

Battle of Agincourt, Rachel McColm

by Rachel Mccolm

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THE PERFORMANCE
OF THE LONGBOW
AGAINST PLATE
ARMOUR AT THE
BATTLE OF
AGINCOURT

TECHNICAL AUTHORING
ACDA 5024

Rachel McColm
2223157

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Task Description

- Research the medieval longbow and needle bodkin arrow used at the Battle of Agincourt.
- Write a report determining if the longbow does or does not deserve the accolade of most decisive factor in the victory at the Battle of Agincourt.
- Report is to contain visual inference to support conclusion/s.

Table 1 - Technical Information Given

Type of Ordnance	Bodkin Arrow
Delivery System	Longbow
Length of ordnance (w/o bodkin)	583.5mm
Length of Bodkin	115mm
Diameter of arrow shaft	11.11mm (assume same diameter for bodkin)
Mass of Arrow	Arrow 0.116kg (1800 grains)
Density of Penetrator	Bodkin 6.25gcm^{-3} Yew Wood 0.67gcm^{-3}
Density of Plate Armour	2.85gcm^{-3} (rank and file) - 5.75gcm^{-3} (knight)
Thickness of Plate Armour	2.5mm – 4mm
Angle of obliquity of impact	30° to the normal and greater
Yield Stress of Armour	350-600 MPa (variation between foot soldier armour and that of a king) ¹
Velocity of system at impact (100m)	Arrow 53.34ms^{-1} Knight on horseback (8.95ms^{-1}) Foot soldier (0.9ms^{-1})

1. Introduction

In what is now referred to as the 100 Years' War, several generations of French and English would battle for land. It was a long dispute between the two over the rightful succession to the French Crown. This war spanned longer than a century from the year 1337 to 1453. In 1413, King Henry V was crowned at the age of twenty-six. King Henry V had a successful campaign in France, including the Siege of Harfleur and the Battle of Agincourt. [1, 2]

This report will discuss factors that contributed to English success in the Battle of Agincourt such as tactics used, the terrain of the battleground and crowd behaviours. This report will also consider if the longbow and bodkin arrow were the decisive factor in their victory as history claims.

1.1 Siege of Harfleur

In August of 1415, Henry V began his campaign in France when he began besieging Harfleur. The southern coast of England was subject to frequent raids from the Port of Harfleur on the northern coast of France. Taking Harfleur would not only serve as a foothold for King Henry V in his campaign, but it would mean his country was safe from piracy from this French port [3] [4]. Henry arrived with an army of around twelve thousand men: of which nine thousand were archers and around two thousand three hundred were men at arms. The city of Harfleur had a population of around five thousand people with a garrison of two hundred to two hundred and fifty men. The city was protected by four-and-a-half-metre-thick walls, twenty-four towers and water defences.

In September 1415, the French conceded as they could not gain reinforcements. The siege took just over a month, using up more time and resources than King Henry V accounted for. Although this was a victory for the English, King Henry V would lose a substantial amount of his army due to an outbreak of Battle Dysentery. In addition to this, Henry decided to leave a garrison of around twelve hundred soldiers to protect their foothold in Harfleur. [5, 4]



Figure 1 - Siege of Harfleur [6]

1.2 Battle of Agincourt

After their success at Harfleur, Henry V decided that they must gather reinforcements before continuing with his crusade. The English army would begin their march to Calais to meet the fleet and return to England. However, they would be stopped at Agincourt by a large French army [7].

The English army was down to around six thousand archers and one thousand men at arms after the Siege of Harfleur. In contrast, the French had an army of around twelve thousand men - although this value varies across various sources. Of those, there were six thousand men at arms, three thousand archers and three thousand infantry soldiers [4]. From these numbers alone it can be seen that the English army was vastly outnumbered and seemingly at a major disadvantage.

Due to a range of factors that will be discussed throughout this report, the English army was victorious at the Battle of Agincourt. The French lost around five thousand men, compared to a much less significant six-hundred Englishmen lost. This victory paved the way for King Henry V's successful campaign in France, and ultimately his claim to the French throne [8, 9].



Figure 2 - Battle of Agincourt [10]

2. Discussion

2.1 English Strategy

The night before the battle commenced, Agincourt experienced heavy rainfall which meant that the battleground would be marshland. Using this to his advantage, King Henry V set up a defensive line of three divisions of foot soldiers in the middle with small groups of archers on either side. Larger groups of archers flanked either side of the defensive line in a curved formation. In front of the archers, were sharpened stakes driven into the ground to protect themselves from enemy charge and impale enemy horses. In addition to this, the King ordered two hundred archers to take a position in the wooded areas on either side of the battlefield hidden from sight. In comparison, the French had two lines of thousands of foot soldiers with archers and crossbowmen placed between them and knights on horseback taking up the position at the back of the troop [4, 8] (see Figure 3 below).



Figure 3 - Battle of Agincourt, English Strategy [4]

When the French began to advance, King Henry V ordered the hidden archers to loose their arrows. As a result, the French began to attack more aggressively but were slowed down due to the terrain and heavy arrow fire. By the time the French reached the English, they were exhausted from dodging the constant barrage of arrows whilst also slogging through the thick mud. The combination of these gave the English an advantage in battle and was a major contributor to their success. [4, 9, 11]

2.2 Terrain of the Battleground

The terrain was another significant factor in the success of the English at the Battle of Agincourt. The muddy conditions would have created a great suction force that would have impeded the advancing soldiers. It must also be considered that the French were wearing heavy armour which made it nearly impossible to get through (see *Figure 4 below*). The Englishmen knew this would be the case and doffed their armour in favour of wearing their simple cloth coverings. This again, gave the English the advantage as it was much easier for them to move through and pull themselves out of the mud. As well as this, the French defensive line started in a large straight line across a wide part of land at the top of an incline. However, where they met the English on the battlefield was much narrower and at the bottom of a hill. This meant that the French were funnelled into a narrower space for which they had not accounted. The impact of this will be discussed further in 'Crowd Behaviours.' The descent to the front line would have made the muddy conditions much more difficult as they would have been travelling at a much faster pace while being compressed into a tighter formation [12, 11].

It can be said that the terrain of the battleground had a massive impact on the battle that day and was a significant factor in the victory.



Figure 4 - French Armour [13]

2.3 Crowd Behaviours

While conducting research for factors contributing to an English victory at the Battle of Agincourt, this unique but significant factor was highlighted in one of the sources. Using new software and knowledge from crowd disasters that have happened throughout history, engineers were able to simulate how the French army would have reacted to the narrowing battlefield, terrain, and barrage of arrows. Firstly, they looked at how the narrowing battlefield could have affected the French. From where the French front line began to where the English front line stood, there was around a 50% reduction in the area of land. This means that when the French would begin to advance, their front line would continuously compress and eventually thin out to compensate for the lack of room. Adding to this is the factor of muddy terrain, which would cause people to slow down and stumble or fall. The French would have continued pushing forward from the back which would have caused a massive stampede and would have impeded the French before considering English archers or other factors. [12]

Although unique, this factor cannot be discounted and in fact, should be heavily considered in determining what aided the English victory.

2.4 The English Longbow and Bodkin Arrow

The English Longbow, also known as the Welsh Longbow, was a powerful medieval weapon used particularly against the French throughout the 100 Years' War. The longbow was made from the wood of Yew trees. The outside of the longbow was made from the sapwood of the Yew tree. Sapwood is the secondary outer layer of trees that can be found just under the wood. It has elastic properties, making it perfect for the outside of the longbow as it would be quite flexible which allows for the constant movement of draw and loose of an arrow. The inner of the longbow was made from the heartwood of the Yew tree. Heartwood is the inner layer of a tree, which has stronger and more brittle properties. These two properties together make the longbow able to sustain repeated and heavy use but remain flexible enough that it will not snap. It was around 6 to 6.5 feet tall [14] and had a range of up to 300m. It was by no means a precision weapon; however, it was four times faster to reload than other weapons of that time such as the French Crossbow. This meant that it could be used to fire as many arrows as possible at one one-time to create a storm of arrows to rain down on the opposition. It was capable of firing around 8 to 12 arrows per minute, which meant that in the first moments of the Battle of Agincourt, around 55000 arrows would have rained down on the French. [12, 15]

The bodkin arrowhead consisted of a long and tapered point made from iron. Iron was a readily available material at that time and was inexpensive in comparison to other options such as steel. The shape of the bodkin arrow was so that there would be little resistance, performing similarly to a modern-day Long Rod Penetrator with its main purpose to be penetrating

armour. An example of this would be the Armour-Piercing Fin-Stabilised Discarding Sabot (APFSDS) as can be seen in Figure 5 below.

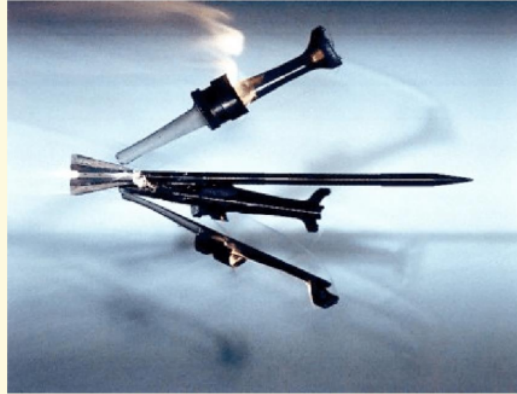


Figure 5 – APFSDS [16]

With modern technology, a study was conducted to see if a bodkin arrow was able to penetrate armour. Used in the study was a plate of 2mm thick mild steel, which would have been similar to that of French armour at the time, and a 36g bodkin arrow at a speed of 37.9 ms^{-1} . When the study was complete, it was found that the bodkin arrow was unable to penetrate the steel and just buckled under pressure (see Figure 6 below).



Figure 6 - Bodkin Arrow [12]

2.4.1 Limiting Penetration Velocity

The conclusion of this study can be further backed up by the application of physics, mathematics, and principles of OME. Using the equation for penetration of a Long Rod (see *equation 1 below*), the velocity required to penetrate the armour of a foot soldier and the armour of a knight can be found. A comparison of these velocities to the velocity of an actual bodkin arrow will tell you if they would have been able to penetrate.

$$V = \left[16.38 \frac{d^3}{W} \left(\frac{p \sec \theta}{d} \right)^{1.12} \right]^{0.5}$$

Equation 1 - Limiting Penetration Velocity

$$\begin{aligned} V &= \text{limiting penetrator velocity (ms}^{-1}\text{)} \\ p &= \text{armour thickness (mm)} \\ d &= \text{penetrator calibre (mm)} \\ \theta &= \text{impact obliquity} \\ W &= \text{projectile weight (kg)} \end{aligned}$$

The following values were taken from the information given in the assignment brief (see *Table 1, Task Description*).

$$\begin{aligned} V &= \text{limiting penetrator velocity (ms}^{-1}\text{)} \\ p &= 2.5 \text{ (standard) and } 4 \text{ (knight) (mm)} \\ d &= 11.11 \text{ (mm)} \\ \theta &= 30^\circ \\ W &= 0.116 \text{ (kg)} \end{aligned}$$

$$\begin{aligned} V &= \left[16.38 \frac{d^3}{W} \left(\frac{p \sec \theta}{d} \right)^{1.12} \right]^{0.5} \\ V &= \left[16.38 \frac{(11.11)^3}{0.116} \left(\frac{(2.5 \sec 30)}{11.11} \right)^{1.12} \right]^{0.5} \end{aligned}$$

$$V = 206.89 \text{ ms}^{-1}$$

Equation 2 - Velocity of Standard Soldier's Armour at an angle of 30° impact obliquity

$$V = \left[16.38 \frac{d^3}{W} \left(\frac{p \sec \theta}{d} \right)^{1.12} \right]^{0.5}$$

$$V = \left[16.38 \frac{(11.11)^3}{0.116} \left(\frac{4 \sec 30}{11.11} \right)^{1.12} \right]^{0.5}$$

$$V = 269.18 \text{ ms}^{-1}$$

Equation 3 - Knights Armour at an angle of 30° impact obliquity

From these equations, it can be said that to penetrate the armour of a foot soldier a minimum velocity of 206.98 ms^{-1} must be achieved. Similarly, a velocity of 269.18 ms^{-1} must be achieved for penetration of a knight's armour. The velocities provided (see Table 1, Table of Figures) show that a bodkin arrow travelled at around 53.34 ms^{-1} , a foot soldier at 0.9 ms^{-1} and a knight on horseback at 8.95 ms^{-1} . These velocities show that an arrow hitting a foot soldier would have been travelling at around 54.24 ms^{-1} and a knight on horseback at around 62.29 ms^{-1} . As shown from the realistic values, they fall much shorter than the velocities needed for penetration. This means that it could not have been possible for the bodkin arrow to penetrate any armour at the Battle of Agincourt.

3. Conclusion

This report aimed to determine if the longbow deserves the accolade of the most decisive factor in the victory at the Battle of Agincourt. From the findings laid out, it cannot be definitively said that it was the most decisive factor. The longbow and bodkin arrow did play a key role in the success. However, the terrain of the battleground, in tandem with English strategy and crowd behaviours, were the more significant factors.

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Battle of Agincourt, Rachel McColm

GRADEMARK REPORT

FINAL GRADE

42/50

GENERAL COMMENTS

Summary:

Rachel, you have clearly listened to this module as you have presented a very strong report, which uses several novel techniques in discussion, as well as maths and OME. Great use of tables, figures and imagery to bring your paragraphs to life. No spelling or grammatical errors either, so a strong piece. My only observation was that your conclusion did not do justice to all the hard work above it. See my detailed comments below.

Detail:

1. A nicely structured report, with good use of coloured paper. Watch for the error bookmark in your table of contents. Always press print (but do not print) before you save as this will always paginate cross references.
2. I liked the way you deferred technical detail to tables, since this facilitated a bang on word count. Well done.
3. For your table of content it is Structure of Paragraphs first, followed by figures, followed by table then equations.
4. Excellent introduction, very brief and accurate. Smashed it!
5. Really good use of imagery to bring your paragraphs to life. Jus the right size with appropriate cross-referencing.
6. I loved the crowd behaviours. This was a very original insight and akin to what occurred when the Scottish beat the English at Bannockburn.

7. Good referencing of old and new technology. Again, novel and interesting.
8. Good visualisation of the metallurgy surrounding the bodkin arrow and armour plate. Maybe not as dramatic as Fig 6 shown given the hardness differences then, but a good analogy.
9. You have used maths, physics and principles of OME to a rogue your case given the limited number of credible references. Again, well done. It adds competency to your report.
10. Is equation 2 caption correct? Do you mean limiting velocity of....
11. Equation 2 correct.
12. Equation 3 correct.
13. Conclusion okay, you could have fleshed this out slightly more. It did not really justify all the hard work above.

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