Effect of Seam-Height on Overhand Curveballs

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Abstract

The difference in seam-height between raised and flat-seam baseballs causes them to react differently when thrown by a pitcher. Altering the seam-height on the ball changes the amount of drag force on it as it travels through the air. The goal of this experiment is to investigate this difference in drag that causes the balls to perform differently, and measure their difference in vertical deflection when pitched with curveball topspin.

Introduction

In hopes to restore the lost offensive numbers, the NCAA baseball committee implemented a new flat-seam baseball in 2015 with markedly reduced seam height. The sports research lab at Washington State University and the Rawlings research lab conducted studies that launched both balls out a machine with home run trajectories, and concluded that the decreased drag from flatter seams leads to batted balls traveling greater distances [1]. The goal of this experiment is to see if the change in seam-height will have a noticeable effect on vertical drop of curveball pitches.

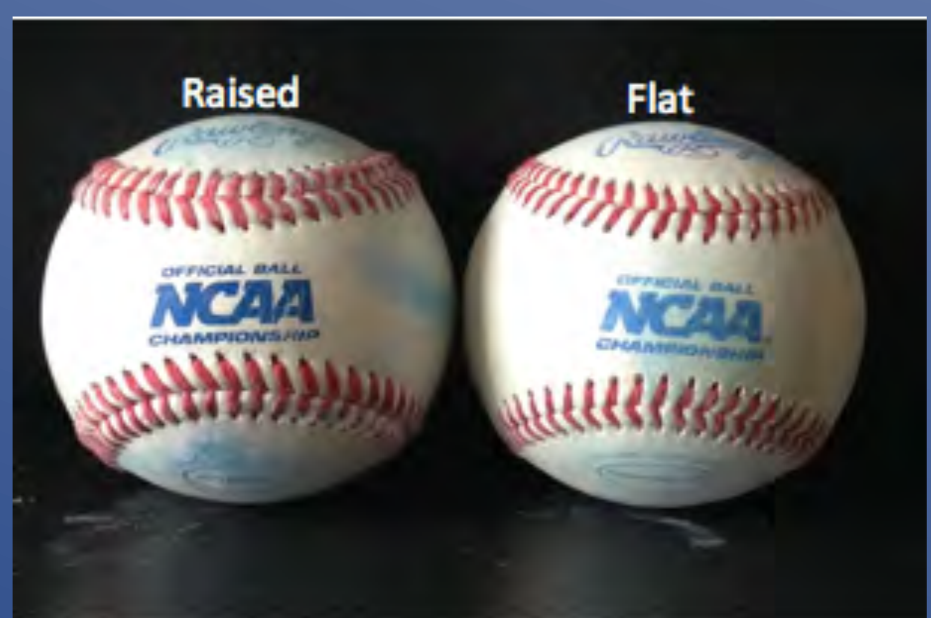


Figure 3.3: Side-by-side comparison of the raised and flat-seam baseballs with seam heights of .048 and .031 inches respectively. Studies done by WSU and Rawlings concluded that flat-seam balls travel greater distances, but there has yet to be a study of their affect on curveballs.

Experimental Method

Figure 3.1: JUGS Curveball Pitching Machine. The top wheel spins faster than the bottom wheel, according to recommended settings in the pitching machine manual, which results in realistic curveballs of any desired velocity [2]

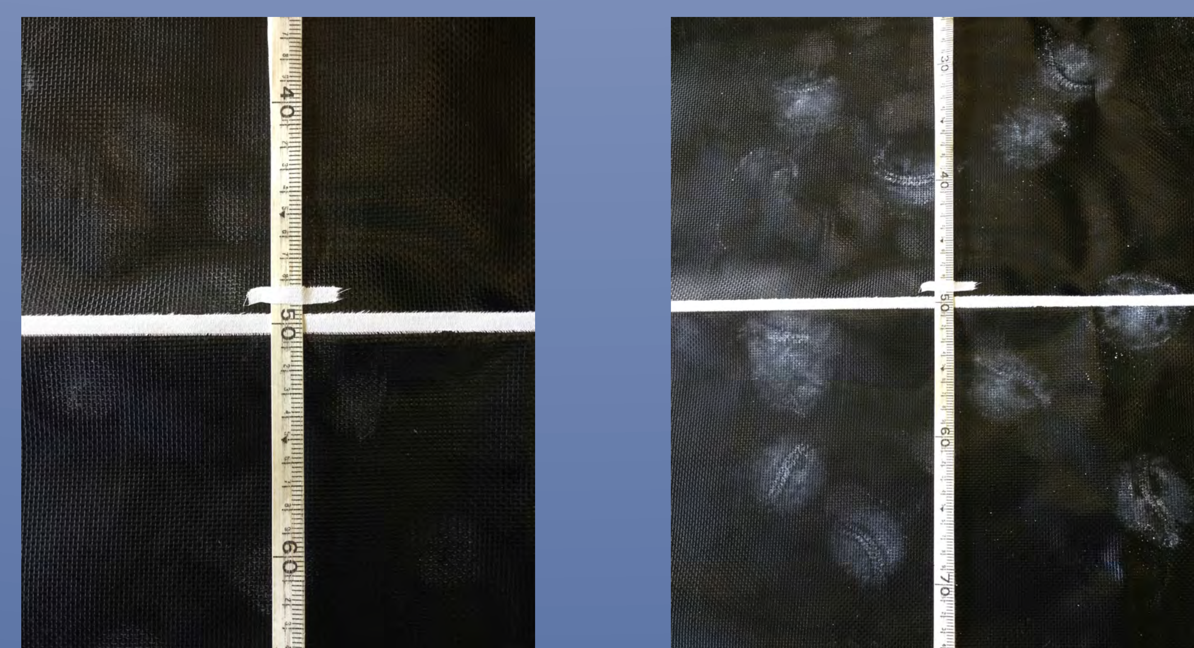
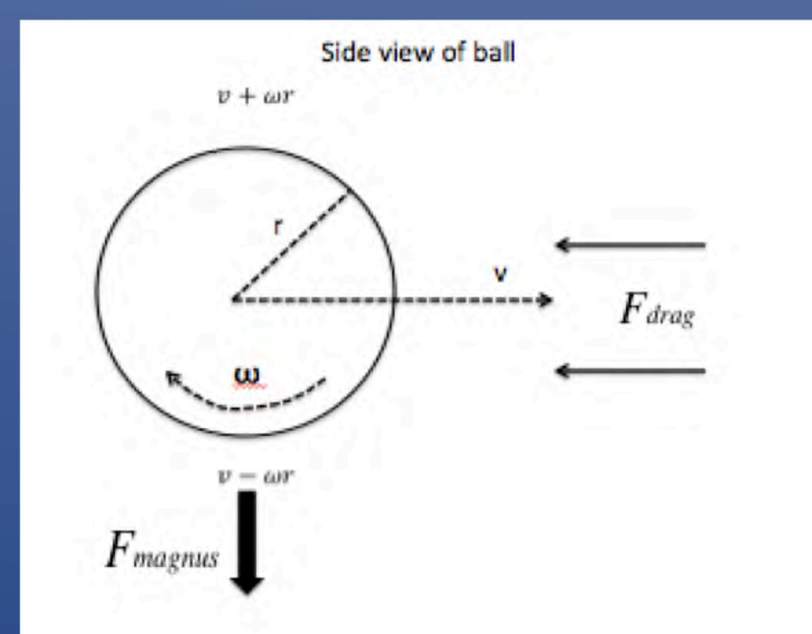


Figure 3.4: Curveball target. Measuring tape was attached to the vinyl target, allowing the impact points of chalk-covered baseballs to be collected. Trials at velocities between 60-80 mph were done for both types of baseballs, and their average impact height for each trial was compared to see the difference in vertical break.

Drag and Spin Forces



$$\frac{dx}{dt} = v_x$$

$$\frac{dv_x}{dt} = -\frac{B_2}{m} v v_x$$

$$\frac{dy}{dt} = v_y$$

$$\frac{dv_y}{dt} = -g - \frac{S_0 v_x \omega}{m}$$

$$F_D = \frac{1}{2} C_D A \rho v^2$$

$$F_M = S_0 \omega v_x$$

Results

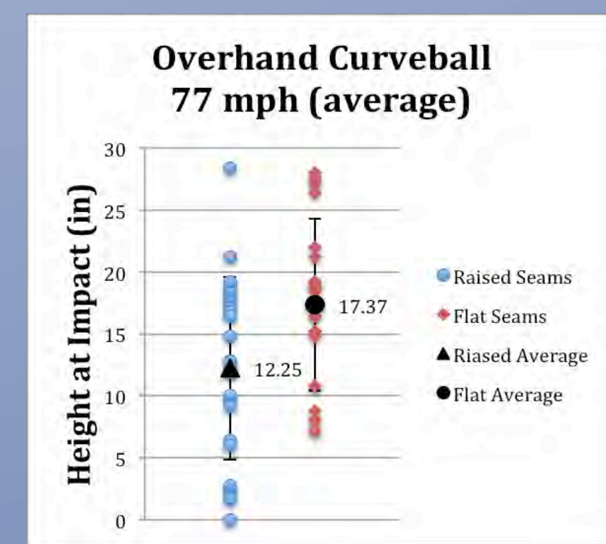


Figure 4.1: Comparing Impact Heights of Raised and Flat-Seam Balls. The raised-seam average is 5.12 inches below the flat-seam average. For both balls, the standard deviation value is greater the difference in their average heights.

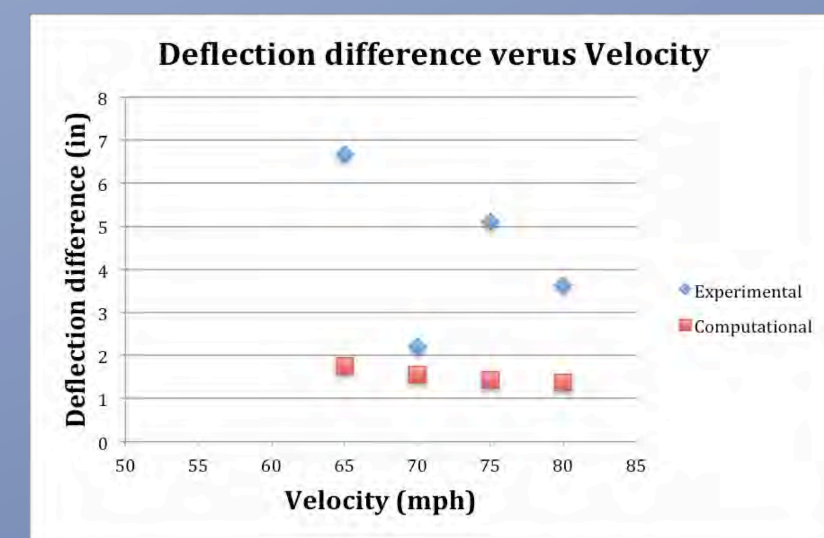


Figure 4.4: Difference in vertical deflection as a function of velocity. 60-80 mph. In each case, the raised-seam ball dropped more than the flat-seam ball, but the difference is smaller in the computational trials. As velocity increases, there is less of a difference between the balls.

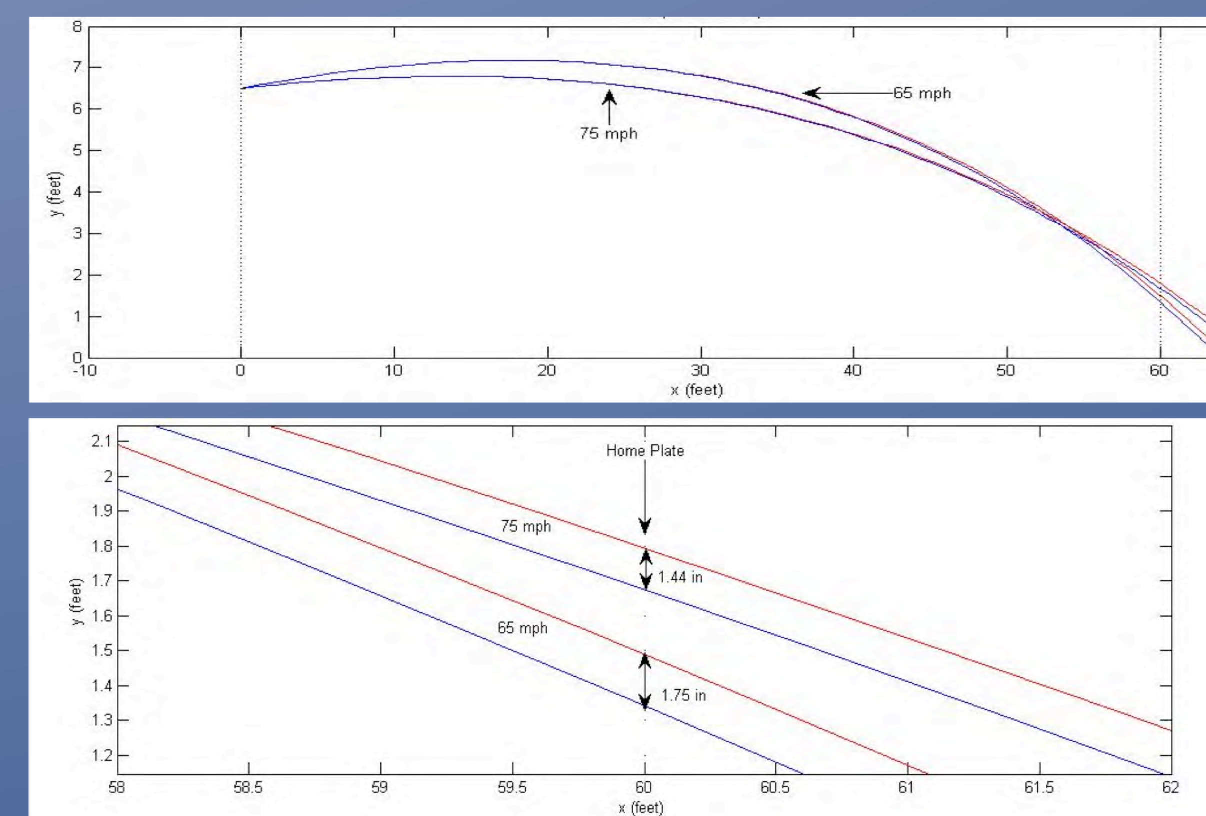


Figure 4.5: Comparing the path of the 65 and 75 mph curveballs. The red line represents the flat-seam ball, and the raised-seam ball is in blue. In order to cross the plate at around the same height at the as the 75 mph pitch, the 65 mph pitch must have a greater initial launch angle. In the slower pitch, the baseball travels a greater distance for a longer amount of time, resulting in a greater difference in vertical deflection between the raised and flat-seam baseballs.

References

1. http://www.baseballamerica.com/college/ncaa-concludes-study-on-ball-seams/
2. https://jugssports.com/Coaches_Corner/various_pdf_files/Machine%20Instruction%20pdfs/curve_instructions.pdf

Acknowledements

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