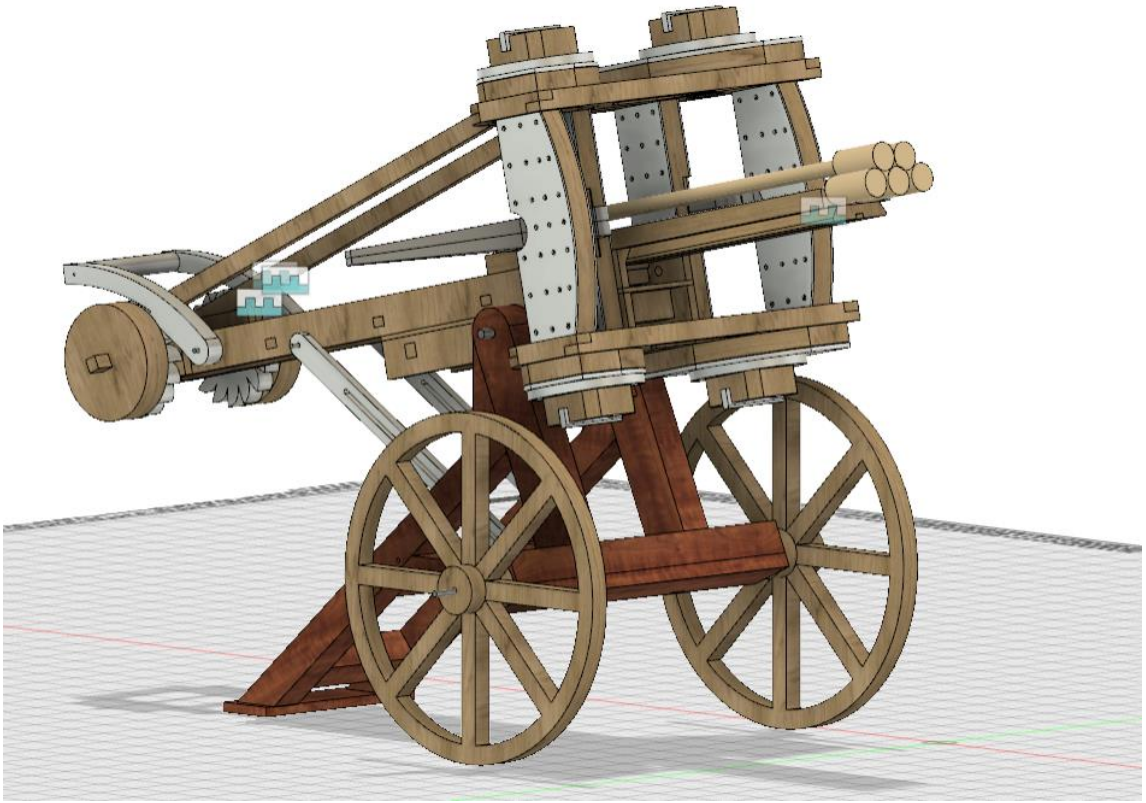
Zen and the Art of Engineering Archaeology: Designs for a SCA “Class A” Combat Siege Engine based on a Roman Palintone “Rock Thrower” Ballista

by

Lord Montgomery Josh,

Orders of the Silver Brooch and Silver Mantle



“Biggus Stickus”

Overview

Based on the research into the operational model Palintone rock thrower and information about past Class A engines (e.g. Widow Maker), I adapted the design to be a full, Class A combat siege engine capable of shooting up to 5 standard combat siege bolts or a single 6.5 inch or larger large ammunition "boulder". I also designed an ammo cart that can safely store the bolts without crushing them and keeping them straight.

Construction is scheduled to start in February 2024 as soon as I can source materials after returning from Birka.

This document is not the complete set of buildable plans for this, but an overview of the planned engine as designed in Fusion 360, a Computer Aided Design and Manufacture software package.

Adaptations for SCA Siege Combat

As-is, the "period right" rock thrower could be used as a single bolt thrower. However, the "Mini-B" Scorpio could be built as-is and function as a single bolt shooter. To make the stock Palintone rock thrower a Class A engine, I made the following adaptions.

Sized the engine at 4x

Roman siege engineering uses part dimensions based off a ratio of the hole carrier hole. This is why the two models have a one-inch hole so the exact sizes of every part could simply be multiplied by the size of the desired hole to produce the size needed. For example, a 2 inch hole would simply double each dimension.

Past torsion engines such as Widow Maker used a 3-inch rope skein, so anything above this should have enough power. I chose 4x so the engine would be large enough to withstand the forces required to launch 5 one-pound siege bolts, and also have the physical size for those bolts. Anything above 4x would be too large to properly transport and use. At 4x, the torsion frame is 40 inches wide and the slider is approximately 48 inches above the ground.

Extended the mid-section by three inches

At 4x, the center section was approximately 7 inches wide. To accommodate 5 bolts stacked with three on bottom and two on top or a sphere at least 6.5 inches in diameter, the center had to be expanded by three inches. This required me to extend the crossmembers, slider, table and ladder rungs, and other connecting parts.

Strengthened the Crossmembers

As given in the historical documents and shown below, the cross members have a clear weak point at the inside of the hole carriers. Some builders have added two vertical cross members but this weakened the joint. To strengthen the corner, I extended the front and rear cross members as shown below. To provide for additional lateral strength I added bracing across the front cross member. These are shown in Figures 1 and 2 below

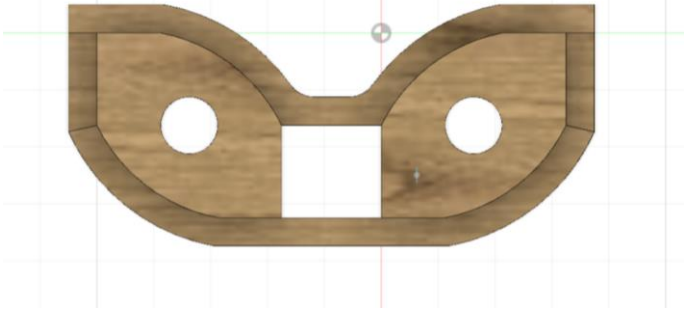


Figure 1: Original Cross Members with hole carriers

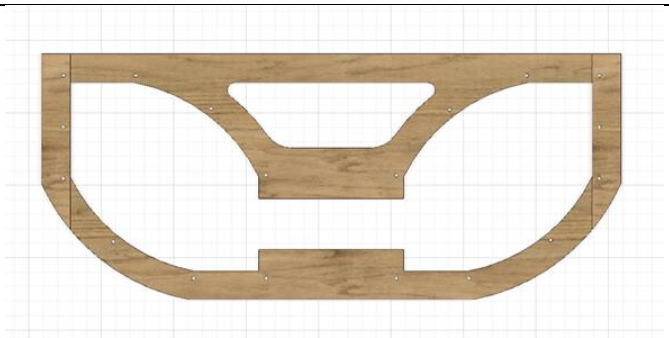


Figure 2: Extended and Strengthened Cross Members without hole carriers

Expanded the top and lower half of the Hole Carriers

The period design has a single piece for each hole carrier. In the model, in order to use the period right wooden washers and have a way to pin the washers in place to prevent them from unwinding, I had to include a ring at the base of the washer. This ring extended over the sides of the default hole carrier as can be seen in the "Stickus DeMinimus" model. There is no documentation on how the wooden washers stayed in place.

Also, period documentation does not describe how the crossmembers attach to the hole carriers. While assembling the model, I found it challenging to keep everything aligned because the cross members attached to the curved sides of the hole carriers.

To give greater surface for the washers to sit on and facilitate connections between the hole carriers and the crossmembers, I extended the top and bottom halves of the hole carriers and added vertical holes to connect them. These are shown in the comparison pictures between the period design and combat design in Figures 3 and 4.

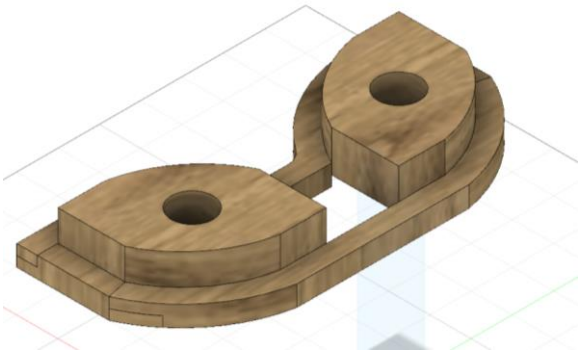


Figure 3: Original Hole Carriers and Crossmembers

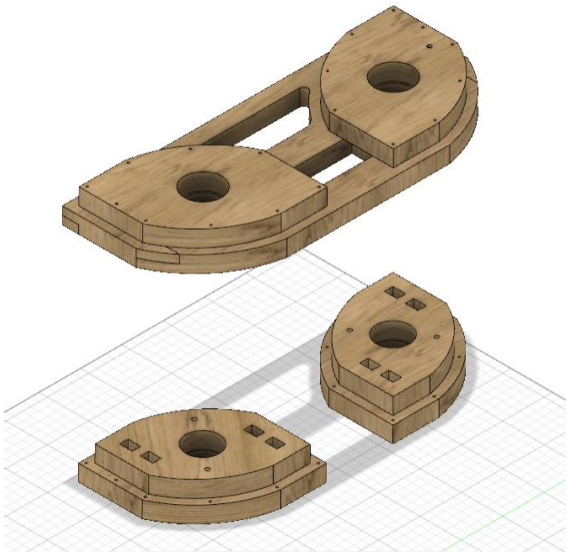


Figure 4: Expanded Hole Carriers

Added a second windlass ratchet

Documentation shows different versions of a ratchet to keep the slider from flying forward. They showed both wheeled ratchets and linear ratchets Some designs had it on one side and others on two. For safety, I added a second rotary ratchet at the rear of the rear stock, and connected the two handles together.

Replaced the slider pulley rope with bicycle chain

In period, the Romans used pulleys with rope for the slider. Depending on the builder and size of the ballista they had different options and configurations. The Polybolas (a period repeating single bolt thrower) used a primitive chain drive to move its slider.

To give reliability and movement as required, I am replacing rope with a modern bicycle chain and sprockets. This will also facilitate experimenting with different size drive sprockets to optimize the strength to crank the ballista versus the time needed to crank for each shot.

Converted the base to a cart

Most of the period documentation shows the large ballista static on a base. For combat use, I placed the ballista on a cart. This will allow for aiming vertically but not left to right. The reason for this is concern of the weight of the engine in the yoke hinge. And when properly balanced, the cart itself can be quickly turned to aim at a new point. The base is given in the renderings.

In order to qualify a SCA siege engine, it must be tested at 45 degrees. To facilitate this, I had to move the pivot point up to allow the engine to tip back the proper angle.

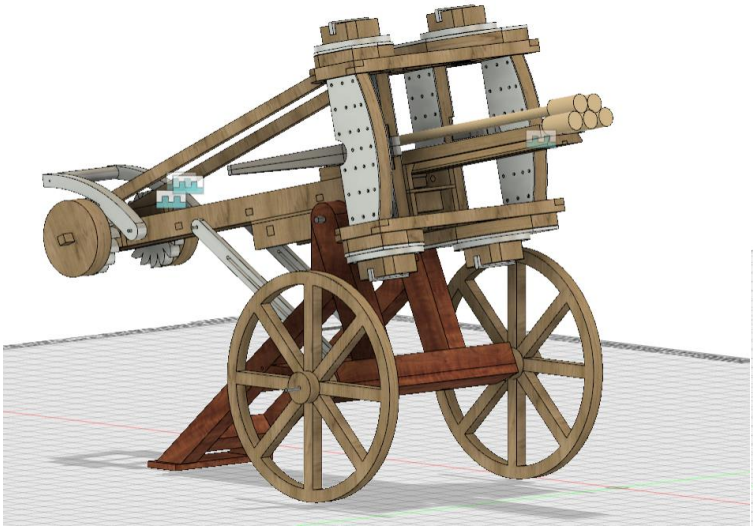
The Ammo cart includes a hitch so the end of the cart can be connected so one person can move both.

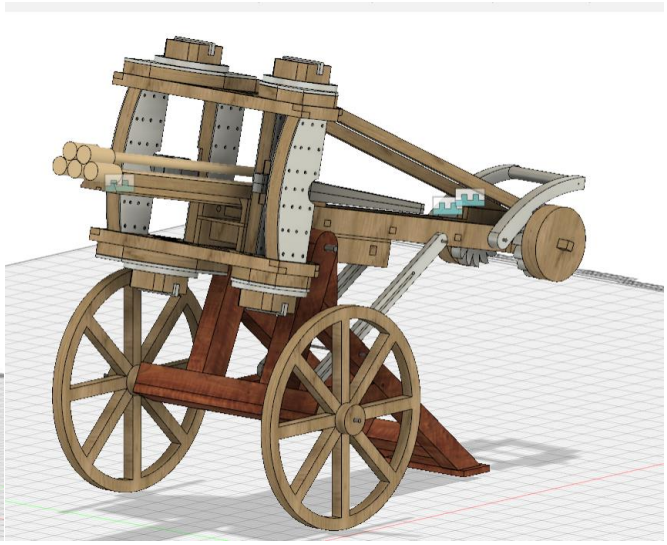
Safety Considerations and SCA Compliance

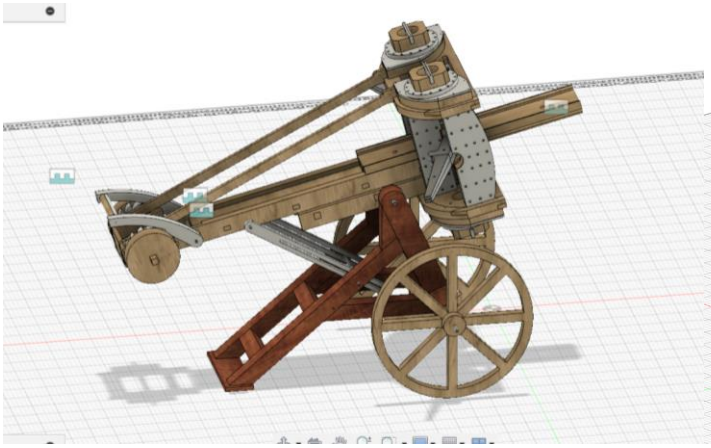
1. Cover the swing arms in glue-soaked sisal rope
2. Addition of a lock pin to the trigger and windlass so it cannot be used inappropriately

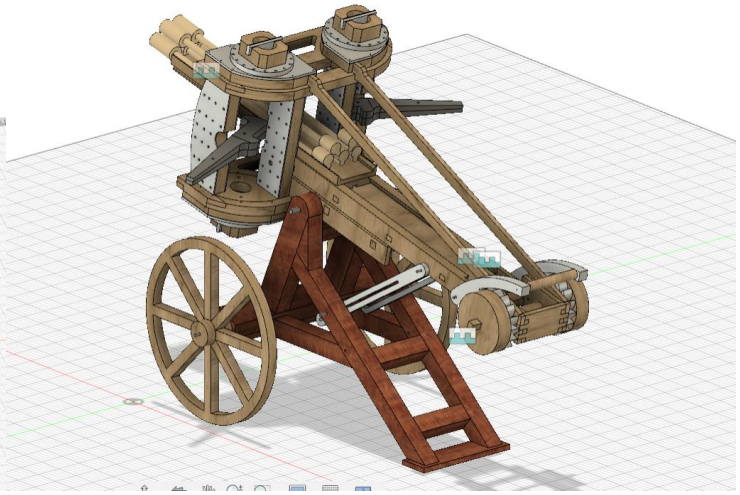
Renderings of the Complete Engine

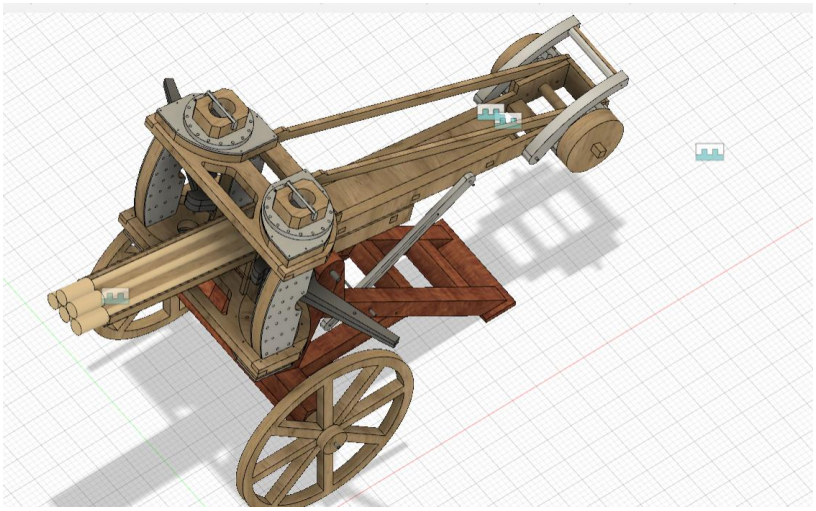
Isometric Views



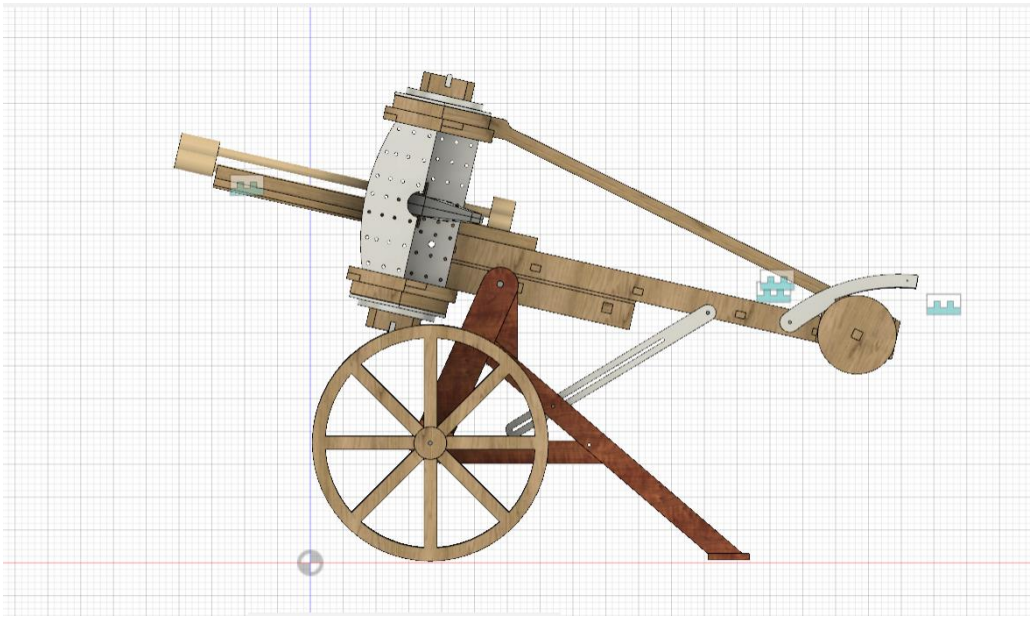




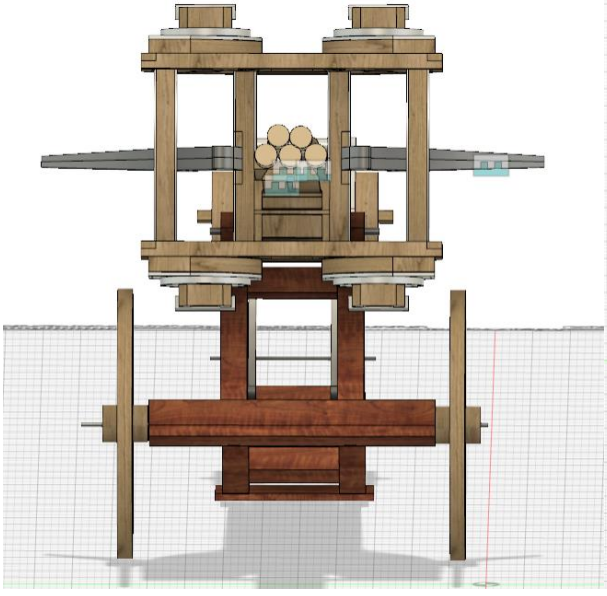


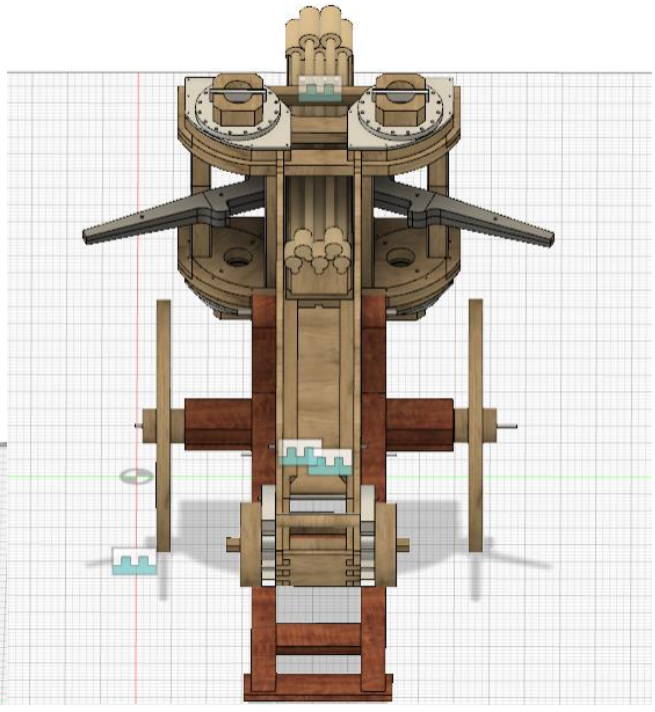


Left Side



Front and Rear



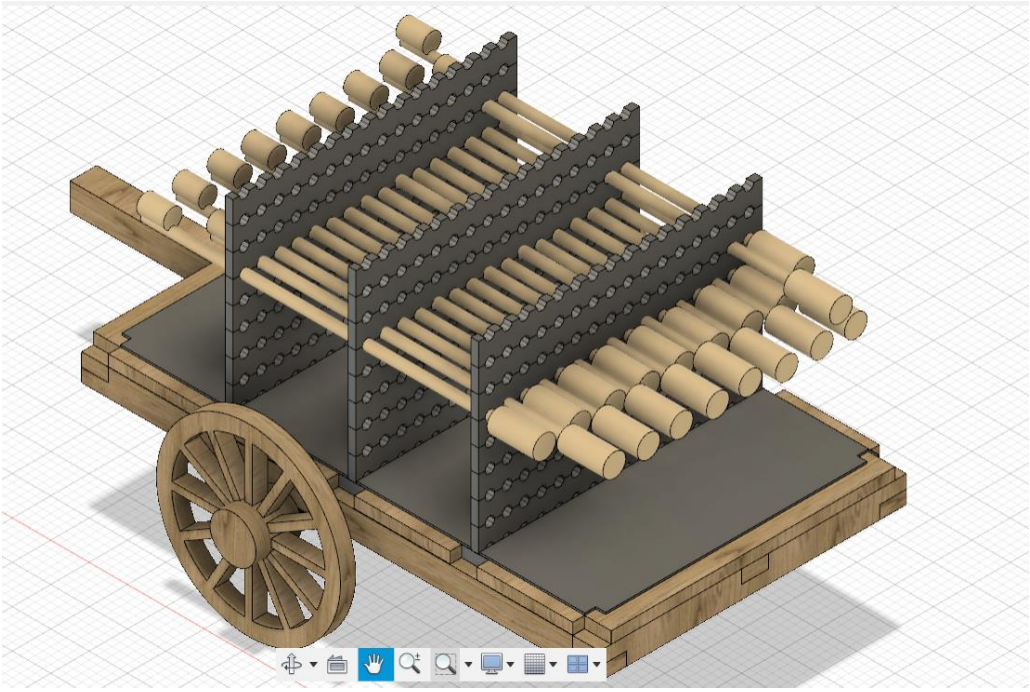


Renderings of the Ammo Cart

The ammo cart as designed can hold up to 120 bolts. It is designed to be a year-round storage device that can also be used on the battlefield. Depending on the situation, engineers can move them to smaller quivers, for example, to supply different engines or reserve bolts for later rounds of the battle.

Details of the removable spacers

The cart has removable spacers that hold the ammo in place. This design prevents them from crushing the fletching and tips. It also holds them in place to keep them from warping.



With the walls

The front and rear walls are permanently fixed to the cart chassis. The left and right walls come off for quick access to the ammo.