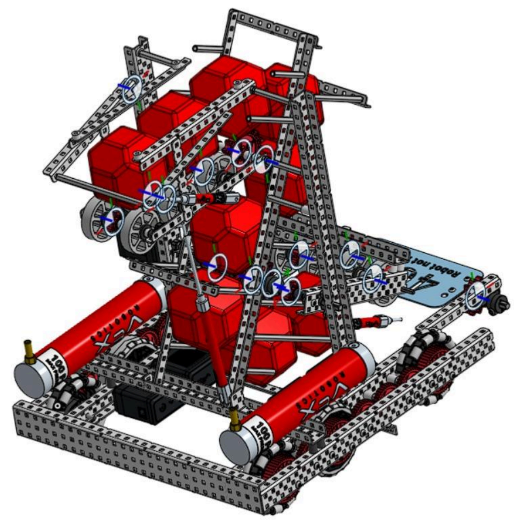
VEX CAD explanation



Overview and Design Goal

This CAD shows a VEX V5 robot designed for the 2025–2026 *Push Back* season. In this game, robots collect balls from the field and score them by placing them into vertical tubular structures, while also withstanding pushing and contact from other robots. The main design goal was to build a robot that could reliably collect balls, move them upward, and score them consistently without losing stability during contact.

CAD was used throughout the design process to plan the full mechanical system before building. This made it possible to test layouts, adjust spacing, and resolve conflicts digitally instead of discovering problems during assembly.

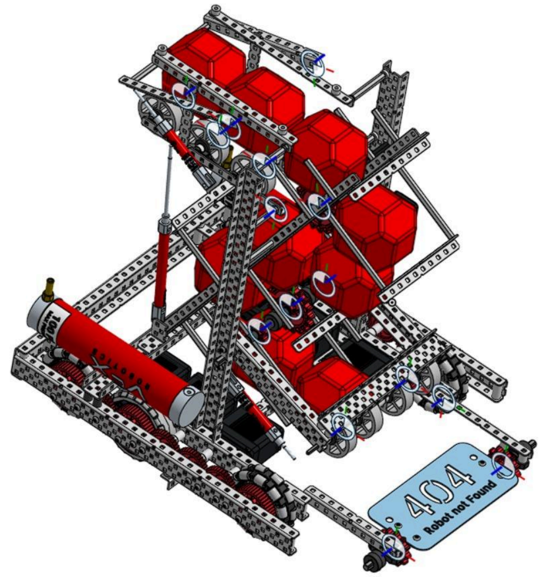
Overall System Layout

The robot is organized into four main mechanical sections:

1. Drivetrain: provides movement, pushing power, and stability

2. Ball intake and transport system: collects balls and moves them upward

3. Scoring interface: guides balls into the tubular goals



4. Structural frame: supports all moving systems and resists bending and twisting

These systems were designed together rather than separately. For example, the intake height was limited by how stable the drivetrain could remain, and the frame layout was influenced by the forces created when balls were lifted vertically.

Design Constraints

Several constraints shaped the CAD:

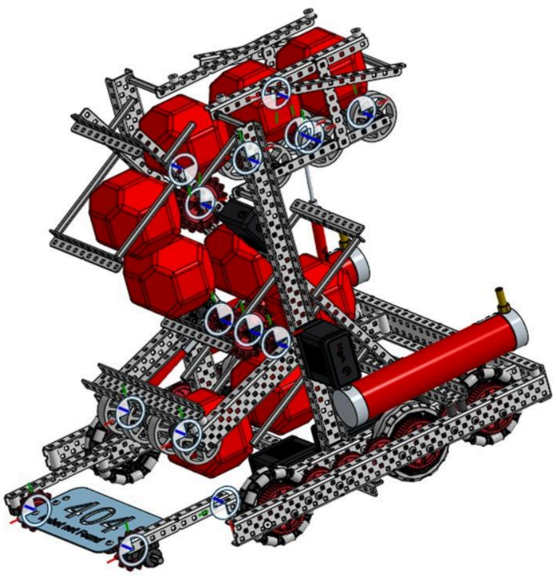
- The robot had to fit within a restricted starting size
- Balls stack vertically, which raises the center of mass
- The robot needed to survive frequent contact and pushing
- Mechanisms had to be compact and easy to service

CAD allowed these constraints to be considered early, which reduced redesign later in the season.

How Balls Are Collected and Moved

The most important mechanism on the robot is the ball intake and transport system. Balls are collected from the field and guided upward using a series of rollers arranged in a vertical path. This design allows the robot to continuously handle balls rather than moving one at a time.

Because balls are spherical, they can easily roll out of place if not controlled properly. CAD was used to carefully set the spacing and alignment of the rollers so that balls stay in contact throughout the entire transport path.



Why Roller Spacing Matters

If the rollers are too far apart, balls lose contact and stall. If they are too close, the balls are squeezed too much and can jam. CAD made it possible to adjust these distances precisely and quickly test different configurations before choosing a final design.

Axles and bearings were aligned digitally to reduce friction and ensure smooth motion. This improved reliability during long matches and repeated cycles.

Preventing Common Problems

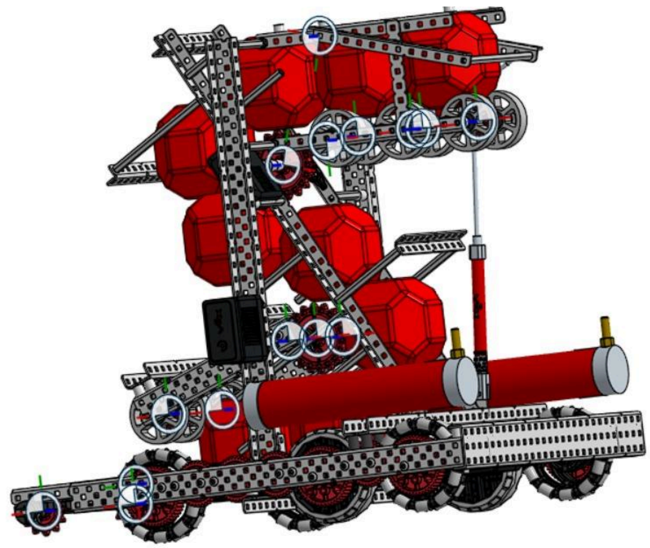
Several potential problems were addressed during the CAD phase:

- Balls getting stuck due to misalignment
- Balls escaping the intake path during vertical motion
- Rollers interfering with the frame

By checking clearances and motion paths in CAD, these issues were resolved before the robot was built.

Scoring Into Tubular Structures

At the top of the system, the transport path aligns with the tubular goal structures. The exit geometry was designed to guide balls smoothly into the tubes with minimal bouncing. This reduces the amount of precision required from the driver and improves scoring consistency.



Structural Design

The frame of the robot supports the intake system and maintains alignment while the robot is driving and being pushed. Bracing and vertical supports were added where loads are highest, especially around the intake system.

CAD helped identify which parts of the frame needed reinforcement and which areas could remain lightweight.

Stability and Center of Mass

As balls move upward, the robot's center of mass rises. To keep the robot stable, heavy components such as motors and batteries were placed low in the chassis, and the drivetrain was designed with a wide footprint.

These choices were evaluated directly in CAD by examining component placement and overall layout.

Iteration and Improvement

The final CAD represents multiple rounds of iteration. Early designs revealed spacing issues, alignment problems, and unnecessary complexity. Each version improved reliability and simplicity.

CAD was used not only to draw parts but to **think through how the robot would behave in real conditions**. This process of modeling, testing, and refining closely resembles how engineering research and real-world design are done.