BOMBS Consulting Company

Executive Summary

In this report you will find our solution to the problem of firing a 50-gram object 10 meters to hit a target whose bulls-eye is approximately 20 inches off the ground. We build a catapult to fire this object and had to make changes as we were building to prefect the accuracy and precession.

Introduction

In this project, BOMBS Consulting Company was asked to design a catapult that was 1.5 ft cubed and could fire a 50-gram object at a target's bulls-eye that was approximately 20 inches off the ground and 3 meters away. The catapult had to be able to be versatile so that it could be adjusted on the spot in order to fix any inaccuracies. This catapult was comprised of many different parts that included the base, the radial arm, the support, the trigger, and the adjustment.

First, the base is a solid structure that is designed to keep the catapult itself from moving around once it is fired. The base is the main support for the catapult. The other support for the catapult was used to keep the radial arm in place so that the arm would always fire in the same direction every time. This support had to be rigid so it wouldn't shatter when the radial arm was fired. The radial arm itself is composed of a mechanism that holds the object that is to be fired and the device that lets the arm swing back and forth. The radial arm is the part of the catapult that uses the medical tubing's tension to propel the object toward the desired target. The trigger is the mechanism that holds the radial arm in a fixed position while the tension is being applied by the medical tubing. When the trigger is released the medical tubing propels the arm forward. The sliding post/stopping post design on the catapult is the part that allows for any changes in trajectory that are needed. This sliding post adjustment had to be made so that the catapult could be changed quick and easy on the spot without any difficulties.

Methodology

The process that we used in the building of our catapult was generally by trial and error. We figured that trial and error would be the most logical and simplistic approach rather than using complicated formulas.

The first step in the design process was to come up with an initial design. We all met for our first group meeting with our own ideas, put all of the best ideas together into one design, and brainstormed to fix in any obvious flaws in the design.

The next step was to build and test a prototype. During the building process we encountered several problems that needed to be altered to make our catapult more simplistic and also to repair other noticeable flaws in our design.

Then we tested our prototype where we encountered other problems and changed them to hone the accuracy of our catapult and also to adhere to the rules that we were given.

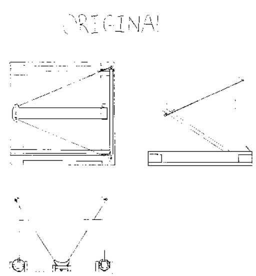
Finally, after the new revisions, we painted it and did a last test of the catapult, which pleased us but made minor changes to maximize safety.

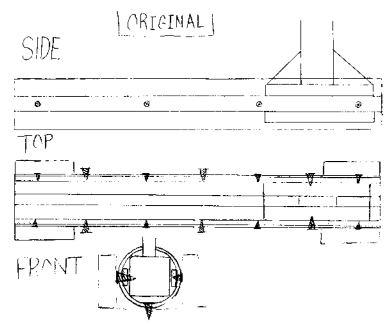
Results and Discussion

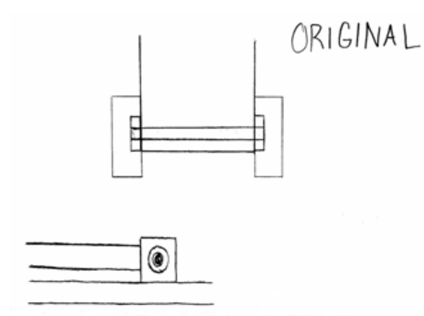
The actual analysis for this project dealt greatly with our accuracy of the catapult. We were required to test the catapult time and time again to obtain the best results for our final competition at the Freshman Engineering Fair. Then we were to collaborate, on a series of charts, all of the data that we had collected from our trials as well as the changes the we had made to any and all parts of the catapult to give the best demonstration and presentation of how accurate we able to make our catapult.

To understand all that we did in altering and adjusting the catapult to get the finished product we now have, it first must be explained of exactly what we started out with. Our original idea for the catapult was to have a basic radial arm that pivoted on a set of bearings, and was given force by a rubber band that was connected to the stopping bar. The stopping bar was to look like a goal post with the bottom of each post set in a cut out slit in a 1.5 foot piece of PVC. The PVC was placed on the far left and right of the catapult, and the slits were made in the top of each piece. The slits were just big enough for the 2 by 4 to fit into while still applying an ample amount of friction. The pieces were then able to slide up and down the PVC, which would either increase or decrease the distance between its center post and radial arm and therefore change the angle at which the golf was released from the radial arm. We never actually build an exact prototype of our first design because we soon as we started to build, there were changes made. So we only had drawings and ideas for our actual prototype. Although this was our first basic idea as we later explain, we had many changes ahead for us.

Drawings for first design

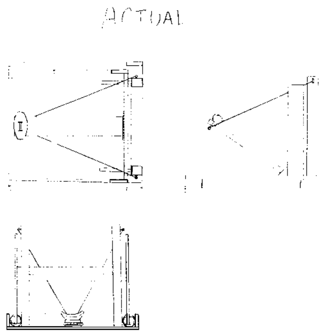


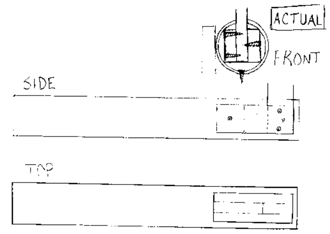


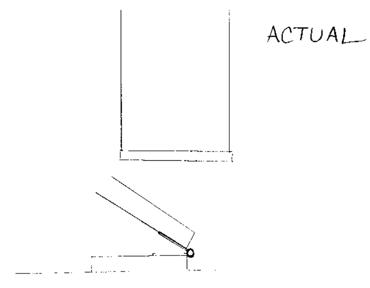


It is necessary to describe many of the changes that we made to our catapult. We made our changes because of two reasons; either it was a design flaw that could not have been foreseen on paper, or that after our first test run we realized a complication in firing procedure. The first changes that we made were in the actual construction process, these changes were made either because of a safety issue, lack of materials, or for more simplicity. One of the first changes that we made was with the rotation of the radial arm. We had originally decided on two bearing and rod for the arm to pivot, but later found out that using a door hinge was simpler for construction purposes and sturdier for the amount of force that we were going to use. An important change that we made was the position of where the tension for the radial would connect too. At first we had planned on attaching it to our stopping post but by doing that we were actually altering the tension and the trajectory when moving the stopping post. So we added a second set of posts that were for the soul purpose of keeping the tension at a constant variable allowing us to change the trajectory at will. The final change that was made during this time was with our sliding stopping post. We had originally devised a complex construction for our sliding device to maximize the friction and stability, but while constructing, simplicity played another important roll. We were able to fulfill our goals in a much simpler design, which ultimately met our stability requirements.

Drawings for Actual



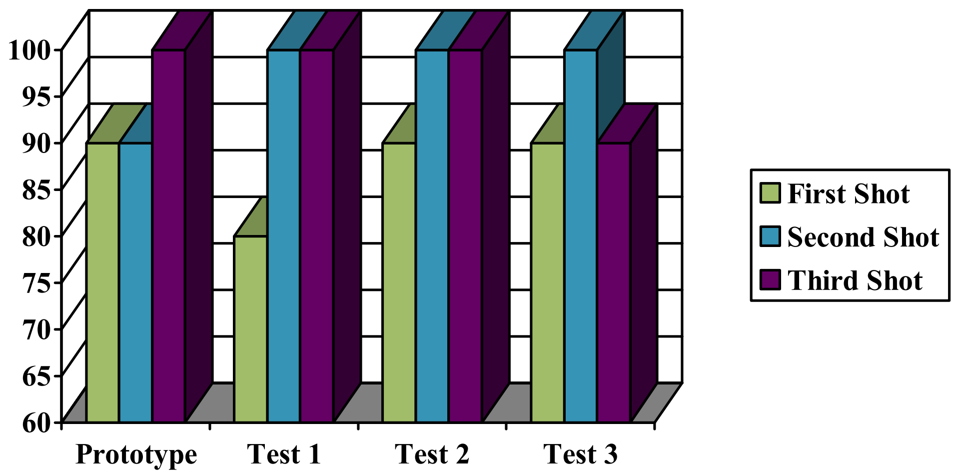




The second set of changes that were made came after the first test run of our prototypes. These changes were made to perfect the accuracy of our catapult and meat any unfilled requirements. The first change dealt with the sliding post's stability. We realize that every time it was fired the post would inch forward ever so slightly but just enough to change the angle of release. So, to increase the friction between the sliding post and PVC were added claps in front of the post so that there was absolutely no movement to maintain constant precision. Another change was the switch from a rubber band to medical tubing as our means of propulsion. The only reason for the change was because medical tubing produced a constant amount of force; where as the rubber band lost its elasticity over time. One requirement that we had missed in our original construction was the addition of a trigger. We used the basic lay-out for our trigger, which consisted of three aligned eye screws, one on the back of the radial arm and two on the base, that were held together by a screw. Firing simply required you to pull the screw out of the eyehole, which released the radial arm. For safety purposes though, we attached a string to the screw so that it could be pulled from any giving area without causing the user to come in contact with the arm as it was releasing the ball. After completely all of these changes we then painted the catapult to give a more aesthetic appearance for the consumer but during this process we realized that our padding we had added on the stopping post was starting to diminish plus the pad was not completely covering the designated area that the radial arm came in contact with. So we added a thicker pad in place of the old one and made sure that at any given point the padding would cushion the radial arms impact on the stopping post; this was all to stop the radial arm safely.

PICTURES

Below, we have constructed a graph that lays out a series of test runs that we preformed to test and alter the accuracy of our catapult. Our test runs contained a range of different number; this was the result of constantly altering the cross bar and tension on the radial arm. First, altering the cross bar gave us the ability to change the angle at which the ball was released.



Conclusion

As you can see we were able to build a catapult that could fire a 50-gram object 10 meters with high accuracy, adjustability, and precession. Our design is not only safe but also eye appealing to the consumer.