CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

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Project Number

36262

Project Title

Rolling Resistance: Effects of Natural vs. Artificial Turf and High vs. Low Inflation on Rolling Soccer Balls

Abstract

Objectives/Goals

Soccer balls appear to move faster and further on artificial turf surfaces than on natural grass fields. Inflation seems to affect how far and fast balls go. This experiment is designed to test the effects of different playing surfaces and air pressures on ball movement.

Methods/Materials

Soccer balls with different pressures were rolled off of an incline plane onto natural grass and artificial turf surfaces to determine the effect of surface type and ball pressure on the distance the ball travels. Balls with different inflation pressures also were struck by a device to apply equal "kick" force to determine the effect on rolling distance.

Materials included: 2 soccer balls (zero and high inflation); Ramp (wood and stand); Striking Device (wood and stand); Measuring Tape; Notebook; 2 grass and 2 artificial turf fields.

Results

The highly inflated ball consistently rolled further than the deflated ball on both artificial and natural turf surfaces. It ranged from 7% to 14% further on each different surface, and 11% on average across all surfaces combined. The balls released from the ramp consistently rolled further on artificial surfaces than on the natural grass surfaces. On average, the balls went 25% further on artificial surfaces. When struck (rather than being released on the ramp), the inflated ball went 52% further than the deflated ball. Comparing the "kick" to the non-impact force of gravity, the inflated ball went virtually the same distance. The deflated ball went 33% further with the ramp release than when struck. The distance rolled is a way to compare how much energy is transferred to the ball to make it move and the rolling resistance to the ball's forward motion.

Conclusions/Discussion

The data confirmed the hypothesis: balls roll further on artificial turf than on natural turf surfaces, and balls with high inflation roll further than un-inflated balls. The difference in distance was less than expected for balls from the ramp. The difference in rolling distance between inflated and un-inflated balls was greater for the kicked balls. This is because rolling resistance is greater on the natural surface, and energy went into deforming the kicked ball instead of into rolling momentum.

Summary Statement

This project is about some of the physical forces (rolling resistance, air pressure and elastic/inelastic collisions, conservation of energy) that affect the motion of a soccer ball.

Help Received

My dad helped me build (power tools) and move the equipment, and we talked about physics. One of us released the ball on the ramp and the other one measured the distance it rolled.