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# Roman Siege Machinery and the Siege of Masada

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# "Guide to Ancient Roman Siege Weaponry" – Final Draft

## I. Introduction

At the height of the Roman Empire, Rome ruled from Britain to Northern Africa to Syria and everywhere in between. One of the main reasons for this dominance was Rome's military might. Today, people primarily have images of vast cohorts of heavy infantry wielding gladii, Rome did not win all of its wars exclusively by sword-wielding soldiers. Siege equipment was crucial in many Roman military victories. This document explores some of Ancient Rome's fundamental siege machines: the siege ramp, the siege tower and the battering ram. Specifically, it is focused on the physical mechanisms describing the construction and operation of each device.

Romans had a perspective on siege warfare that was different from most other civilizations in antiquity. Much of the Greek siege weaponry was as focused on intimidation as inflicting damage. The *helepolis* of Epimachus, a large siege tower used in the Siege of Rhodes in 304 BCE, had a massive 21 m per side square base and a height of 40 m.[i] Roman siege ideals focused on functionality. Their siege engines tended to be smaller, yet more practical. The towers built by Titus at the siege of Jotapata in 67 CE and the siege of Jerusalem in 70 CE had heights of 15 m and 22 m respectively.[ii] While not necessarily making significant changes to siege engine design, the Romans brought an aggressiveness and pragmatism to siege warfare, which had not been seen before.[iii]

II. Siege Ramps

Many of the fortified settlements that Rome laid siege to were located on areas of raised elevation. This type of terrain easily lends itself toward fortification. Typically, defenders built walls around the perimeter of the summit of their high ground. Settlements such as Avaricum in Gaul and Masada in Judea typified such defenses.[iv,v] The Roman solution to laying siege to these locations was the siege ramp.

The Roman siege ramp (*agger)* was essential to most sieges. Not only did they enable Roman siege engines to reach the defender's elevated walls through proximity, but siege ramps provided a flat, regular surface that engines could easily traverse as well. Typically, these ramps consisted of earth and rubble with a gentle gradient up to defenders' fortifications, as shown in Figure 1. These structures varied in height and width according to each scenario in which they were used. During the siege of Avaricum in 52 BCE, Caesar built a ramp 80 ft high and 330 ft wide, with ample room for two siege towers.[vi] During the siege of Masada in 73-74 CE, Silva ordered a 300 ft tall embankment to be built.[vii]

While it is easy to appreciate why these embankments were useful and how they were used, how they were built is less obvious. Construction of the ramp commenced as far as possible from the settlement under attack. Soldiers would bring baskets filled with earth and brush up the ramp and dump them over the edge. Horizontal timber beams atop the earth and rubble compacted the material below and acted as a framework for structure. In addition, horizontal timber beams supported the earthworks as shown in Figure 2. Earthwork atop the timber beams permitted flat surfaces and structural stability. The timber beams in the ramp built for the Siege of Masada are still visible today.[viii]

To protect the earth-moving soldiers from enemy missiles throughout construction, two types of defensive structure were built: *vinea* and *plutei*. *Vinea*, depicted in both Figure 1 and Figure 2, were light wooden structures, open end-to-end, with enclosed wicker-work sides and roof. Four vertical wooden posts in each corner supported the structure. Many adjacent *vinea* formed enclosed "tunnels" in which construction soldiers would transport their baskets of earth. Typically, raw-hide encasing the wicker-work provided fire-resistance to the wooden structures. *Vinea* received their name from their resemblance to vineyard trellises.[ix]

*Plutei* served the purpose of providing frontal protection to workers exiting the *vinea* to deposit their buckets of earth. These structures consisted of large convex, wicker-work shields with arched roofs, and most likely were also covered in raw-hide. Between the *vinea* and the *plutei*, soldiers were able to safely transport the earth required to build large embankments.

III. Siege Towers

As the primary Roman siege engine, siege towers were multi-purpose machines. Their functions included creating wall breaches, scaling battlements, clearing the tops of ramparts, and protecting the soldiers involved in each of these activities. Each main functionality comprised a distinct story on a Roman siege tower, as shown in Figure 3. Typically, the bottom story held the battering ram used to penetrate fortifications. A middle story held a drawbridge enabling Roman infantry to storm enemy walls. Ropes attached to the ends of these drawbridges would lower them into place on the enemy ramparts. Typically, these bridges included protective sides and were constructed from wicker-work and raw-hides, similar to an inverted *vinea.* Since the Romans wanted their soldiers to traverse these bridges quickly, they could not be too sloped when extended onto the ramparts. This required that the drawbridge story of the siege tower be approximately level with the defenders' bulwarks.

The top story of the Roman siege tower was uncovered and comprised of a flat platform from which artillery and bowmen shot down enemy soldiers on top of the enemy walls. Additional stories were added to the structure as needed such that each of the three primary stories was at a proper height. An internal network of platforms and ladders allowed movement between stories. Exceptionally large siege towers could have had two systems of ladders: one for ascending and one for descending.

Supporting each of these platforms was a framework made from large wooden timbers. The longest and thickest of these timbers were used as the corner supports. These could be reinforced by iron bands and traversed the entire height of the siege tower while connecting each story and the base structure, called an undercarriage. Most likely, a horizontal square frame made of additional large timbers supported each platform and connected it to the corner supports. In addition, secondary support beams extending from one platform to the next provided extra stability to the entire structure.

Proper design and construction of the undercarriage was crucial for the successful operation of the siege tower since the movement of the wheels was transferred to the rest of the machine. Simply, the main frame of the undercarriage was four beams in a rectangle. At least two additional beams crossed the undercarriage in each direction to provide support, as shown in Figure 4. Also, solid wooden wheels connected to the rest of the siege engine through the undercarriage. Typically, individual axle and bearing components attached each wheel to the undercarriage separately. These wheels were able to be detached from the siege engine and rotated 90 degrees, so that the tower could move forwards, backwards or laterally, as shown in Figure 5. These wheels could be anywhere from 3 ft to 9 ft in diameter and 1 ft to 3 ft in width.[x] Understandably, larger wheels were used on larger towers, since larger wheels allowed for easier movement than smaller ones. Towers typically had four wheels, but could have more if extra support was needed. Wheels always connected to the interior of the undercarriage; external wheels would have created a weakness on the tower that enemies could have exploited.

Around the framework of a siege tower, various layers of material protected the soldiers inside. A base layer of wood-planking provided the primary defense. Softer woods such as fir or pine were used on the planking of the exterior and on each platform, while harder woods such as oak or ash were used on the load bearing components, such as the wheels and undercarriage. Since wood was susceptible to burning, fire-resistant materials were necessary. This could be achieved with layers of clay, rawhide or iron sheets fastened atop the original layer. Iron sheets were the most effective at providing additional defense, but their additional mass caused some towers to collapse under their own weight. Clay and rawhide could be used in conjunction, such that the rawhide prevented the clay from being washed off by the enemy. Rawhide and other materials, such as seaweed and vinegar-soaked chaff, provided a cushioning layer against oncoming missiles. The use of all of these materials was variable for a given siege engine, depending on what was available.

No ancient source adequately described how these siege towers generated movement.[xi] Various methods of propulsion have been proposed by modern day historians. As the traditional power source in the ancient world, beasts of burden pulling siege towers via ropes was one of the most obvious ideas. However, there is a major flaw with this theory. Oxen would have been vulnerable to enemy projectiles before the siege tower would have been in place. Another proposed theory posits using ropes anchored in front of the siege tower and winches. Benefiting from the mechanical advantage of the winches, Roman soldiers could have slowly pulled the towers along the ropes. Either oxen or winch methods could have leveraged a series of pulleys and anchors to generate additional mechanical advantage and transfer the generation of power to behind the siege tower. It is possible that none of the above methods accurately reflect how these engines were transported.

The design of Roman siege towers stressed functionality. With the ability to destroy walls, launch infantry assaults and shoot missiles at defenders, the tower forced the besieged to deal with a variety of threats. Every physical part of the tower had a specific purpose: the frame supported the machine, the undercarriage and wheel assemblies enabled it to move, and the wooden planking plus additional layers protected everyone inside. This functionality led to their widespread use and success in most Roman sieges.

IV. Battering Rams

While siege ramps and towers were essential in most sieges, battering rams provided the heavy-hitting to destroy enemy stone walls. Repeated blows from a ram dislodged or shattered individual stones in a wall. As more and more of the individual stones failed, eventually the entire wall would collapse. On the other hand, rams only had limited success against clay-brick and earthen walls. Against these walls, the ram head would compact the wall material upon impact instead of dislodging material. Regardless, battering rams were quite effective in breaking through the majority of defenses.

Rams could have been integrated into a siege tower or operated as a separate engine. When combined with a siege tower, they were located on the first story of the machine. Separate ram-tortoises took a slightly different design, as shown in Figure 2. Roman ram-tortoises were single-story engines possessing an undercarriage similar to that of a tower. However, instead of the square frusta shape of the siege tower, ram-tortoises took the form of a triangular prism; steep sloping sides met at a single ridge along the length of the machine with the front and back ends open. Wooden timbers extended from the sides of the undercarriage to the central ridge to create the frame of the ram-tortoise. Additional supports extending vertically from the undercarriage supported this frame. Just as with the siege tower, the sides of the ram-tortoise were covered in wood-planking with various layers of padding and fire-resistant materials. With only one story and open front and back ends, ram-tortoises were more easily constructed than siege towers.[xii]

The ram itself consisted of a large wooden trunk capped with an iron ram's head. Josephus mentions that it was conventional to cast this tip in the shape of its namesake animal's head. The head slotted onto the ramming-beam and was fastened in place by an iron collar. Since the ramming-beam was under compression on each impact, harder woods, such as ash, were typically implemented in its construction.

Two different mechanisms propelled the ramming-beam into the fortifications. Most commonly, the beam was suspended from a beam holder at two locations along the length of the beam, as shown in Figure 2 and Figure 3. The beam was then lifted up via human power, assisted by a system of ropes and pulleys on the back end of the beam. When the ropes were released, the beam would move through its range of motion and strike the enemy wall. To increase the effectiveness of this setup, an iron weight could be placed on the back end of the beam, with the beam slid forward to still maintain balance. Increasing the mass of the beam in such a manner would impart more energy on the wall if the beam was raised to the same initial height. The second technique for actuating the ram involved tension in ropes generated by winches as shown in Figure 6. Instead of being suspended on ropes, the ramming-beam rested on a series of rollers. Once the winches generated sufficient tension in the ropes, they were released. The tension from the ropes pulled the ramming-beam forward and into the enemy's fortifications. Of the two methods, the former was more common in battering ram construction.[xiii]

Special considerations had to be taken into account when battering rams were in use. First, the force of the ramming-beam against the enemy's defenses could have propelled the entire engine backwards, possibly down the siege ramp. To prevent this, wedges placed behind the wheels inhibited backward movement. In addition, the ramming-beam was vulnerable to attacks from defenders on the battlements above. This weakness was exacerbated by the significant amount of time it took for battering rams to cause structural failure. Heavy objects could be dropped onto the beam to crack or shatter it. Defenders could lasso the beam to prevent it from moving. The Romans had two ways of dealing with these threats. Ideally, cover fire from a siege tower would keep defenders off of the ramparts and not allow them to perform these actions. On the ram-tortoise, the central ridge beam could be extended forward past the base of undercarriage, to continue to cover the front part of the battering ram. This extended roof made it more difficult for defenders on the ramparts to assault the ram by simply providing a more complete shield for the machine. While battering rams were successful at destroying enemy fortifications, they needed to be in a stable position to be used properly.

V. Conclusion

The siege ramp, siege tower and battering ram all had specific uses during a Roman siege. The siege ramp gave the siege engines easy access to the fortifications of the enemy. The siege tower removed defenders from their battlements by showering them with projectiles and protected Roman soldiers close to the enemy walls. The battering ram brought down the enemy's defenses and enabled a large force of Roman infantry to invade the besieged settlement. However, each of these machines relied on the others for a successful siege. Battering rams need the protection of the siege towers in order to have sufficient time to break through the enemy's ramparts. Both the battering ram and the siege tower relied on the siege embankment to be able to get where they needed to go. The siege ramp did not pose an actual threat by itself. Separately these devices were not effective, but with all machines working together successfully, Rome's military prowess was immediately obvious.

Figures

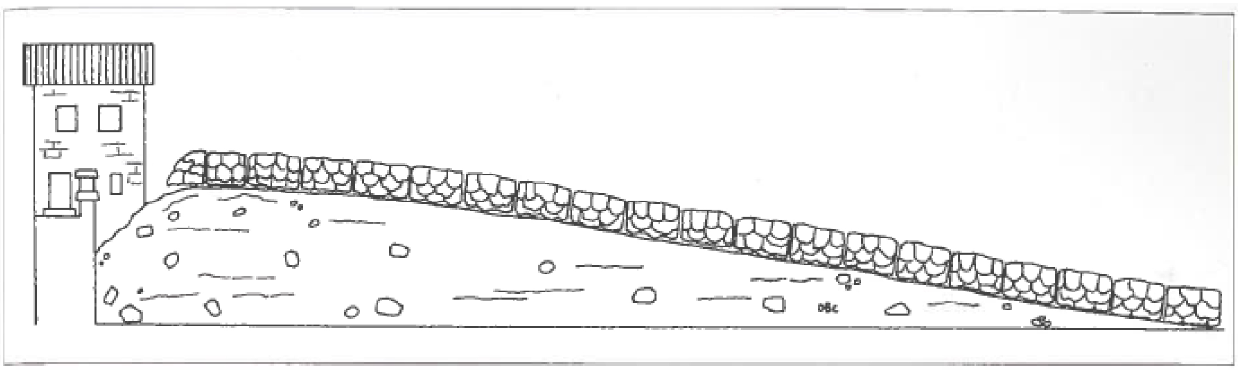

**Figure 1 depicts a Roman siege ramp. A series of v*inea* protect soldiers throughout the construction of the ramp.**[xiv]

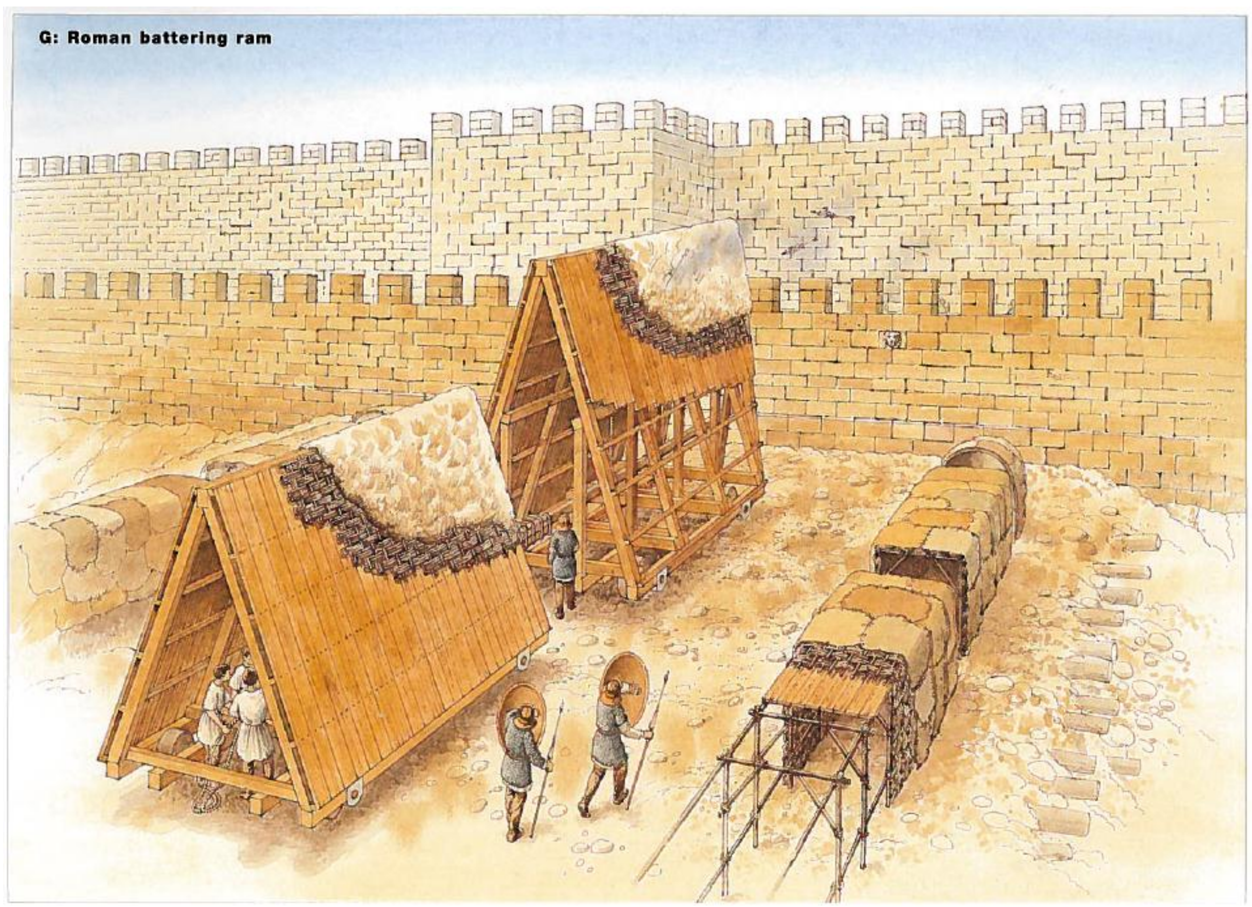


**Figure 2 depicts a battering ram (center-left), *vinea* and *plutei* (center-right) on a siege ramp. Timber beams providing support to the structure protrude out of the side of the ramp. (right)**[xv]

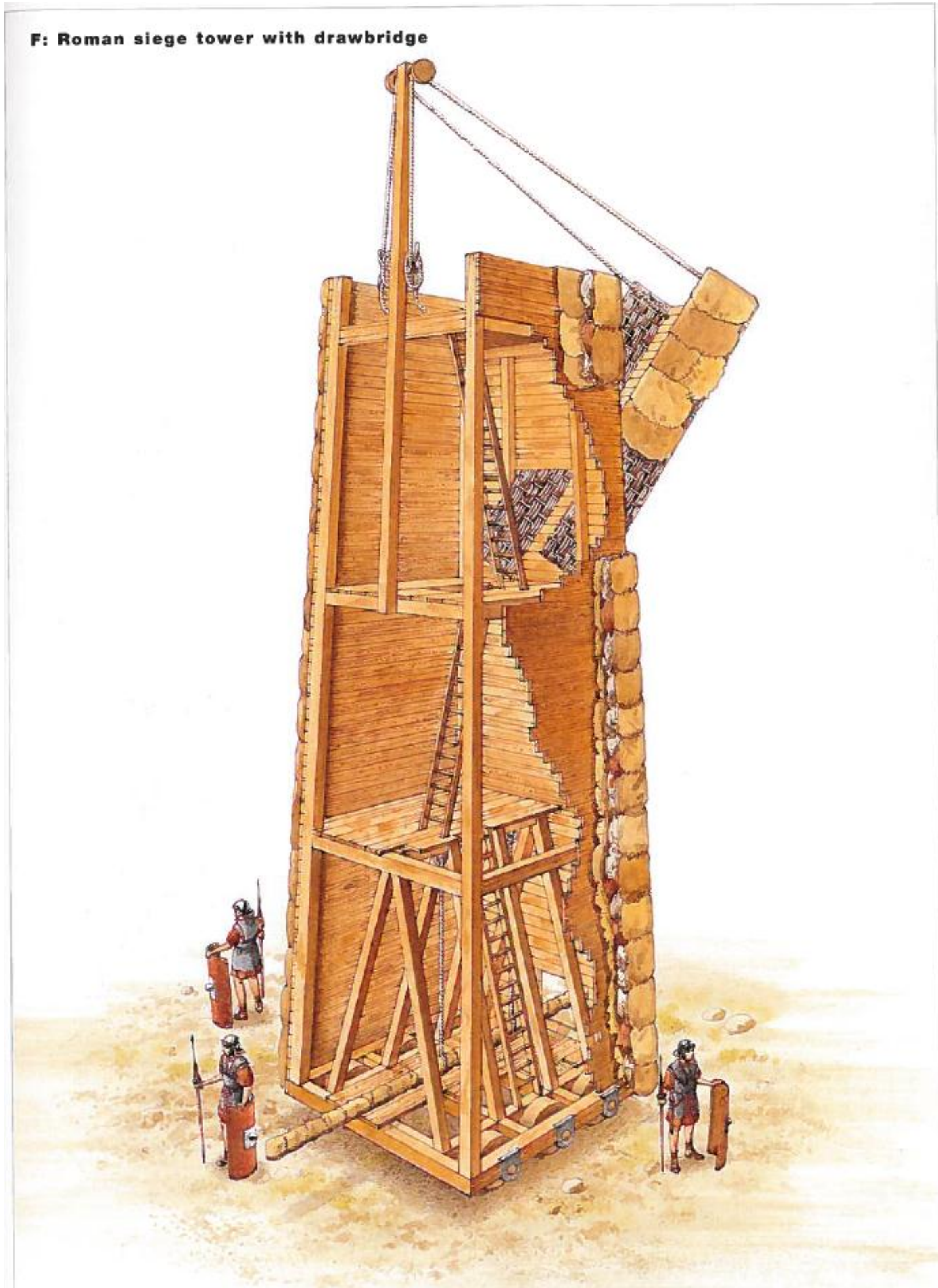


**Figure 3 depicts a Roman siege tower complete with a battering ram, a draw bridge and an open platform for artillery.**[xvi]

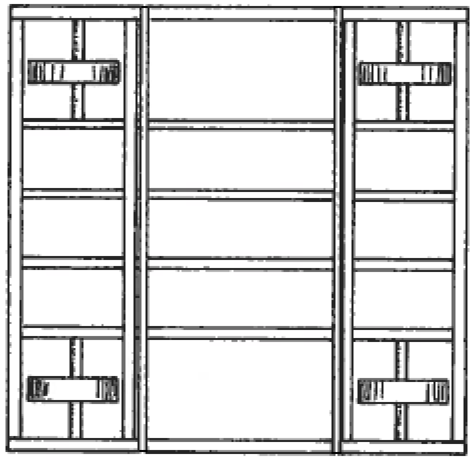

**Figure 4 shows the undercarriage of a siege tower with four wheels.[xvii]**

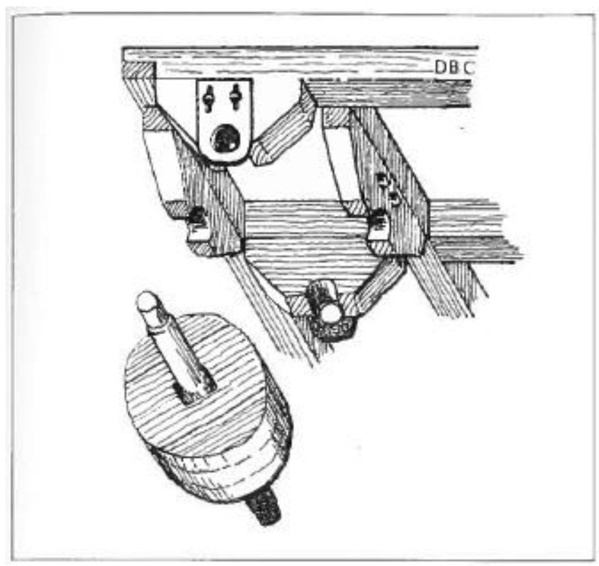


**Figure 5 shows a general wheel assembly for siege engines.[xviii]**

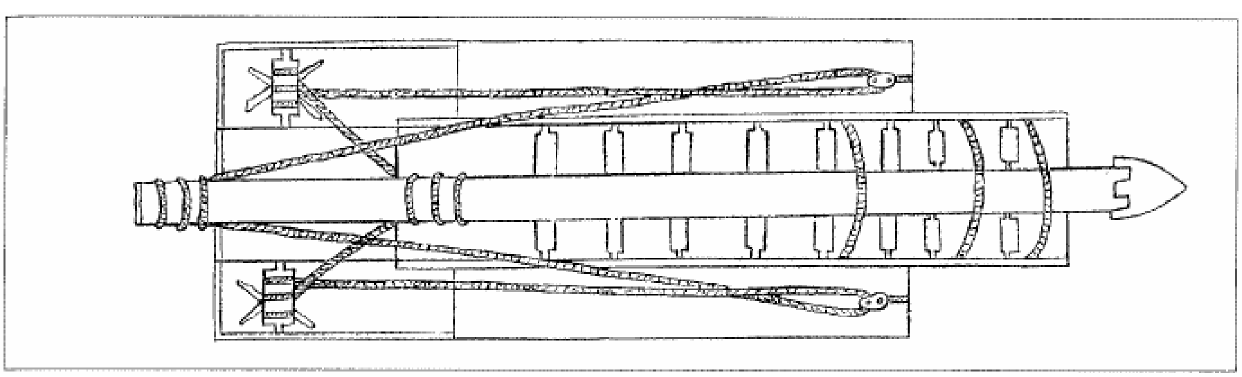

**Figure 6 depicts one method in which battering rams were actuated. Energy is stored in the tension of ropes through the use of winches.[xix]**

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Endnotes

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[i] Campbell, pp. 9
[ii] Campbell, pp. 37
[iii] Goldsworthy, pp. 149-151
[iv] Campbell, pp. 35
[v] Josephus, pp. 395
[vi] Campbell, pp. 35
[vii] Josephus, pp. 397
[viii] Gill, pp. 569
[ix] Campbell, pp. 35-37
[x] Campbell, pp. 8
[xi] Campbell, pp. 12
[xii] Campbell, pp. 40-42
[xiii] Campbell, pp. 40-42
[xiv] Campbell, pp. 35
[xv] Campbell, pp. 32
[xvi] Campbell, pp. 31
[xvii] Campbell, pp. 14
[xviii] Campbell, pp. 15
[xix] Campbell, pp. 19