# Preliminary Design Review

The Group That Is Better Than You
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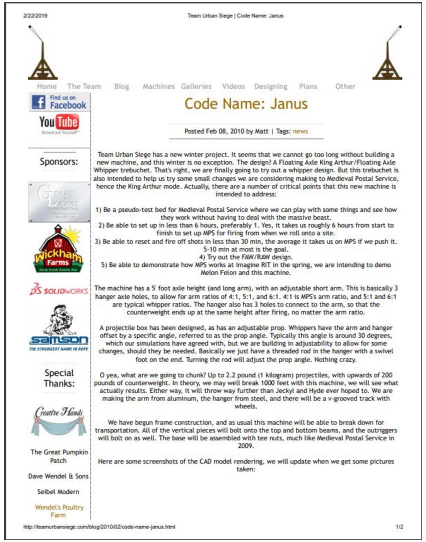
# Design Objective

to research, design, build, and test a trebuchet that will throw a 12" circumference softball as far as possible using only a simple lever. The trebuchet must fit within a 2 ft cube while loaded and must not contain any objects or parts that extend or "fold out". That being said, our true motive is to dismantle and destroy the opposing team as we bring home the coveted title of the best trebuchet engineers. Through strategy, higher intellect, passion, and raw enginuity, we will strip our opponents of their honor as we throw our way to the ultimate victory.

# Gather Information





2/22/2019 Team Urban Siege | Code Name: Janus

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## Code Name: Janus

Posted Feb 08, 2010 by Matt | Tags: news

Team Urban Siege has a new winter project. It seems that we cannot go too long without building a new machine, and this winter is no exception. The design? A Floating Axle King Arthur/Floating Axle Whipper trebuchet. That's right, we are finally going to try out a whipper design. But this trebuchet is also intended to help us try some small changes we are considering making to Medieval Postal Service, hence the King Arthur mode. Actually, there are a number of critical points that this new machine is intended to address:

1) Be a pseudo-test bed for Medieval Postal Service where we can play with some things and see how they work without having to deal with the massive beast.
2) Be able to set up in less than 6 hours, preferably 1. Yes, it takes us roughly 6 hours from start to finish to set up MPS for firing from when we roll onto a site.
3) Be able to reset and fire off shots in less than 30 min, the average it takes us on MPS if we push it. 5-10 min at most is the goal.
4) Try out the FAW/RAW design.
5) Be able to demonstrate how MPS works at Imagine RIT in the spring, we are intending to demo Melon Felon and this machine.

The machine has a 5' foot axle height (and long arm), with an adjustable short arm. This is basically 3 hanger axle holes, to allow for arm ratios of 4:1, 5:1, and 6:1. 4:1 is MPS's arm ratio, and 5:1 and 6:1 are typical whipper ratios. The hanger also has 3 holes to connect to the arm, so that the counterweight ends up at the same height after firing, no matter the arm ratio.

A projectile box has been designed, as has an adjustable prop. Whippers have the arm and hanger offset by a specific angle, referred to as the prop angle. Typically this angle is around 30 degrees, which our simulations have agreed with, but we are building in adjustability to allow for some changes, should they be needed. Basically we just have a threaded rod in the hanger with a swivel foot on the end. Turning the rod will adjust the prop angle. Nothing crazy.

O yea, what are we going to chunk? Up to 2.2 pound (1 kilogram) projectiles, with upwards of 200 pounds of counterweight. In theory, we may well break 1000 feet with this machine, we will see what actually results. Either way, it will throw way further than Jeckyl and Hyde ever hoped to. We are making the arm from aluminum, the hanger from steel, and there will be a v-grooved track with wheels.

We have begun frame construction, and as usual this machine will be able to break down for transportation. All of the vertical pieces will bolt onto the top and bottom beams, and the outriggers will bolt on as well. The base will be assembled with tee nuts, much like Medieval Postal Service in 2009.

Here are some screenshots of the CAD model rendering, we will update when we get some pictures taken:

SOLIDWORKS

samson THE STRONGEST NAME IN ROPE

Special Thanks:

Creative Hands

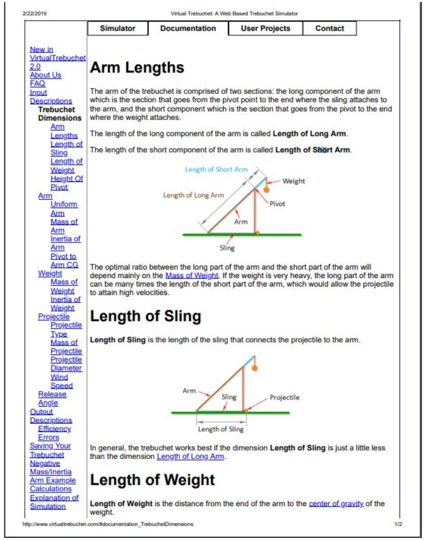
The Great Pumpkin Patch

Dave Wendel & Sons

Seibel Modern

Wendel's Poultry Farm

http://teamurbansiege.com/blog/2010/02/code-name-janus.html 1/2



2/22/2019 Virtual Trebuchet: A Web Based Trebuchet Simulator

Simulator | Documentation | User Projects | Contact

New in VirtualTrebuchet 2.0
About Us
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Input Descriptions
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## Arm Lengths

The arm of the trebuchet is comprised of two sections: the long component of the arm which is the section that goes from the pivot point to the end where the sling attaches to the arm, and the short component which is the section that goes from the pivot to the end where the weight attaches.

The length of the long component of the arm is called **Length of Long Arm**.

The length of the short component of the arm is called **Length of Short Arm**.

Length of Short Arm
Weight
Length of Long Arm
Pivot
Arm
Sling

The optimal ratio between the long part of the arm and the short part of the arm will depend mainly on the Mass of Weight. If the weight is very heavy, the long part of the arm can be many times the length of the short part of the arm, which would allow the projectile to attain high velocities.

## Length of Sling

**Length of Sling** is the length of the sling that connects the projectile to the arm.

Arm
Sling
Projectile
Length of Sling

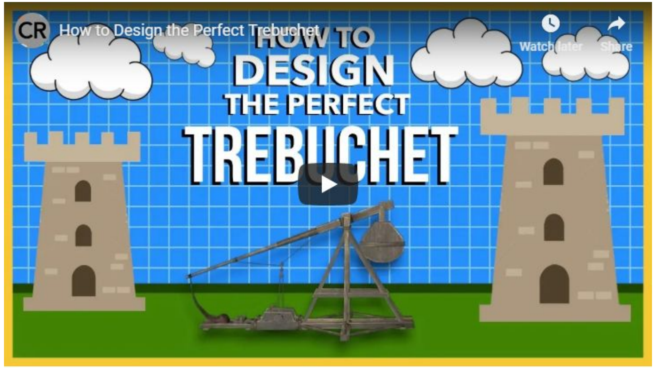
In general, the trebuchet works best if the dimension **Length of Sling** is just a little less than the dimension Length of Long Arm.

## Length of Weight

**Length of Weight** is the distance from the end of the arm to the center of gravity of the weight.

http://www.virtualtrebuchet.com/#documentation_TrebuchetDimensions 1/2

# Gather Information (Continued)




2/22/2019 Whipper - Trebs on the Web

## Trebs on the Web

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### Whipper

#### Overview

The whipper is a modern take on trebuchets, geared towards throwing lighter missiles long distances for sport, rather than devastating fortresses for profit. It's the brainchild of Raymond "Ripcord" Goodsell, a New York State medievalist and catapult enthusiast. He says that he was inspired by the highly innovative King Arthur trebuchet of Chris Gerow and the Floating Axle Trebuchet series of Ron Toms. In principle the whipper has some similarities to the King Arthur, but none to the FATs.

The very first example was the Golf Ball Whipper, a strange device, but one whose features actually were rather logical. It was tall, spindly, and overpowered, and it simply could not withstand the stresses it developed. As with many new mechanisms there were things that needed improvement, but the fact that it worked inspired a number of hurlers to adopt the system and work to perfect it.

Probably the best of the early ones were the Pumpkin Whipper series entered in the Youth Trebuchet class at the World Championship of Punkin Chunkin by Ryan Hunter in 2004, 05, and 06, taking first place those years and setting a distance record that would only be broken years later by a much larger conventional treb. The current European champion and record holder is also a whipper, named Excalibur. And the WCPC youth record was reclaimed by another whipper, originally named Arbiter, rebuilt and renamed Sanford Slinger by the Sanford School. Another big one is the latest Pumpkin Hammer, though it has suffered from teething troubles.

What makes a whipper so effective? No secret: the counterweight falls much farther than with a conventional design. More "drop" means more energy in the system, and if you can channel that energy you will throw farther. The same can be said for FATs and KAs, of course.

What sets whippers apart is ithe arm motion. While most conventional hinged counterweight trebs have around 135 degrees of motion, and a KA has nearly 180, the whipper might have as much a 270 to 300 degrees. When you see a whipper you know it's different; the arm is angled upward and toward the target rather than down and away. And the counterweight is above the arm, pointing in nearly the same direction. In action, when the arm is released it drops together with the CW until it is about vetrtical, at which point the CW begins to go straight down while the arm continues around, and soon the action is just like a conventional HCW except a whole lot faster.

https://sites.google.com/site/trebsontheweb/whipper 1/4

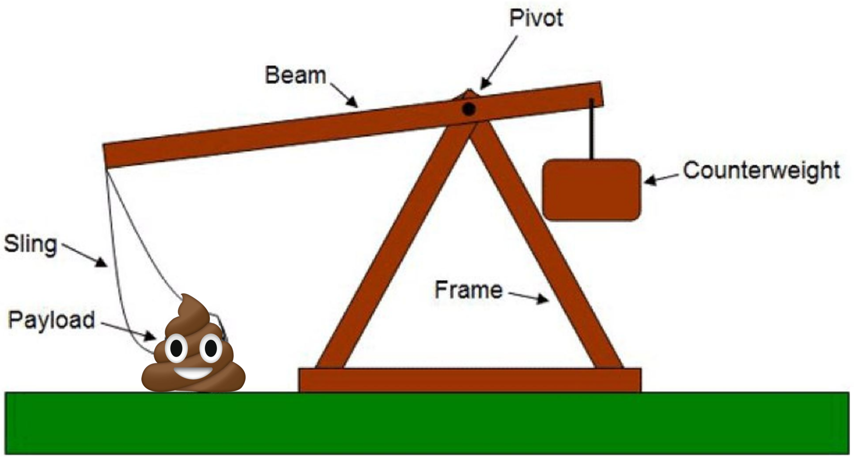

The Whipper Trebuchet: setting ready to fire

Wouter Markey

YouTube - Dec 11, 2010

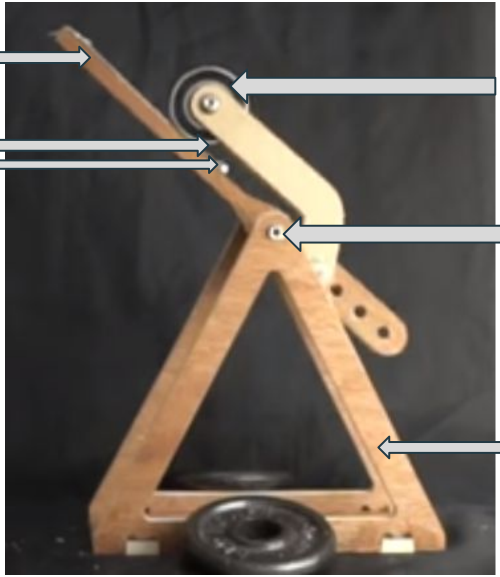
# INFERIOR AND OUTDATED DESIGN

# Superior and Modern Design




(Traditional)

(Additional Visual Aids)




("Whipper")

# Whipper vs. Traditional

Pros:

- Greater acceleration, arc of rotation, torque, linear velocity, and kinetic energy (and hopefully launch distance)
- Looks freakin' legit

Cons:

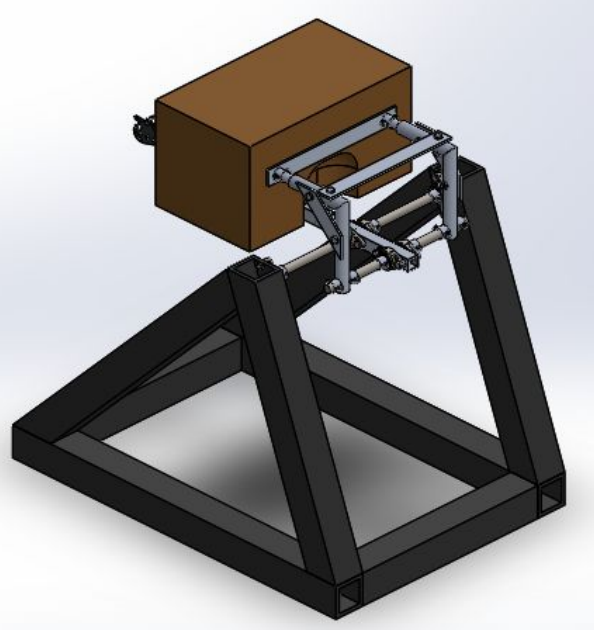
- More complex (testing variables and mechanical components)
- More parts = higher cost
- Arms must be able to rotate 360°, resulting in shorter arms within our constraints

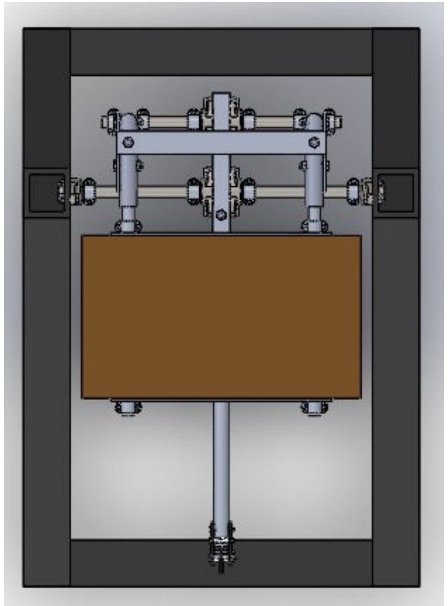
# Inspiration

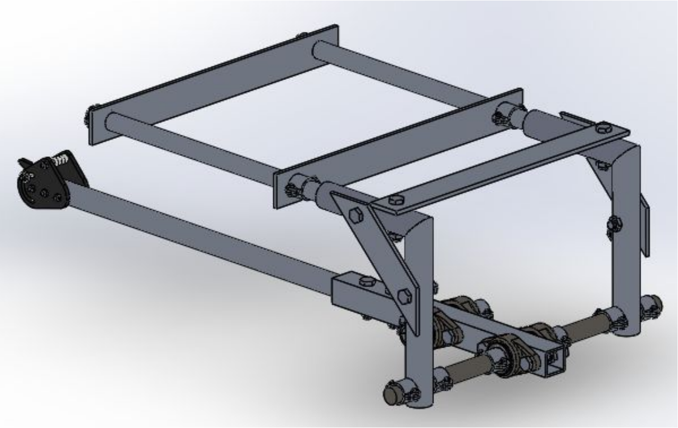
https://www.youtube.com/watch?v=-gn2RGPqe_A&t=639s

From 0:48-5:10

# Our Design Concept

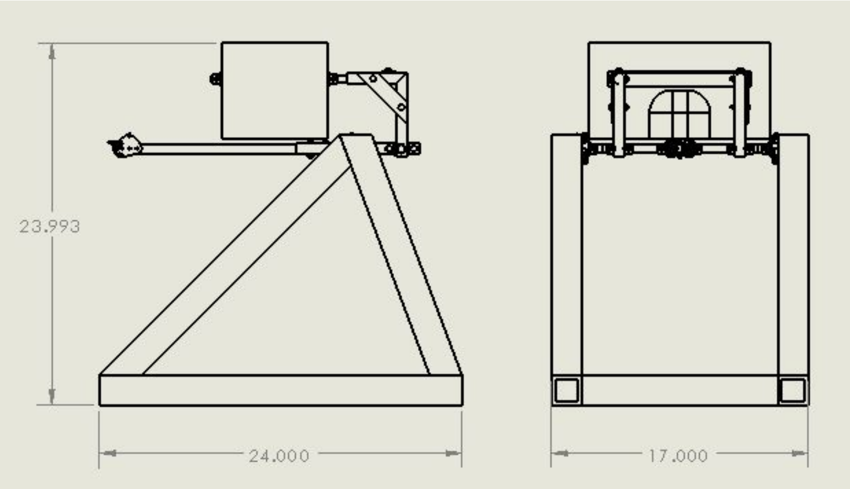






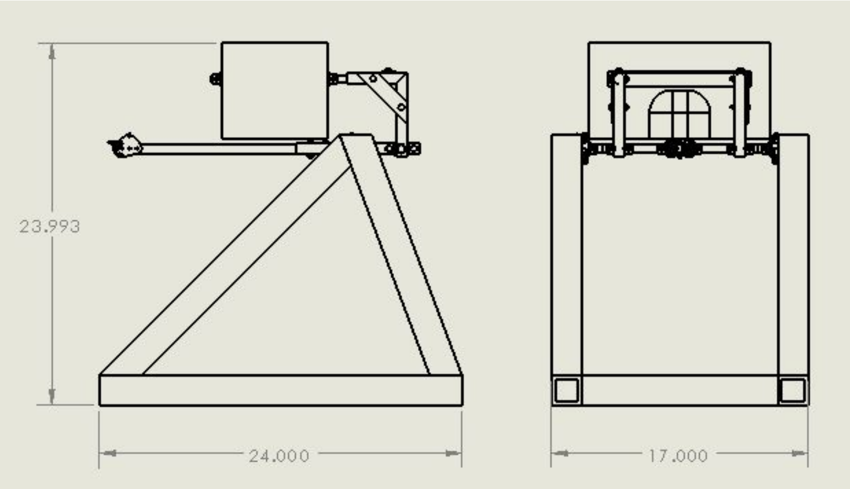
# Base Calculations/Proportions (Approx.)

- Long Arm = 16.5in
- Short Arm = 3in
- Arm Ratio = 5.5:1
- Hanger Radius (counterweight corner to hanger axle centerpoint) = 13.8in (7in vertical, 11.9in horizontal)
- Height of Release = 17in
- Counterweight = 53lb
  - 6.375in height x 7in depth x 12in width
- Weight Ratio 106:1 (55 lb counterweight to 0.5 lb projectile)
  - Projectile = 12in circumference, ø3.8in
- Arc of Rotation (from launch to release) = 270°



# Materials

Our current concept is comprised solely of materials at our disposal. The counterweight will be made of granite. The long arm, short arm, and hangers will be made mostly of aluminum square tubing and hollow rods (excluding the fasteners), although we have not dismissed the use of composites. The release mechanism will be made of 3D-printed PETG plastic, the frame and possibly the axles will be made of steel, and we have yet to determine the composition of our sling and pouch. The bearings and clamps will be made from whatever we can get our hands on.



# Whipper in Motion

https://www.youtube.com/watch?v=-gn2RGPqe_A&t=640s

From 10:50-10:59

https://drive.google.com/open?id=0B4tJI5J3Y1aCUE41SzRweGNvdzZmMDR1SXp4Z2NRS0IxUlA0

# Adjustable Release Mechanism

https://drive.google.com/open?id=0B4tJI5J3Y1aCa2oyXzR4RmVLRUR4VXFNNkpFcE9va1RHekhZ

# Next steps

1. Acquire materials.
2. Construct prototype.
3. Test.
4. Analyze/redesign.
5. Repeat steps 1-4 until optimized.
6. Compete and crush our weak opponents . . . (They never stood a chance).

# Work Cited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