

Abstract

Vestil offers many options of forklifts and attachments. Several Vestil distributors have requested a vehicle capable of off-road travel while loaded with a 2500 lb. pallet. A prior prototype was constructed but was underpowered and had inconsistent steering control. The team from Trine has been tasked with 1) upgrading the prototype to meet power and steering requirements, and 2) designing a commercially viable machine.

Customer Needs and Requirements

Needs:

- A gas engine power a hydraulic system
- Ability to lift a pallet of brick while traversing difficult terrain
- Ensure the driver remains safe and comfortable
- Ability to lift a pallet on and off a flatbed truck
- Project should be completed in a fashion so that Vestil can reproduce the product at or less than \$15000

Requirements:

- The vehicle must lift 2500 lbs.
- The vehicle will safely traverse inclines/declines grades in table 1A of the ASME B56.1-2004 standards
- The vehicle must lift the 2500 lbs. from ground to 48 inches and back to ground at 4 inches per second
- The cost to produce is under \$15,000

Concept Selection

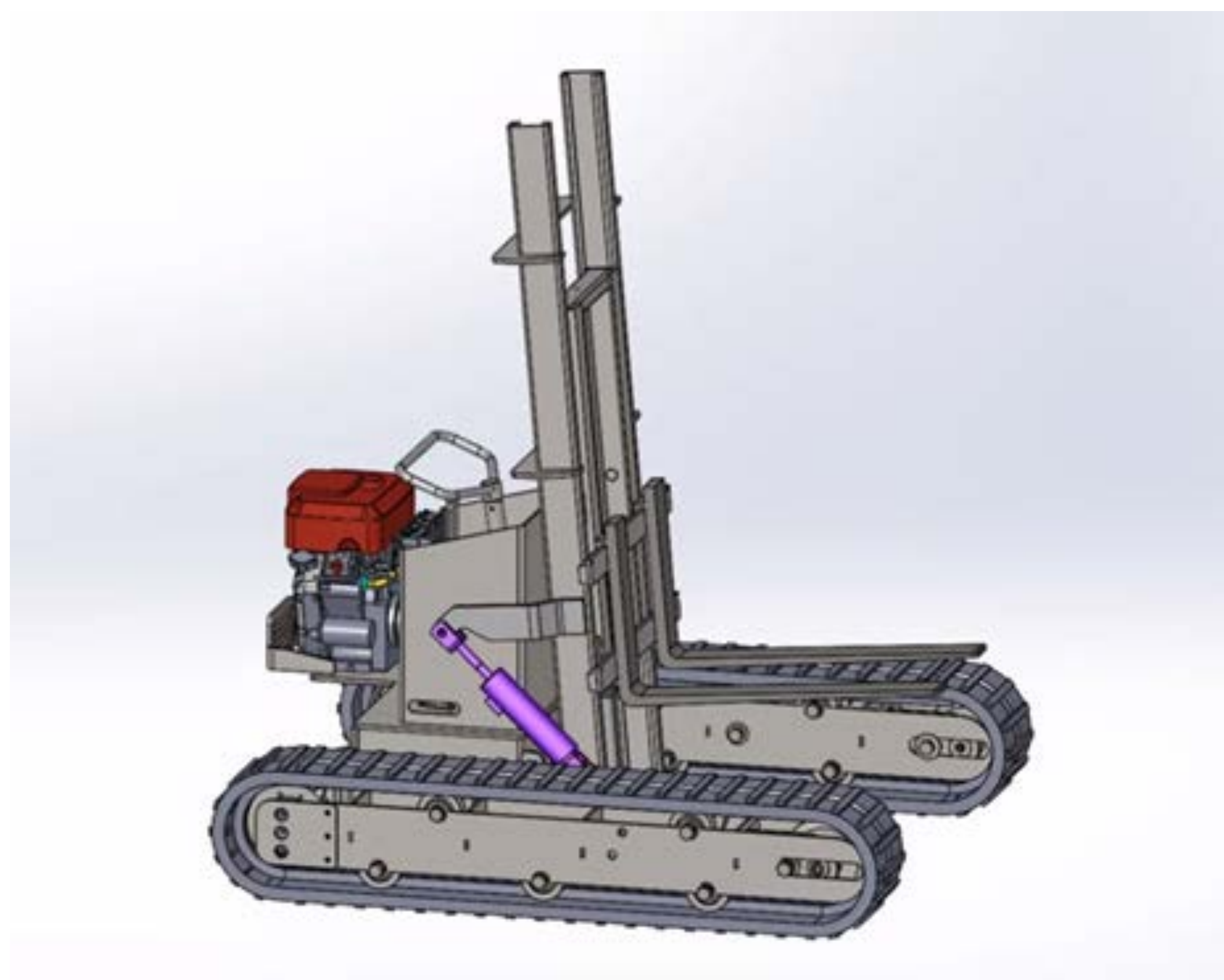


Hover over image to zoom



- Chose a 35 hp engine because it had the lowest price per horsepower.
- Created a MATLAB code that determine the pressure loss in the hydraulic lines to be 14 psi
- Used a previous design as a baseline model
- Chose the PM10 series pump

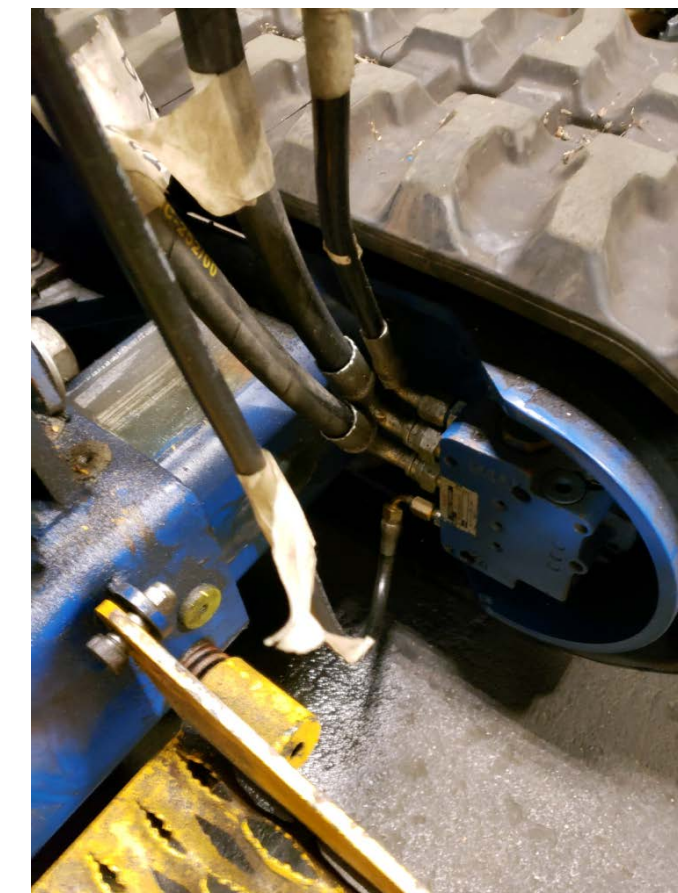
Prototype Design Solution



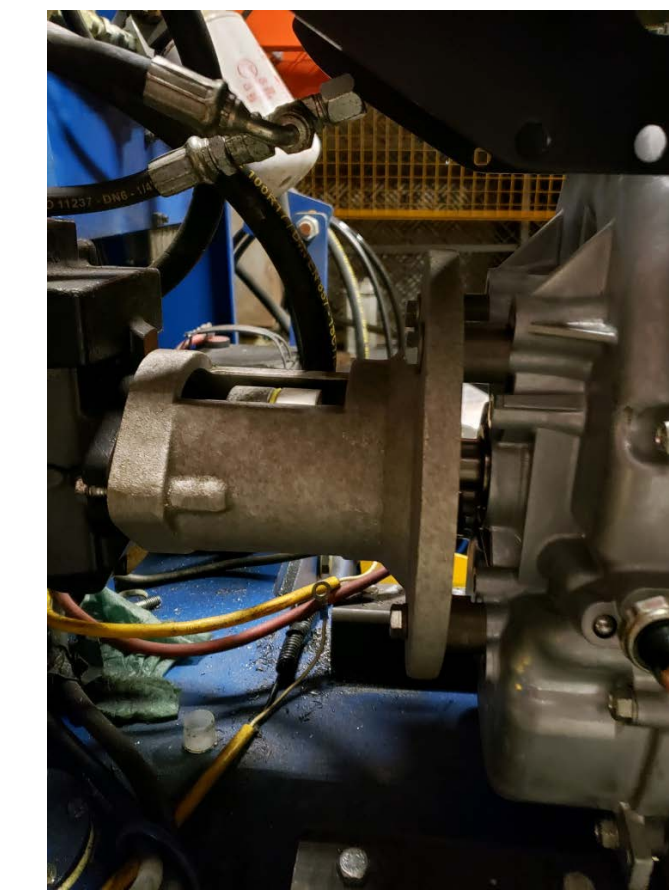
Manufactured Prototype



Hydraulic hoses were plumbed from the pump to the motors



The hydraulic motors are connected to the pump



A coupler was used to attach the pump to the gas motor

Prototype Testing and Validation



Test 1: Basic Operation
Successfully moved:

- Forward/Backward
- Left/Right

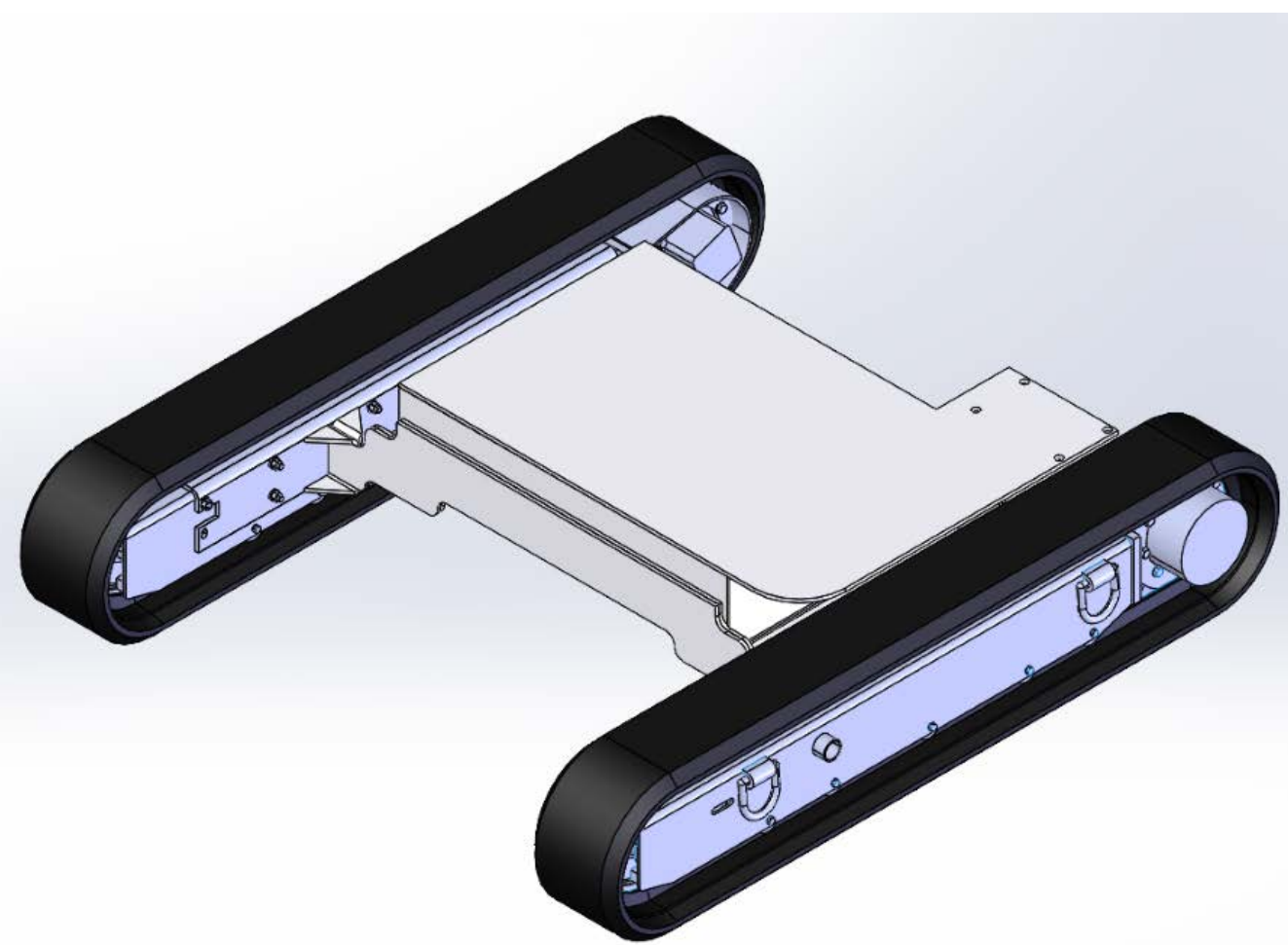
Test 2: Lifting Test

- Successfully lifted 2565 lbs.
- Avg. speed: 6.5 in/s

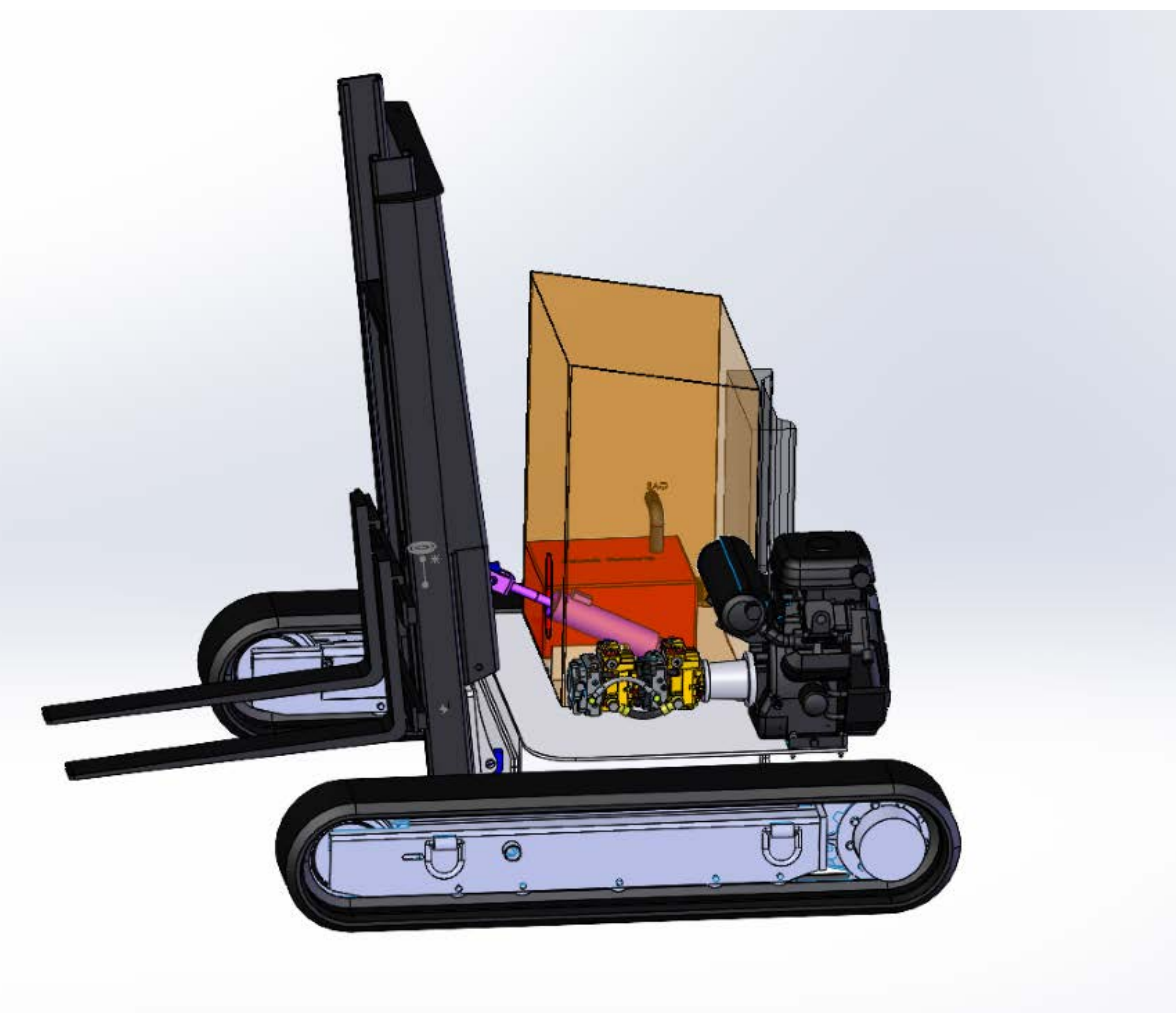
Test 3: Incline Test

- Moved up an 18% incline
- Speed of 2.6 mph

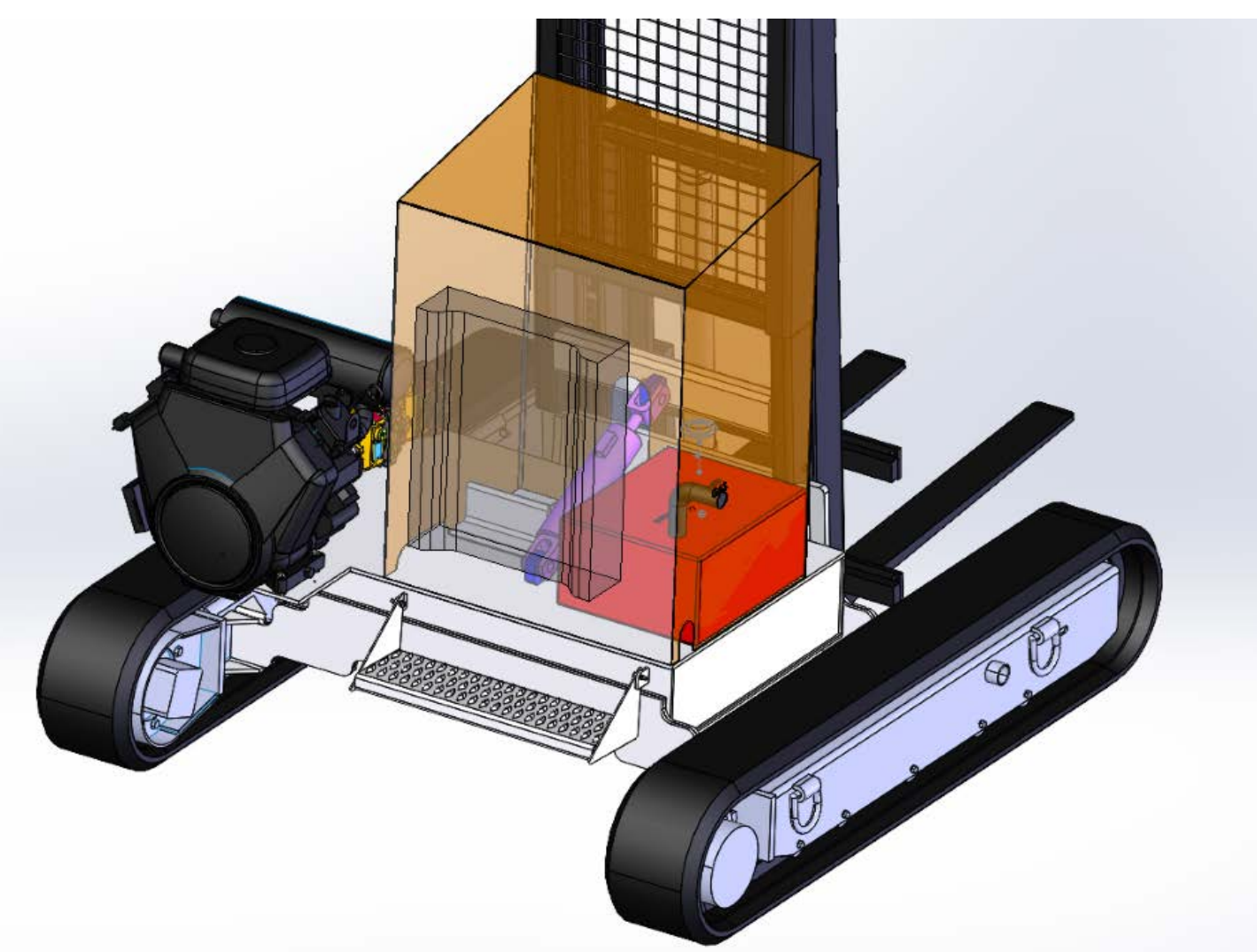
Commercial Design



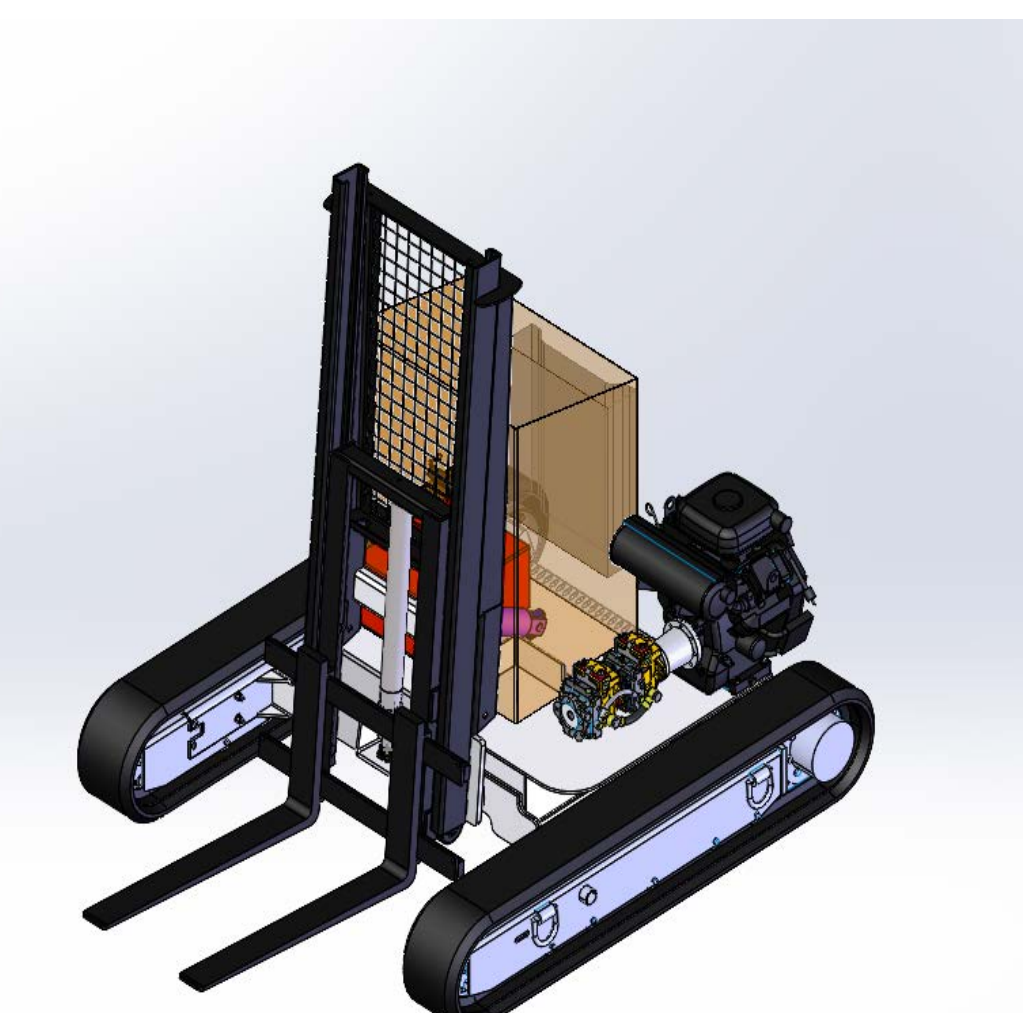
The base of the forklift was redesigned to accommodate the width of a pallet and to withstand the forces of everyday operation.



One cylinder is used to control the tilt of the forklift. This allows for a cheaper build as well as more space.



The podium was redesigned to be accommodating for the operator and to house the hydraulic cylinder, gas tank, and battery.



Isometric view of final design

Acknowledgments

The Vestil Senior Design group would like to thank Vestil Manufacturing for the opportunity to work with one of their products. Specifically we would like to thank Barry Trine, Matt Clemens, and Dale Stevenson. We would also like to thank Matt Rossman at Progressive Hydraulics for the guidance in hydraulics.