Bounce and Roll Testing at Philadelphia Cricket Club (Militia Hill Course)

1. Summary

A modified baseball pitching machine was used on Philadelphia Cricket Club's Militia hill course, simulating incoming drives onto the fairway. The total bounce and roll from these impacts were measured along with the inbound speed, angle and spin. As has been observed in other similar experiments, the total bounce and roll is dominated by the angle with which the ball strikes the turf.

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2. Methodology

Bounce and roll testing was conducted at Philadelphia Cricket Club's Militia Hill course. The Militia Hill course is a modern course, opened in 2002. The fairways are bentgrass. A baseball pitching machine, modified to fire golf balls, was used to launch golf balls into the turf at a variety of speeds, spins and angles. The range of launch conditions was intended to cover any range Table 1 shows the design launch conditions.

Table 1 Design Launch Conditions

Test Condition	Angle (deg)	Speed (ft/s)	Spin (RPS)
1	20	100	20
2	20	100	35
3	20	115	35
4	30	85	35

5	30	100	20
6	30	100	35
7	30	100	50
8	40	85	35
9	40	100	20
10	40	100	35
11	40	115	35
12	50	85	35
13	50	100	20
14	50	100	50
15	50	115	50

Each test condition was repeated five times. The actual launch conditions were recorded using a Vector launch monitor mounted at the mouth of the pitching machine. The gross tilt of the pitching machine was recorded using a digital level. Finally, TruFirm readings of the fairways were recorded.

The fairway landing zone was tested for holes 17 and 18. These adjacent holes had reasonably level landing areas and ran in opposite directions.

It should be noted for future testing that the Vector launch monitor was prone to spurious readings, especially for spin and often missed shots. It is recommended that the GC2 monitor be explored as a possible improvement to the test setup.

3. Results

3.1. Sensitivity of Bounce and Roll to Angle

As has been seen in previous testing, the inbound angle is by far the most significant predictor of bounce and roll. Figure 1 shows the bounce and roll as a function of inbound angle for the two holes tested.

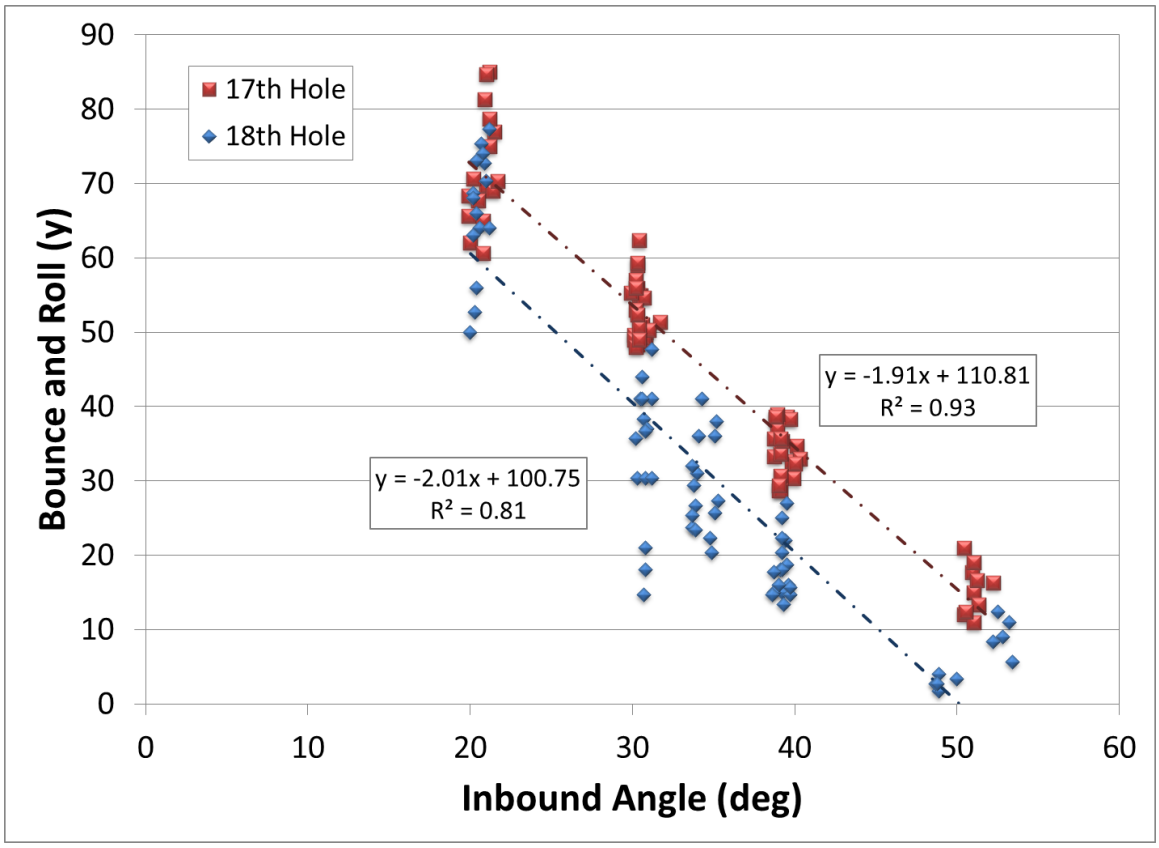

Figure 1 Bounce and roll as a function of angle

It can be seen in Figure 1 that the inbound angle was a very strong predictor of the total bounce and roll. It can also be seen that there is a significant difference between the two fairways with the 17th hole averaging nearly 15 yards longer bounce and roll. There was a significant difference in the TruFirm readings for the two holes:

17th = 0.375" ±0.006"

18th = 0.454" ±0.017"

The 17th hole also ran slightly downhill.

Interestingly, it can also be seen in Figure 1 that the 17th and 18th holes had very similar sensitivity of bounce and roll to angle at 1.91 and 2.01 yards per degree of angle respectively. Other, non-linear functions of angle (sine, squared and square root) were correlated to the bounce and roll but they were not significantly better than the linear fit.

3.2. Influence of Other Parameters

Even though the bounce and roll is most significantly predicted by the inbound angle, it is also affected by the other parameters such as inbound speed and spin. The bounce and roll was predicted well using the inbound angle, speed and spin as well as the hole number (17 or 18). The best fit linear regression equation was:

$$d_{br} = 314 - 1.82\theta + 0.28V - 0.22\omega - 13.4H \quad (3.1)$$

where d_{br} is the bounce and roll distance (in feet), θ, V and ω are the inbound angle (in degrees), velocity (ft/s) and spin (in RPS). Figure 2 shows the bounce and roll predicted by Eq. 3.1 and the measured bounce and roll.

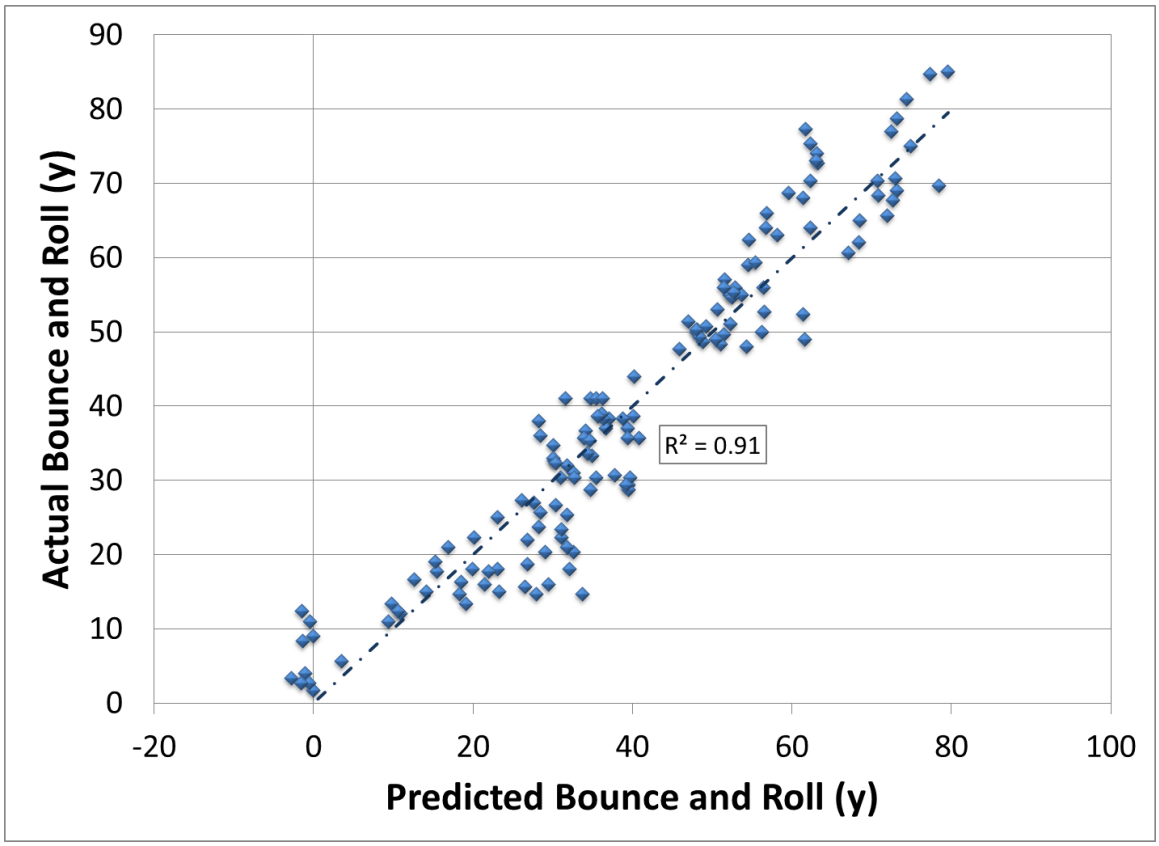

Figure 2 Predicted and measured bounce and roll

Other combinations of the measured inbound conditions were also tried in an effort to better predict the measured bounce and roll without success.

Appendix A – List of Figures

Appendix B – List of Tables