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P6_7 Doom Divers

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Abstract

In this paper the feasibility of a catapult launching a goblin in a crude wing-suit used to guide itself to its target is discussed. The forces experienced by the goblin at launch are calculated to be roughly $336g$ for $0.055s$, enough to severely injure them. The maximum range of such a catapult, with the wing's effect taken into account, would be $3km$. It is found that the goblin would not serve any purpose beyond a dumb projectile, rendering the main purpose of the catapult obsolete.

Background

In the tabletop game of *Warhammer Fantasy*, and the surrounding literature, there was a piece of artillery called a *Doom Diver Catapult* which was a large slingshot that would fire small humanoid creatures called *Goblins* named *Doom Divers* [1]. These goblins would strap wings made of leather to themselves such that after being launched into the air they could control their descent to ultimately hit their enemies.



Figure 1: A photograph of the miniature(s), produced by Games Workshop for the game *Warhammer Fantasy*, for the *Doom Diver Catapult* unit [2].

The aim of this paper is to discuss the feasibility

of such a catapult, by calculating the forces involved in the launch and the potential maximum range.

G-Forces of Launch

The goblins are said to reach cloud level, which at their typical lowest extent is around 1000 feet [3], or approximately $300m$. If the assumption is made that goblins are similar in weight and stature to a 10 year old boy, meaning a weight of $30kg$ [4], and thus from inspection of the miniature, seen in Figure 1, the catapult is $5m$ long and at an angle of 25° , it would be possible to calculate the forces experienced by the goblins while being launched, whether they could be survivable, and the maximum distance the goblin could travel.

To find the acceleration the goblins would experience at launch, standard Equations of Motion under uniform acceleration were used. Firstly, using the equation,

$$u_{vert} = \sqrt{2gh - v_{vert}^2}, \quad (1)$$

to find the required vertical velocity to reach cloud level, where u_{vert} is initial vertical velocity.

ity, g is vertical acceleration, h is vertical height reached and v_{vert} is final vertical velocity. Using the height of 300m, vertical acceleration as acceleration due to gravity, $g = 9.81\text{ms}^{-2}$, and a final vertical velocity of 0ms^{-1} , u_{vert} is found to be 76.72ms^{-1} . Next the equation,

$$u = u_{vert} \cdot \sin(\theta), \quad (2)$$

is used to find the total launch velocity u , where θ is the launch angle from the horizontal. u was found to be 181.5ms^{-1} , using the calculated vertical velocity and a launch angle of 25° .

Finally, the launch acceleration a , can be calculated using,

$$a = \frac{u^2 - u_0^2}{2l}, \quad (3)$$

where u_0 is the initial velocity of the goblin and l is the length of catapult. Using $l = 5\text{m}$, and assuming the goblin is at rest before launch ($u_0 = 0\text{ms}^{-1}$), a is found as 3296ms^{-2} which is roughly $336g$.

This acceleration would be over a very short time period, t_{acc} , calculated with,

$$t_{acc} = \frac{2l}{u + u_0}, \quad (4)$$

that gives a time of 0.055s .

Catapult Range

If an equation of the same form as Eq. (4) is used to calculate the time to peak height, with vertical height, $h = 300\text{m}$ in place of l and u_{vert} instead of u_0 and final velocity $v_{vert} = 0$ instead of u , the flight time to peak height is 7.82s . Using,

$$u_{horiz} = \frac{\cos(\theta)}{u}, \quad (5)$$

to calculate the horizontal velocity u_{horiz} , as 164.5ms^{-1} . Multiplying this with the flight time to find the distance travelled horizontally while the goblin climbs to maximum height is 1286m .

The ratio between horizontal travel distance and fall distance of a human wing suit diver is at maximum 5.5:1 [6]. If this assumed to

be the same for the goblin doom diver, then from 300m they would travel around 1650m horizontally. Combined with the distance travelled while reaching 300m , this puts the total range of the catapult at 2936m or roughly 3km .

Conclusion

The highest ever recorded acceleration a human has survived (with very severe injury) was $214g$ [5], that was likely over a similarly short time period to the goblin being launched, as it was the result of a motor-sport accident. Thus, it can be concluded that, unless the goblins are far more resilient than humans to high accelerations, it would not be possible to survive the severe acceleration necessary to reach such a height, given the launch angle of 25° . In the unlikely event the goblin did survive they would be injured such that they would be no better than a simple projectile, even with their leather wings. Therefore, even in spite of the 3km range, the sacrifice of the goblin divers would be in vein as the intended function of this catapult is unfeasible.

References

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