

Performance of the longbow

by Scott Ling

Submission date: 30-Oct-2022 02:38PM (UTC+0000)

Submission ID: 187689037

File name: 12407_Scott_Ling_Performance_of_the_longbow_451433_75629917.docx (3.27M)

Word count: 3077

Character count: 15245



The performance of the Longbow against plate armour at the Battle of Agincourt.

Scott Ling | Technical Authoring ACDA 6015 | October 2022

Abstract

For the purpose of this assignment the author has been set a task to research the medieval longbow that was used during the Battle of Agincourt. The long bow has been rewarded with the title of the major contributing factor of the English's win over the French. This report will attempt to determine if the long bow does in fact deserve this title or if there are other factors that underpinned the achievement of the English over the French.

Contents

What was the Battle of Agincourt?	2
What is a Medieval longbow?	3
What is a Bodkin Arrow?	4
What is Plate Armour?	4
Group 1	4
Group 2	4
Group 3	5
Angle of Attack vs sloped armour	5
Other Factors that may have helped winning the battle	5
Weather/terrain	5
Strategy	6
OME Experience and knowledge and the technical specification of the delivery system and ordinance	6
Discussion	8
Conclusion	8
Appendix	9
References	16

What was the Battle of Agincourt?

The battle of Agincourt was the decisive battle that happened during the hundred-year war period that actually lasted 116 years from 1337-1453. As a result of this battle, it resulted in the English claiming victory over the French. The English army which was led at the time by King Henry V whom managed to achieve victory over the French Army. Even though the French had far larger numbers within their army.

On the morning of the 25th of October, King Henry stationed his army ready for battle on a recently ploughed field which was enclosed by woods on either side; as seen in Figure 1. Henry had positioned his men-at-arms in the center of the battle field with his archers flanking from either side. The archers were armed with longbows which had an effective range of approximately 250 yards/229 metres.

The terrain overall was stacked in favor of King Henry's army which gave a massive disadvantage to the opposition. The French were exposed by the fact that the battle was taking place between woods on either side, so their advantage of having larger numbers was irrelevant. They would not be able to spread out and they would be forced to be funneled into the battlefield. Illustrations of this can be found in Figure 1 and Figure 2.

The first advancement from the French was the French knights being led by their cavalry to the frontline. The battlefield that the French were advancing to was heavily saturated due to the rain that had fallen prior to this battle. The effects of the muddy field hampered the advancement of the French knights and cavalry. The English had positioned the longbow archers within their attack range. Due to the slow-moving advancement of the French this enabled the English to attack first using the longbows.

Having finally reached the English frontline the French cavalry were faced with the English knights. During this the French had the advantage over the English knights due to being on horseback. This saw the first wave of the battle which demonstrated the French's superiority in the battle.

The French then sent a second wave of soldiers forward which were met with another round of arrows from the English longbow archers. It much harder for the French to mount an attack this time due to the battlefield conditions worsening. With the French army being slowed down and narrowed towards the English line, the archers could lay down their bows and begin fighting hand to hand with their men at arms. The French knights were unable to use their weapons effectively due to being fatigued and disorientated this in turn then swung the battle in favor of the English.

The lighter armoured English soldiers were able to capitalize on this advantage over the French troops and that is what won them the battle. [1] [2]

What is a Medieval longbow?

The medieval longbow enabled the archers to attack from a further distance away from the enemy, by doing this the longbow was able to deliver a much greater force than that of a short bow. The archers were able to deliver their arrows at much quicker rate.

The longbow is usually the same size of the user; however, they can go to the length of approximately 2 metres. With the diameter of the bow being approximately 12 centimeters. The bow would have generally had a gradual narrowing towards the end of the shaft.

A typical bow would be made from yew with the wood being harvested in the winter time. The longbow shaft would be cut from the section of a yew tree where the inside and outside part meet. This would then be left to mature for a few years before they were brought into service. [3]

The longbow would need to be strung, the material that would be used for this could be: sinew, linen or hemp. Animal tendons are used in the make up of sinew, these would hit with a flat stone until the tendons started to separate into individual strands. Once the strands had been separated these would then be wrapped around each other to maximize the strength of the bow string. To hold the string to the shaft of the bow the typical material that was used would have been horn tips. [4]

The draw weight for a bow is the where the archer needs to apply to bow in order for the arrow to fire. The typical draw weight of a longbow ranged from 35 kilograms to seventy kilograms. The smaller the bow the less force is required. The draw length for a long bow is the distance the archer needs to pull the string back before firing. An illustration of the longbow has been provided in Figure 3. [4]

For example, a long bow with a draw length of fifty centimeters would require the archer to exert forty-five kilograms of force.

An Archer would have an arrow placed at the center of the string and would then exert a pulling motion on the string until it reached either their chest or chin, once the arrow was in position the archer would then aim and release the arrow. [3]

The distance the arrow would travel is relative to the size of the arrow head the smaller and streamlined the arrow head was, the further this would travel. The number of arrows that the archer could fire was all done to the skills and experience of said archer.

The performance of the bow would not be uniform across the archer's unit this down to the bows being handmade which means that there would not be a uniform build.

What is a Bodkin Arrow?

A bodkin is a type of arrowhead. A bodkin is a metal point with a variety of lengths. The use of the Bodkin arrow was down to its common design and widely used across a wide span of historical battles. They were predominantly used in battles where chain maille armour or non-metal armours were worn.

During the later stages in they were not used as much due to plate armour taking the lead by the wearers and the arrow struggled to provide fatal whilst wearing the armour plates.

The various types of design of the Bodkin arrow can be seen within Figure 4. Over the years there have been numerous tests and trials carried out looking into the Battle of Agincourt and the longbow. To be able to defeat plate armour the arrow would need to a minimum of 160 joules to penetrate a 2mm armour plate. [5]

What is Plate Armour?

Armor is best described as a protective layer of clothing that has the given ability to deflect or absorb the given impact from a projectile or weapon that is being used against the person wearing the armor. The variabilities of plate armour would come down to how thick the plate was, the material properties of the plate such as the carbon level, steel and the quality of the steel that has been used as well as the hardening and tempering process.

The type of armor worn by the wearer would often denote their social importance or status. The types of armor have three main categories these are as follows:

GROUP 1

- Leather
- Fabric
- Mixed layers of both the above

These types of armour could have had a felt or quilted reinforcement Figure 6 provides and image of fabric armour design.

GROUP 2

- Chain Mail

This would be constructed from rings of either iron or steel. Chain maille has its advantages as it has a very flexible property so the wearer still has maneuverability and is able to withstand numerous attack platforms.

Figure 7 provides an illustration of chain mail armour.

GROUP 3

- Plate Armor

Plate armor was used to protect knights; this was constructed using large plates of either iron or steel and these would be linked to offer the wearer maximum protection but not so tightly that it impeded the wearers' ability.

Figure 8 provides an illustration of what a knight wearing plate armour would look like during a battle. [6] [7]

ANGLE OF ATTACK VS SLOPED ARMOUR

To achieve a dead-on hit would have been highly rare to achieve during the battle. The rigid armour was shaped to be able to deny the enemy attack even at close range; this wouldn't be achievable.

If you change the arrow shot the angle of impact will change. When the arrow is fired into it, it will then have a descending angle. The descending angle is how close the shot is to maximum range.

A high angle of impact will not help with arrow penetration; this will be for the following reasons: energy of motion is the first; the arrow is likely to go along the target rather than going through the target. This means it will glance off the armour rather than penetrate. [6]

The second reason is that a hit at an angle will have to move through the more material rather than a dead-on strike which will effectively make the armour seem thicker. [7] [8]

An illustration can be seen in Figure 9.

Other Factors that may have helped winning the battle

There are other factors to take into consideration that helped towards the English winning the Battle of Agincourt; these are as follows:

WEATHER/TERRAIN

The weather and terrain aided the English's victory over the French during this battle. This was a result of the battle happening on a recently ploughed field that prior to the battle had endured several days of torrential rain which resulted in a muddy quagmire.

These conditions would favor the English army due to the French already being weighed down with their heavy armor. The French knights would be weighed down by the mud that their armor collected when trudging their way into the battle field.

Even if the soldiers made it to the enemy position on the battle field they were completely unorganized and disorientated. A lot of the French army ended up falling before making in to the battle field due to the sheer numbers the French had heading towards the battlefield these men are likely to have died to either crush injuries or suffocation from the muddy terrain.

STRATEGY

The Battle of Agincourt was carried out in a field surround by trees either side. This was an advantage to King Henry due to the lay of the land it meant the large numbers from the French army would be kettled in towards the battle field. King Henry made the first move by sending in his fighters this caused the French to retaliate by sending in their mounted knights.

King Henry had created long spikes to help protect the longbowmen and in turn this helped to disable the French cavalry, with the French cavalry advancing the English longbowmen rained arrows down upon them.

A second charge was carried out by the French but this is said to have been too late due to the lack in numbers of this charge the French were losing control of the horses due to the English longbowman disabling them as the only protection that the horses had was plate armour on their heads so a direct hit from an arrow had the potential to be lethal.

Sending the horses into the battlefield proved costly as this made the muddy battlefield even worse. They would have churned the already poor conditions up for the advancing foot soldiers. Most of the English fighters were not wearing any heavy armour this was a key factor for them as they were more agile and nimble and were able to attack the already tired and struggling French soldiers and by doing this, they were reducing the numbers of the French army.

OME Experience and knowledge.

The author has been provided with predefined technical specification data for the delivery system of the size and weight of the bodkin arrow with the velocity upon impact. In the specification table the specification for the armour that the soldiers would be wearing upon their rank as well as the velocity's have been provided these can be found in the following Figure 10.

The author has experience and knowledge of scientific principles within the OME (Ordnance, Munitions and Explosives) field and has an understanding that the delivery system used during the battle of Agincourt would not be able to achieve the speeds required to perforate the armour that would have been worn during that battle.

The speeds required to perforate the armored plate would need to be in the region of 300ms^{-1} , the longbow delivery system can fire an arrow up to speeds of 225 fps (Feet per second) this equates to approximately 69ms^{-1} these are for modern day arrows.

During the battle of Agincourt, the arrows would have been fired at a lower speed than modern day arrows this was due to the limited materials available to them during this time.

The Author will use the following formula to support the suggestions of the speeds that would need to be achieved for the arrow to penetrate.

$$B = \frac{V \times \sqrt{P}}{K \times \sqrt{D}}$$

The letters in the equation are as follows:

B= Thickness of the Armour

V=Velocity on impact

P=The mass of the projectile

D=The calibre of the projectile

K=Resistance constant

The Author has used the velocity set to try and calculate the depth of penetration of the plate armour using the figure of 53.34ms^{-1} using Krupp's calculation the depth of penetration from the bodkin arrow at that velocity would be 1mm this can be seen in Figure 11.

To be able to achieve a successful perforation of the plate armour worn during the battle of Agincourt the arrow would need to have been fired at a minimum of 300ms^{-1} this can be confirmed by looking at Figure 12 with the results provided by using the Krupp's calculation. [9] [10]

Discussion

The battle of Agincourt is one of the most one-sided victories within medieval history. The French had outnumbered the English however using the strategy and having the longbow men this enabled the English to attack the French advancement from a distance, these attacks would not have been fatal due to the arrows as they were not travelling fast enough to cause fatalities through these means.

The arrows would have provided enough of a distraction to disorientate and cause havoc amongst the French army. The Longbow men would fire their arrows at an angle to the enemy, these would still not prove fatal even with the angle or obliquity.

The performance of the bow would not have a uniform effect due to the following:

- Bow- slight difference in the bow manufacture
- Archer- Different strengths of the archer this could be down to physical properties of the archer,
- Draw of the bow-one archer could have a better draw on the bow than another or the material properties of the bow it could either give an advantage or disadvantage on gaining the distance,
- Arrows- the arrows could be made of different materials depending on what they can acquire or is available at the time of the battle.

Conclusion

In conclusion to the findings of this report it would suggest that yes, the Longbow was the defining weapon of the Battle of Agincourt, however this was not the defining reason on why the battle was won by the English.

The longbow was a contributing factor towards the English winning the war and enabled them to have a chance of a battle as they were out numbered against a strong French army.

The long bow enabled the English longbowman to have a stand off from the advancing French army which offered them protection from close quarter combat.

Ultimately the French thought that they had the battle won due the sheer numbers they had in their army,

Appendix

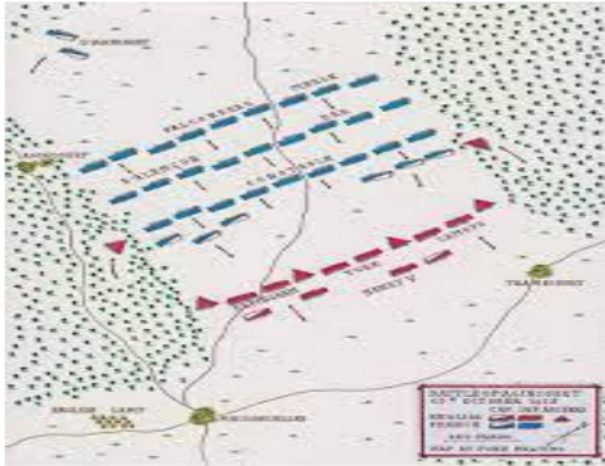


Figure 1 Formation of battle

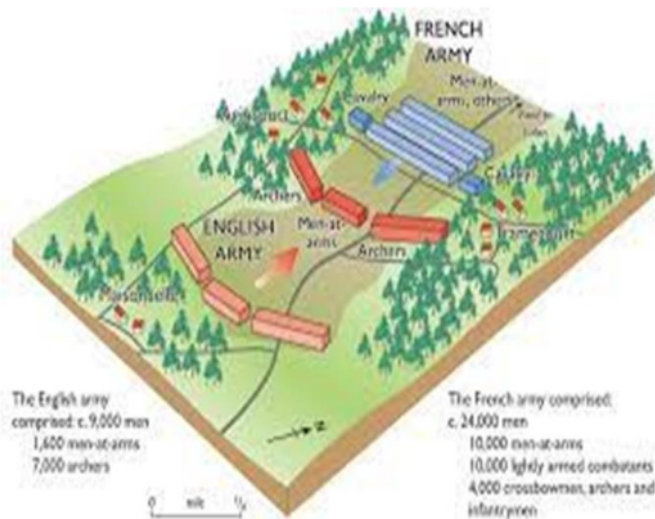


Figure 2 Battlefield schematic

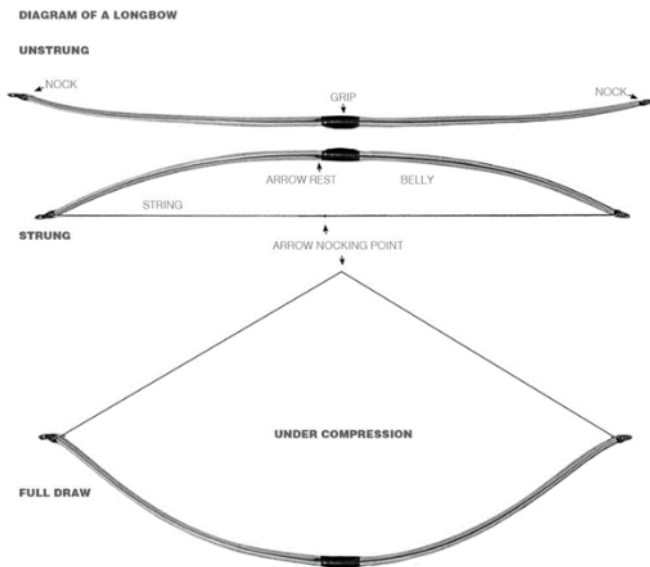


Figure 3 Longbow Design

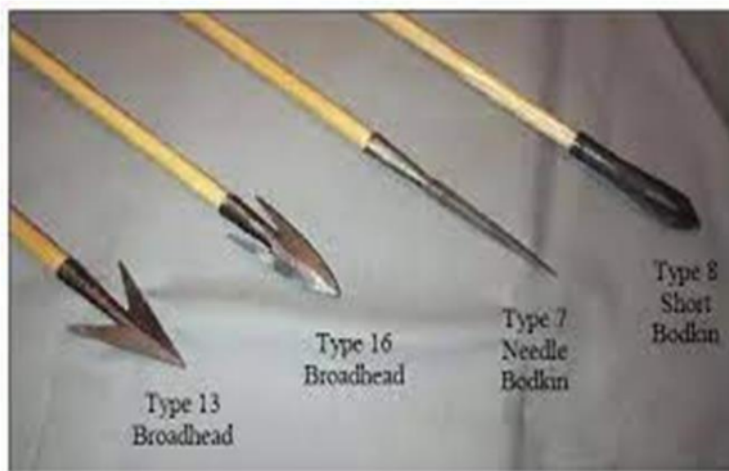


Figure 4 Arrow designs

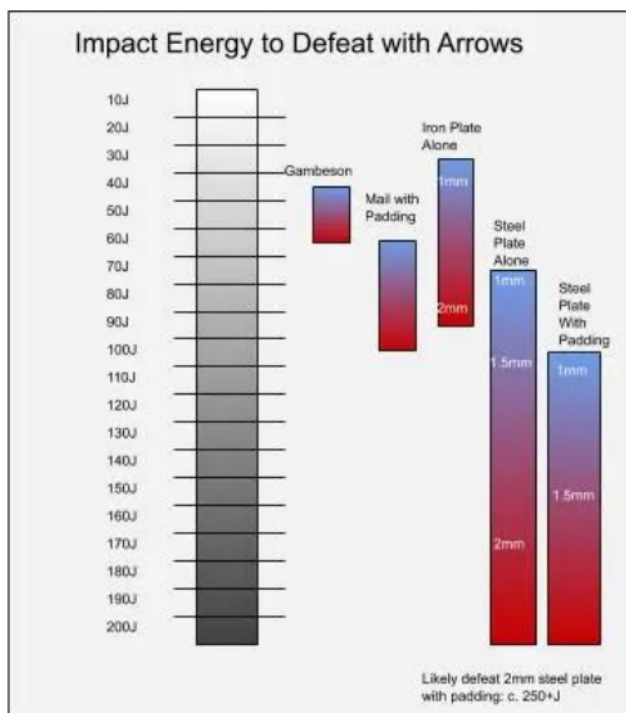


Figure 5 Energy levels required to defeat various types of Armour.



Figure 6 Fabric Armour



Figure 7 Example of chain mail Armour



Figure 8 Example of Plate Armour

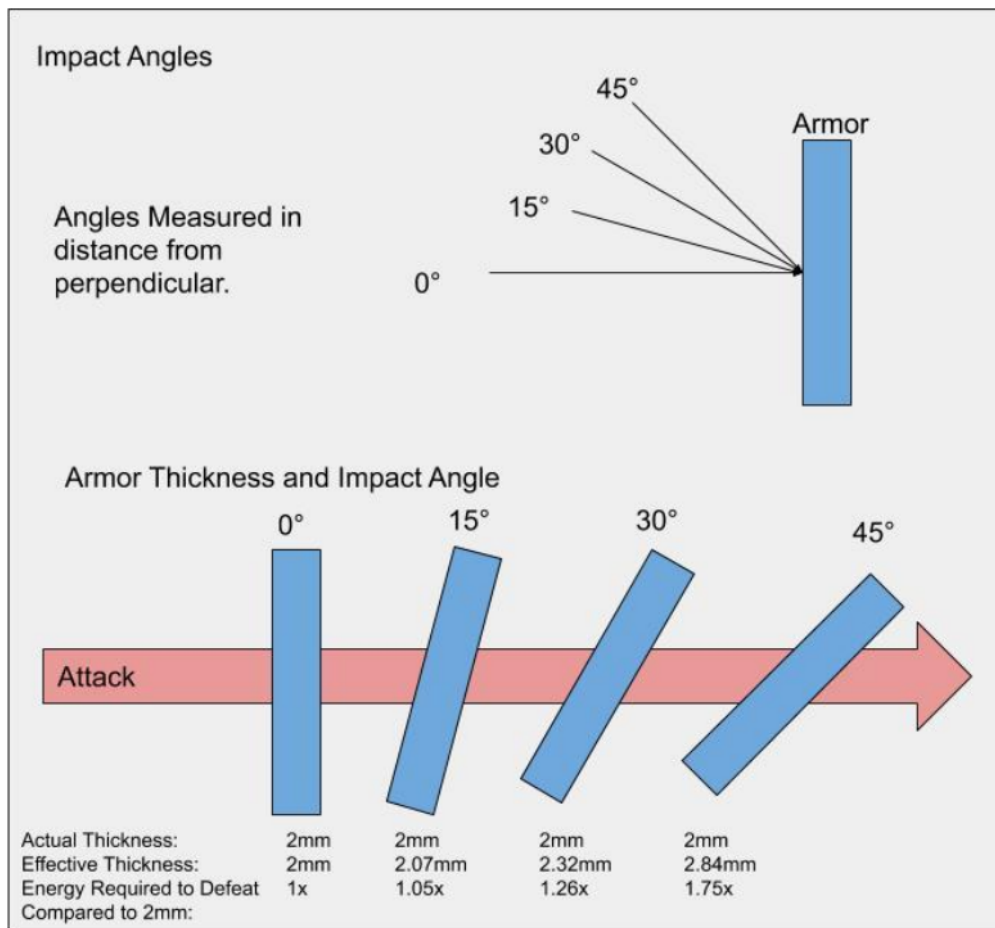


Figure 9 Attack angles

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 0.67 gcm ⁻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)

Figure 10 Design specification for delivery system and ordnance

Penetration Calculator

Use the calculator on this page to estimate penetration for armour piercing projectiles. Read a bit more about the equations and see an example [here](#).

Estimate:	
Caliber	115 mm
Mass	0.116 kg
Velocity	53.34 m/s
Penetration	1 mm
Reference (DeMarre only):	
Caliber	mm
Mass	kg
Velocity	m/s
Penetration	mm
Calculate (Krupp) Calculate (DeMarre)	

Figure 11 Penetration Calculation for Set Velocity

Penetration Calculator

Use the calculator on this page to estimate penetration for armour piercing projectiles. Read a bit more about the equations and see an example [here](#).

Estimate:	
Caliber	115 mm
Mass	0.116 kg
Velocity	300 m/s
Penetration	3 mm

Reference (DeMarre only):	
Caliber	mm
Mass	kg
Velocity	m/s
Penetration	mm

Figure 12 Calculation for the penetration of armour

References

- [1] M. Stretton, Artist, *Testing Arrows against plate armour*. [Art]. 28 january 2016.
- [2] s. archery, "Shire archery," Shire Archery, 2013-2017. [Online]. Available: <https://www.shirearchery.co.uk/shop/arrow-materials/arrowheads/historical-arrowheads/needle-bodkin/>. [Accessed 16 10 2022].
- [3] S. v. Asselin, "Battle of Agincourt," Ati, 2019.
- [4] M. stretton, "Warbow Archery,Tips,Techniques, and seminars," 28 January 2016. [Online]. Available: <http://markstretton.blogspot.com/2016/01/testing-arrows-against-plate-armour.html>. [Accessed 22 october 2022].
- [5] L. Davies, "Why the battle of Agincourt is still important today," The Gaurdian, 2015.
- [6] T. m. ages.Net, "Longbow," the middle ages.net, [Online]. Available: <https://www.themiddleages.net/longbow.html>. [Accessed 23 october 2022].
- [7] O. Archery, "History of the longbow," odinson Archery, [Online]. Available: <https://odinsonarchery.com/history-of-the-longbow/#:~:text=The%20longbow%20was%20invented%20by,4%20years%20for%20best%20results..> [Accessed 22 october 2022].
- [8] Royal armouries, "Longbows of Agincourt," Royal armouries, 2018-2022. [Online]. Available: <https://royalarmouries.org/stories/our-collection/longbows-of-agincourt/>. [Accessed 29 october 2022].
- [9] Tods workshop, "Arrows vs Armour," 2022. [Online]. Available: <https://todsworkshop.com/blogs/blog/arrows-v-s-armour-agincourt-myth-busting>. [Accessed 26 october 2022].
- [10] S. V. Archers, "How Fast can an arrow travel," [Online]. Available: <https://www.soarvalleyarchers.com/>. [Accessed 24 october 2022].

- [11 B. rose, "Can Arrows pnertrate medieval armour?," 29 August 2012. [Online].
] Available: <https://www.benjaminrose.com/post/can-arrows-penetrate-medieval-armor/>. [Accessed 26 october 2022].
- [12 T. Archives, "penetration calculator," Tank Archives, 5 october 2014. [Online].
] Available: <http://www.tankarchives.ca/p/demarre-calculator.html>. [Accessed 27 october 2022].

Performance of the longbow

GRADEMARK REPORT

FINAL GRADE

29/50

GENERAL COMMENTS

Instructor

Word count 3077.

The use of English in some parts of the report could be better, and detracted from the overall presentation. Some of the paragraphs could have been tidied up a little.

Use of American spell checker, not English.

Historical content good, as was the description of the longbow, ordnance and armour.

From the Gestalt perspective, it would have been to enter the figures under the text to achieve the optimum impact. This would be particularly important for the historical reader.

Many of the key aspects you discussed in your presentation are deferred to the Annexes and could have been lifted in to the main report.

So, overall, a reasonable attempt at the technical report but consider delivering the written and visual aspects in logical sequence. This is where you lost the marks.

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

PAGE 11

PAGE 12

PAGE 13

PAGE 14

PAGE 15

PAGE 16

PAGE 17

PAGE 18