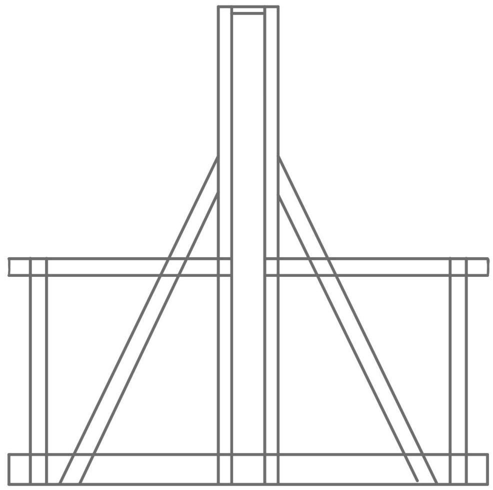
Team War Machine
Group #06
Amaan Ahmed, Connor Kalvar, Jake Buchsbaum



Introduction

We are team War Machine, and we were tasked with building a trebuchet that would be able to launch a tennis ball a far distance. We decided to build a variation of the trebuchet called a floating arm trebuchet as we believed this would give our build greater range and energy.

Problem Statement

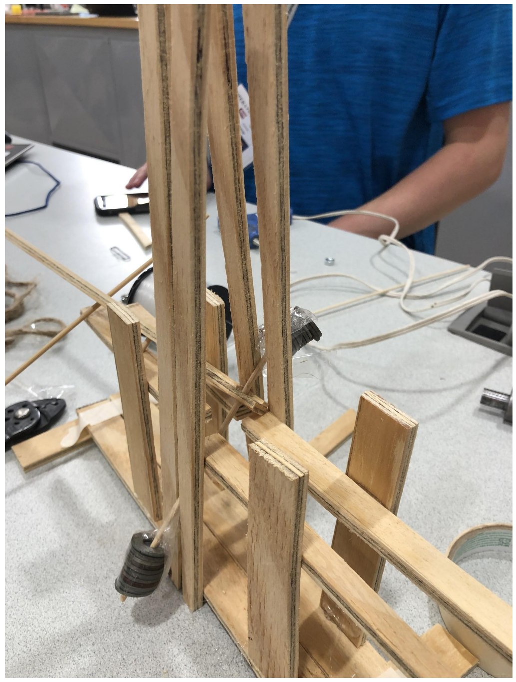
An army of evil boilermakers is attempting to invade Rose-Hulman! The only way they can be stopped is by aerial bombardment by tennis balls launched from a far distance. We need to build a device to allow us to prevent the evil plague from spreading.

Background Information

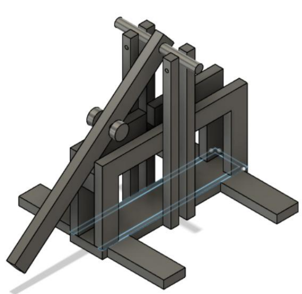
The main physical principle behind the operation of a trebuchet is conservation of energy. Assuming the forces of friction and air resistance are negligible, the energy of the trebuchet system should remain constant. This means that the initial potential energy stored in the trebuchet arm as a result of its height will be transformed into kinetic energy as the gravity does work on the trebuchet and the arm drops. The principle of conservation of energy also motivated our choice of a floating arm trebuchet, as the structure of a floating arm trebuchet allows the arm to drop further, giving the projectile more speed than in a normal trebuchet.

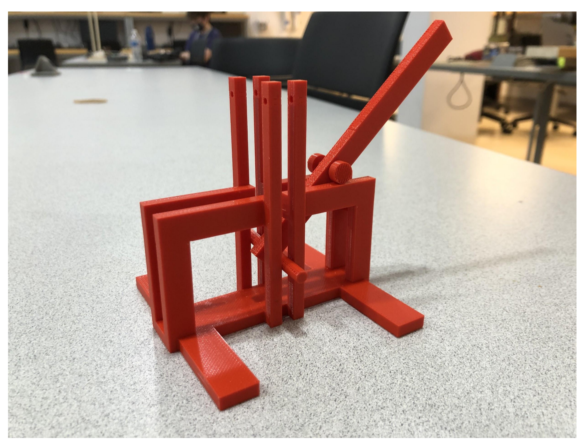
Design Process

We began by researching different types of trebuchets and quickly chose the floating arm trebuchet for our design. Although floating arm trebuchets are more difficult to build, the ability of the arm to move and drop allows the trebuchet to transfer more potential energy into motional energy, causing the ball to launch at a faster speed. After consulting some designs of trebuchets online, we constructed an initial prototype of the trebuchet design. However, due to a lack of materials and precise measurements this prototype.



We then began to build the second form of our trebuchet using CAD modeling. After modeling, we used the 3D printer to create a small model to test the design with. From this model, we were able to adjust some dimensions, like the distance between the towers, for our final build.





We then constructed the final model of the trebuchet. Once it was completed, we began to test multiple different variables, like the pin angle and rope length, in order to find the best possible range.

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Results

We found the optimal rope length to be 3.5 feet and the optimal pin angle to be 75 degrees. With these values, the trebuchet launched the tennis ball a distance of 167 feet. The trebuchet was not able to meet our full expectations, but the reasons for this are beyond our control. Environmental factors like friction and air resistance mean that energy can never truly be conserved, so our trebuchet will never be able to meet its full potential. However, despite these setbacks, we were still able to successfully construct the trebuchet and launch the ball a good distance.

Reflection

This project gave us a greater understanding and appreciation of the process of designing and constructing a solution to a problem. We also learned about how to adapt to and work around limitations on our solution, whether they be man made (price and size constraints) or natural (working around friction and air resistance).