Journal of Physics Special Topics

A1_7 Why Can't Chickens Fly?

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November 19th, 2012

Abstract
This paper investigates whether the size of an object may affect its take-off velocity and therefore whether this could be one of the reasons the modern chicken can't fly in comparison with its flight capable ancestors. The relationship between the take-off speeds of two birds (v_1 and v_2), with one bird being a factor of B greater than the other (where B>1) was found to be $v_2 = v_1\sqrt{B}$. Therefore it may be that the modern chickens are incapable reaching the higher take-off velocity required to lift their larger bodies.

A1 Why Can't Chickens Fly?

Introduction
In recent years it has generally been accepted that chickens are a form of flightless bird. In fact that has only become the case in more modern times. Chickens, or at least their ancestors (commonly thought to be Red Junglefowl[1]), used to be able to take to the skies when needed much more easily than chickens today, even flying hundreds of feet over lakes and rivers[2]. One reason for this is that farmers clip their wings preventing them from escaping. However this paper investigates whether there could be another reason. We have always wanted our food meatier and larger and so will selectively breed our animals and plump them up with unnatural diets and feeding[3]. This is the same for chickens that are bred specifically for their meat. Perhaps this change in size has affected the chickens ability to fly? To answer this question we will be using fluid dynamics to compare how the size of something affects its take-off velocity and then be applying it to birds. We shall make some basic assumptions, such as, we are treating the take-off of a bird similar to that of the take-off of an aerofoil plane. We are modelling the bird as a lifting body.

Theory
Assuming the dimensions of the bird increase by a factor of B times bigger than the original size, where B>1, we shall calculate the respective take-off speed in respect to one another.
Each of the birds dimensions increases by a factor of B;

$$X_2 = BX_1,$$
$$Y_2 = BY_1,$$
$$\text{and } Z_2 = BZ_1.$$

Therefore the volume of the bird increases by the relationship,

$$V_2 \propto B^3 V_1, \quad (1)$$

and the area can be related to

$$A_2 \propto B^2 A_1. \quad (2)$$

Now, using the equation,

$$v = \sqrt{\frac{2Mg}{(m^2-1)\rho A}}, \tag{3}$$

and separating for V_1 and V_2,

$$v_1 = \sqrt{\frac{2M_1 g}{(m^2-1)\rho A_1}} \text{ and} \tag{4}$$

$$v_2 = \sqrt{\frac{2M_2 g}{(m^2-1)\rho A_2}}, \tag{5}$$

we can reach a single equation relating the two. By subbing in Equations (1) and (2) we get

$$v_2 = \sqrt{\frac{2B^3 M_1 g}{(m^2-1)\rho B^2 A_1}}. \tag{6}$$

Mass is a three dimensional value and therefore $M_2 \propto B^3 M_1$, as with the volume in Equation (1). Similarly Area is 2-D and so is related by the B^2. Where v is the take-off velocity, B is the factor of increase as stated previously and g is the gravitational constant (9.81). A is the area, ρ is the density of air and m is the aerofoil constant.

Obviously the B's can cancel to give us the equation

$$v_2 = \sqrt{\frac{2BM_1 g}{(m^2-1)\rho A_1}}. \tag{7}$$

Now by noticing the difference between this equation and Equation (4) we can make our final step, to give us the relationship between the velocities as,

$$v_2 = v_1\sqrt{B}. \tag{8}$$

Conclusion

This shows that the size of the object (in our case the chicken) has a large affect on the take-off velocity required to lift it. This, therefore, may well be a valid reason for why the modern chicken is no longer capable of sustained flight. According to Equation (8) the modern chicken needs to reach a higher take-off velocity than its ancestors did due to its increase in size. It is likely that because no real survival adaptation has been required in the comfort and safety of a chicken farm, the modern chicken has had no need to adjust to these physical changes and therefore is physically incapable of reaching this new take-off velocity. Consequently the modern chicken is usually unable to fly.

References

[1]http://articles.timesofindia.indiatimes.com/2008-08-07/flora-fauna/27923679_1_bird-flu-domestic-birds-poultry-industry - accessed 19th November 2012

[2] http://redjunglefowl.webs.com/significance.htm - accessed 19th November 2012

[3]http://www.chickenindustry.com/cfi/broilerindustryreport/selectivebreeding/ - accessed 19th November 2012