGN PROCESSES** are highly important to keep projects efficient and on-task, so we adapted the **Engineering Design Process** to a process that is a better fit our project.

This is our **Design Flow** for our response to the **Make It Real** online challenge.

## 1 Define The Problem

- What is something we could improve in VEX?
- What can we make easier?
- What can we simplify?

## 2 Select Software

- What 3D modelling program best fits our needs?
- What program is easiest to learn?

## 3 Modeling

- How should the component be used?
- What functions should the component have?
- How easy should the component to use?

# THE PROBLEM

**SCREW JOINTS** are the pinnacle of quality robots in VEX Robotics.

The main concept behind a **screw joint** is using screws instead of axles.

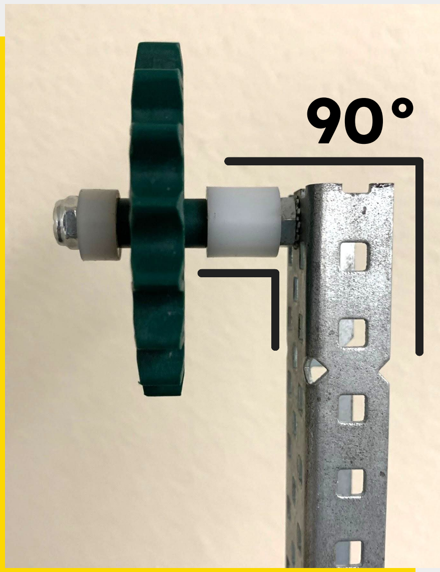



**Figure 1:** Screw Joint


**Figure 2:** Axle

**Screw joints** don't bend as easily as axles, have less friction, and less "slack" in comparison to square axles even when using bearing flats (shown clearly between **Figure 1** and **Figure 2**).

Additionally, over extended use, shaft collars that keep axles in place loosen without constant maintenance. **Screw joints** do not, making it best to use them in mechanisms under high stress in matches - of which there are *many*.

While mentoring at local middle schools, our team found that teams often over tighten their **screw joints**, causing more friction than with axles and losing all the advantages of having **screw joints**.

## FOR OUR CAD ENGINEERING CHALLENGE,

we wanted to address this issue by designing a new screw aimed to simplify and improve **screw joints** while retaining its effectiveness.

# THE SOFTWARE

**OUR SOFTWARE OF CHOICE** to start designing our envisioned component was **Autodesk Inventor 2022**.

Any prior experience in CAD programs was only in **Solidworks**, a software that does not meet the challenge's requirements. We sought to find a software that was as similar as possible to **Solidworks** to reduce the learning curve needed to design our robot part.

We found that in **Autodesk Inventor**.

**Figure 3:** Autodesk Inventor Logo

**Inventor** offers a top quality interface that can be learned easily. It perfectly fit our needs and had many online resources for any issues we could encounter in development.

**OUR PLAN** for CADing the screw will consist of a series of extrudes to form the shaft and head and a helical cut to create the threads.

We will also be making three different screw sizes to simulate the varied lengths **screw joints** may take - **2.5 inches**, **2 inches**, and **1.5 inches**. Any sizes longer or shorter would be ineffective.

# >>>>>>>>> THE DESIGN

**OUR GOAL** is to be able to use this component to teach the principles of **screw joints** without unnecessary friction.

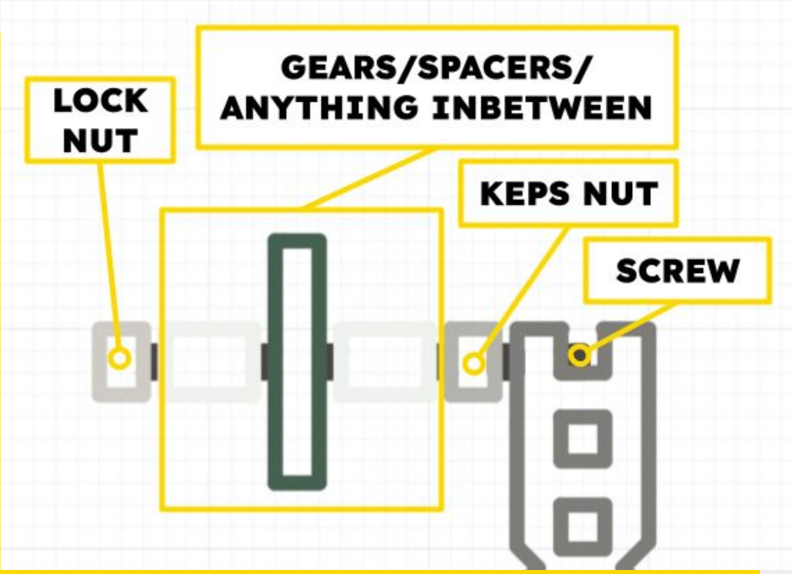



**Figure 4:** Screw Joint Fundamentals

**FUNDAMENTALS** of **screw joints** we need to include are:

1. **Screw** itself
2. **Shaft** of screw where other components go on (gears, spacers, etc)
3. **Shoulder** that prevents screw from rotating freely

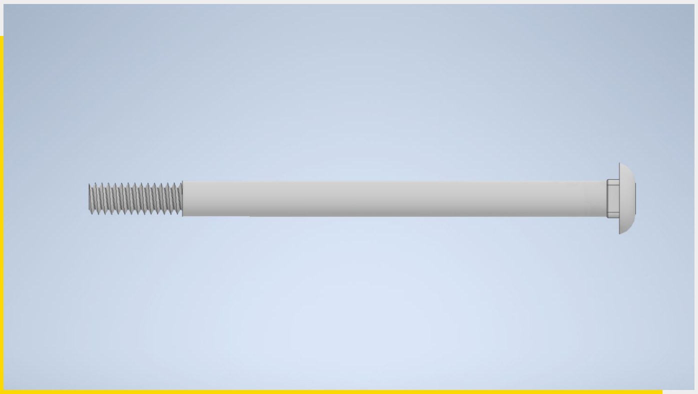
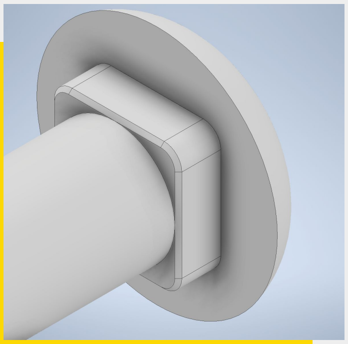


**Figure 5:** Screw Side View

**Figure 6:** Screw Isometric View



We designed a **screw shoulder** (**Figure 7**) that perfectly fits the size of a standard square VEX hole on a C-Channel. This **shoulder** stops the screw from rotating and acts as a **keps nut**.

**<- Figure 7:** Screw Shoulder

# THE DESIGN

In addition the screw utilizes a **partial thread .5 inches** long which prevents students from over tightening a lock nut on the **screw joint**. The **partial thread** leaves room for other components on the non-threaded section without covering threads.

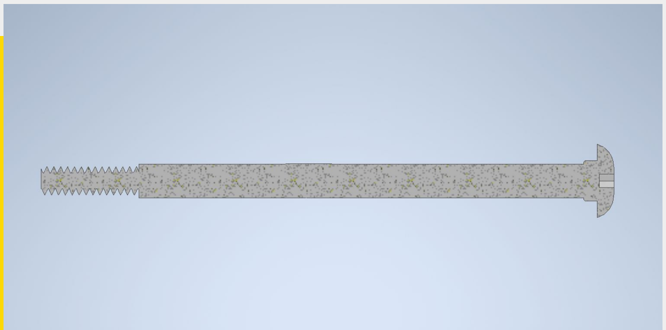


**Figure 8:** Screw Cross-Section View

**EXAMPLES** of how the **screw** would be used are shown below, with all three sizes depicted.

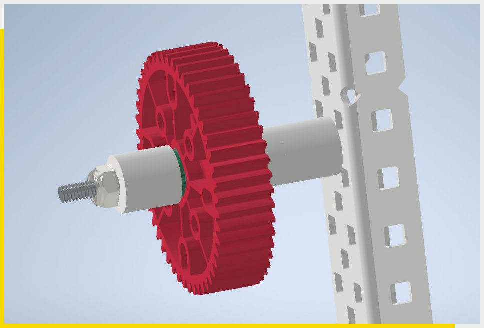


**Figure 9:** 2.5” Screw Joint Isometric View

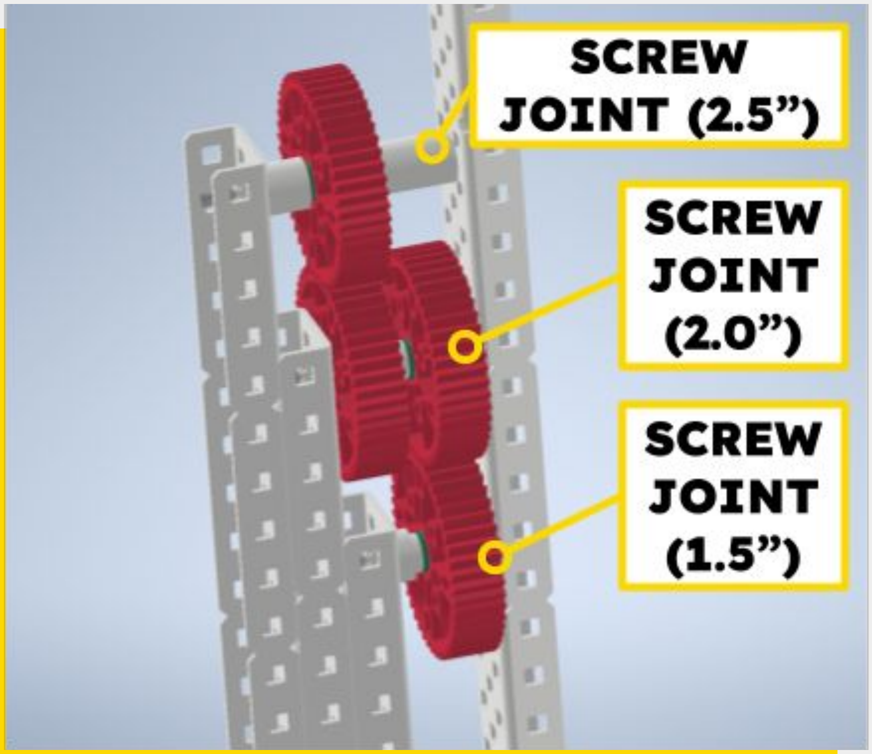



**Figure 11:** All three screw sizes, demonstrated use in CAD

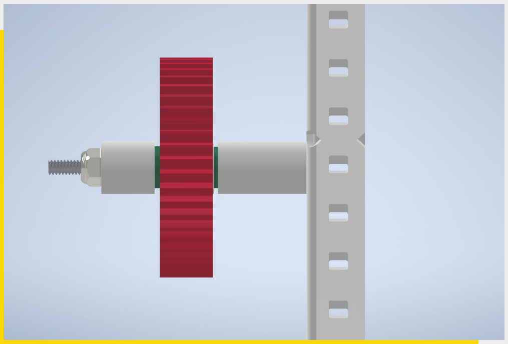


**Figure 10:** 2.5” Screw Joint Side View

We wanted originally to 3-D print out prototypes, but the printers available to us don’t have enough precision to print the threads accurately.

# >>>>>>> DIMENSIONS

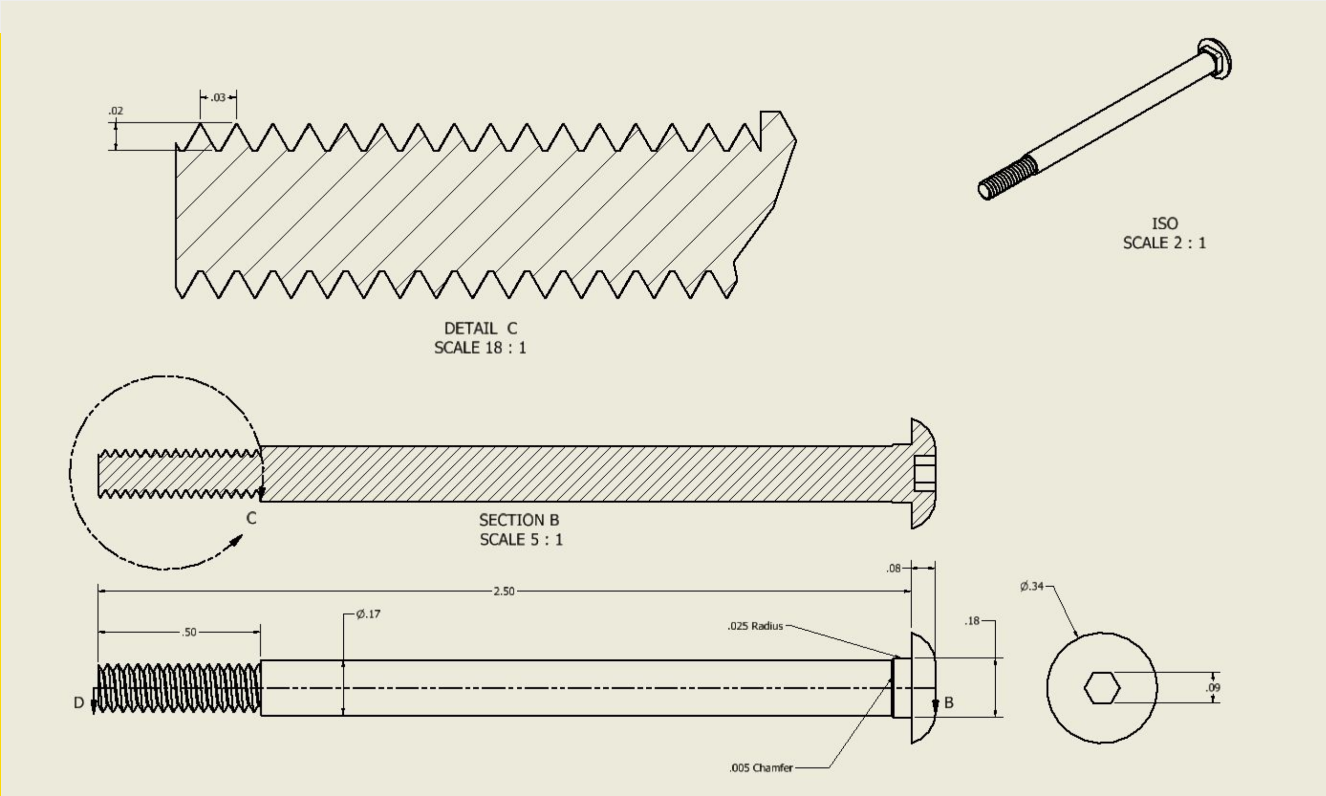



**Figure 12:** Dimensions of screw component

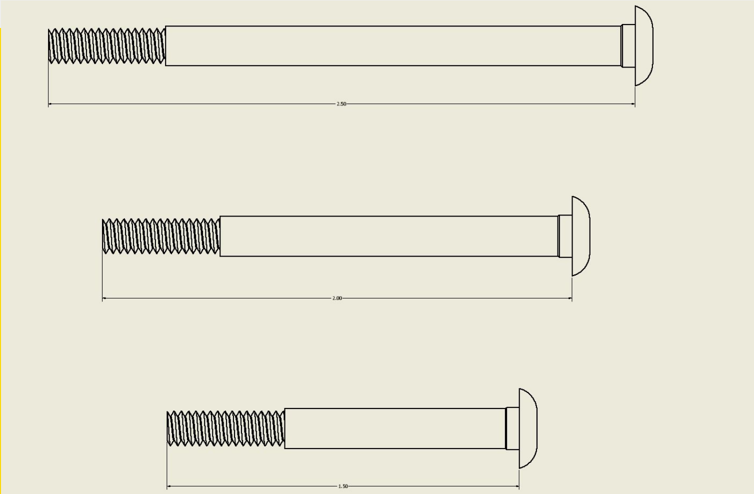


**Figure 13:** Dimensions of 3 sizes

The screw is designed to come in multiple sizes, 2.5", 2", and 1.5". Within Inventor, the length and threads of the screw are based on the same extrusion, allowing for effortless changes in screw size.

We used a dimension chart to design the threads of the screw to make it accurate to the size of an 8-32 screw, the same size that VEX VRC uses.

# >>>>>>> CONCLUSION

Overall, we were very satisfied with the way that our component came out. We accomplished our goal of making a component that would greatly simplify the creation of **screw joints** while retaining its effectiveness.

All team members on our team have experienced some sort of mentoring, whether it be given or received. We know the value of knowledge and want to help future generations of VEX VRC participants to be as prepared as possible when entering this competitive area.

With this component, we hope that many more students, especially younger, less-experienced students, will be able to incorporate **screw joints** into their own builds and forge new, innovative ways of thinking.


**6627A**