Basketball Surfaces and Coefficient of Restitution

Kristyn Peacock and Faith Pearson

International School Bangkok,
39/7 Samakee Rd, Pakkret,
Nonthaburi, 11120, Thailand
Email: faithmpearson@gmail.com

Abstract

A basketball was released from varying drop heights to simulate the impact speeds of a typical soft, medium, and hard dribble. This was repeated across four different surfaces that students typically play on – exposed aggregate concrete, maple wood flooring, EPI Outdoor Sport flooring, and playground rubber mesh. From the measured drop and bounce heights, the coefficient of restitution (COR) was calculated. It was concluded that only playground rubber mesh had COR's below the regulation range, with the other three surfaces having COR's within regulation.

***Keywords*:** basketball, court surface, coefficient of restitution

I. INTRODUCTION

Basketball is played on a variety of surfaces. Playing on different surfaces require the players to adjust their play – namely dribbling – accordingly. The purpose of this paper is to calculate the coefficient of restitution (COR) for a variety of surfaces found in typical schools for a range of dribbling speeds. The material of the surface is pertinent because all surfaces vary in elasticity, and elasticity corresponds to how well the ball bounces. The COR is a constant that represents how an object bounces on a surface. The COR is defined as,

$$COR = \sqrt{\frac{h}{H}} \qquad (1)$$

where H is the drop height and h is the bounce height[1].

Official basketball regulations specify that when the ball is "dropped onto the playing floor from a height of approximately 1,800 mm measured from the bottom of the ball," it will rebound to a height of "between 1,200 mm and 1,400 mm."[2] This corresponds to a COR ranging from 0.82-0.88. Regarding the court surface, the regulation states that the material should be made of "standard material", which can include synthetic or natural hardwood surfaces. Accepted playing surfaces are given as "wooden flooring, mobile wooden flooring, mobile synthetic flooring, and permanent synthetic flooring". [2] The surfaces investigated in this paper are shown in Figure 1. The COR was determined for each of these surfaces for a range of impact speeds typically experienced during dribbling in basketball play.

Figure 1. (Clockwise from upper left): Exposed aggregate concrete, maple wood, EPI Outdoor Sport flooring, playground rubber mesh.

II. METHODS

A Women's 28.5-inch basketball was inflated to regulation pressure. To simulate the range of dribbling impact speeds typically found during play, a varsity basketball player simulated a soft dribble. The ball was then left to bounce freely after a single dribble, and the bounce height was measured. The basketball was then dropped from a height such that it replicated the bounce height of the gentle dribble.

The same method was used to determine the drop height needed to replicate the impact speed of a medium and hard dribble. The drop heights used were approximately 0.75 m simulating the gentle dribble, 1.05 m for the medium dribble and 1.35 m for the hard dribble. The drop and bounce heights were determined and the coefficient of restitution calculated for the four surfaces and the three dribble types.

III. RESULTS & DISCUSSION

Figure 2 shows the coefficient of restitutions for the different dribble speeds for each of the surfaces. The shaded horizontal band shows the regulation range of COR. Of the four surfaces, rubber mesh was the only surface that did not have a COR within the official range for basketball.

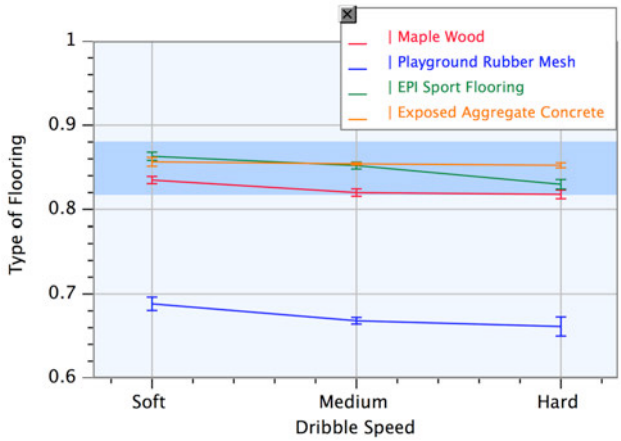

Figure 2. Coefficient of restitution for the four surfaces for each of the dribble speeds tested.

From Figure 2, it is clear that the playground rubber mesh had a COR significantly below the other three surfaces, and well below the regulation range. Students playing on this surface would need to dribble much harder while playing. The other three surfaces all had COR's within the regulation range, with the exposed aggregate concrete having the highest average COR for all the dribble types. While the EPI Sport flooring and exposed aggregate concrete had similar COR's, the Sport flooring's COR decreased noticeably as the dribble speed increased, while exposed aggregate concrete stayed relatively constant. The maple flooring was the lowest of these three surfaces, but remained within regulation COR. Even though aggregate finish concrete had COR's within regulation, it is understandable why FIBA advocates "standard materials" such as maple wood and synthetic material[2] and not aggregate finish concrete, as falling on this surface can result in serious injury. FIBA's standard materials optimize both the safety of players and the quality of the sport.

IV. CONCLUSION

The Coefficient of Restitution was investigated by measuring the bounce of a basketball on different surfaces in simulated basketball game scenarios. It was found that three of the surfaces had COR's within regulation, with only playground rubber mesh being below the regulation range. Exposed aggregate finish concrete had the highest COR, but the most ideal surfaces to play on would be EPI Sport flooring and maple wood flooring due to safety concerns.

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