

Journal of Physics Special Topics

An undergraduate physics journal

A1_2 Boxing Trees

J. Harrison, N. Carr, A. McCulloch, J. Whitaker

Department of Physics and Astronomy, University of Leicester, Leicester, LE1 7RH

December 15, 2022

Abstract

This paper looks into how a professional boxer could punch a tree down in the style of the video game Minecraft, calculating forces required to do so and comparing them against the main character from the game, Steve. Data from average professional boxers gives a punch force of 5.4×10^6 Pa and this has been used to determine that it takes 5.2 million punches to fell an English Oak Tree, compared to Steves 12 punches. The JANKA hardness test has been used to find the force, pressure and volume per punch removed and it is concluded that a professional boxer would become exhausted before removing a 1m high section of English Oak.

Introduction

The video-game, Minecraft, hit its peak popularity in 2020. However, since being released in 2011, the player usually starts the game by collecting wood. The wood is obtained by punching a tree until a log is released. This paper looks into the reality of a professional boxer being able to destroy a 1 m tall section of tree, how long this would take and the amount of punches required compared to the character Steve from Minecraft.

Theory and Assumptions

The most common type of wood used in Minecraft is Oak. However, as oak refers to a genus of tree instead of a specific species the 'English Oak' tree has been used to construct calculations. The JANKA hardness test is used to collect values on wood hardness [1]. The test involves a small metal ball of diameter 11.28 mm (d) and calculates the force required to insert half of it into the wood. It is assumed that an amount of pressure from a boxers fist could be used to remove the same volume of wood from

a section of tree similarly to the metal ball. For each type of wood there is a different force required to remove a certain volume, for the English Oak Tree this value is 5000 N (F) which can be converted into a pressure of 5×10^7 Pa with the following equation:

$$P = F/\pi(d/2)^2 \quad (1)$$

Also taking into account the diameter of the English Oak with values between 7-97 cm an average can be calculated of 52 cm (d) [2]. The volume of a 1 m high (h) section of the English Oak tree can be calculated using equation for the volume of a cylinder (V)(2):

$$V = \pi(d/2)^2 h \quad (2)$$

Taking into account the fact of 5×10^7 Pa removes half the volume of the small ball, 3.8×10^{-7} m³, this can be scaled and compared to the pressure per punch of the average professional boxer and how much volume of wood would be removed with each punch. The aver-

age punch of a professional boxer at full strength is 5.4×10^6 Pa of pressure [3]. The quickest way to remove the full section of English Oak would be for the boxer to be constantly throwing the full strength punches. However, due to the limitations of the human body there is only a certain limit of punches that can be repeatedly thrown at full strength. Professional boxers are trained to keep within this full strength limit for much longer than the average human, this is up to an average of 65% of time in the ring in what is known as the 'Red Zone' (90% and above, Heart Rate) [4]. There is up to 12, 2 min, rounds in a boxing match with 1 minute rests between each. An upper limit for punches thrown each round is 150. The character you play in Minecraft, Steve, manages to mine a 1 m^3 section of the same English Oak in 3 seconds at a rate of 4 punches per second and fist of area of 0.063 m^2 [5]. I will be comparing a cylindrical section of realistic English Oak against the 1 m^3 section in the game to find out the volume removed per punch of each character. These values can then be equated to give a final result.

Results and Discussion

Taking into account values in the above section a volume 0.214 m^3 of English Oak is needed to be removed for an average English Oak. Each punch of 5.4×10^6 Pa removes $4.1 \times 10^{-8} \text{ m}^3$ resulting in a minimum of 5.2 million punches at maximum strength to remove the entire volume of English Oak. However, if compared to boxing rounds and what the limitations of a professional boxer are, every 3 minutes only 98 punches out of the 150 would be close to full strength. If just these full strength punches were taken into account it would take a professional boxer 53000 rounds and 2660 hours to punch down an average section of English Oak tree. Comparing this to the character of Steve, he manages to destroy a larger 0.083 m^3 volume of English Oak per punch which equates to 1.1 Pa of pressure per punch, equating to a force of almost 700 GN. If a human was to punch with a force of 700 GN it would most certainly destroy their arm almost

completely if not cause more damage to their body entirely.

Conclusion

Overall it is very unlikely a professional boxer would be able to punch down an average Oak tree like in Minecraft as it would simply take too long and would most likely result in the boxer exhausting themselves. This also proves how much stronger Steve is compared to a professional boxer and that if Steve were to punch a human it would certainly kill them with only a single punch. Looking into this for further study it would be recommended to look into the affects of equipping a professional boxer with an item which would reduce the unit area in contact with the tree. Doing this would increase the pressure exerted into the tree causing more damage per unit force. The example of a lumberjack using an axe to cut down a tree is a perfect reason to observe the affects of other tools. The fact that Steve can cut down a tree with just his bare hands gives an example to video games being non-realistic and creations of an individual's imagination.

References

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