RockBats
Technical Note
RB-TN-002

September, 2006

Detection of the Baseball Bat Sweet Spot through Vibration Testing

When a solid-wood bat collides with a baseball, this induces flexural vibrations along the whole length of the bat, analogous to the vibrations seen in a diving board after the diver has jumped. The largest flex (and stress) occurs in the handle and smaller tapered regions of the bat. For the batter, the severity of the vibrations felt in the grip (2), depends on where the ball makes contact on the barrel (1), as shown in the graphic to the right. Contact on the end of the barrel, or in the handle, results in the greatest flexural vibrations. There is a small region on the barrel that when contact is made with a baseball at this location, results in the smallest induced vibration in the batters' grip. This region is commonly referred to as the "sweet spot". There are many definitions of "sweet spot", and what is described here is the vibration form that results when a node of vibration coincides with the batters' grip (2**)**. Because solid-wood bats vary due to the density and stiffness of the wood, the location of this "sweet spot" varies from bat to bat. In other words, no two solid-wood bats are alike.

An experiment was carried out by RockBats to determine the vibration response between two identically-shaped bats, having two different densities. We selected two 33" model RB bats; one weighed 32.3 ounces and one weighed 29.5 ounces. We attached sensors to the handle while contact was made along the barrel at 1-inch increments, from the tip of the barrel to the handle. Figure 1 shows the vibration test results for the heavier 32.3 oz. bat, and Figure 2 shows the results for the lighter 29.5 oz. bat. The individual peaks represent the vibration response for each individual impact made on the barrel, and all of the individual responses at the handle were plotted sequentially on one graph.

Note that each impact is represented by a large spike, and then followed by a secondary vibration. The large spike represents what is commonly referred to as "crack of the bat", and is the high-pitched sound that the bat makes when it contacts the baseball. The secondary vibration is the induced vibration in the bat after the baseball makes contact. It is the secondary vibration that is felt in the batters' grip, and most often causes breakage in baseball bats.

The important features in both Figures 1 and 2 are that there are two vibration trends seen in this series of tests along the bat length. The secondary vibration peaks, represented by the dashed line, come to a minimum at the sweet spot location that is determined on all RockBats. The "sweet spot" that is marked on our RockBats corresponds to the contact point that produces the least vibration in the batters' grip. Another vibration trend observed is the "crack of the bat" peaks, which is represented by the solid line. The solid line comes to a minimum approximately 2-inches away from the RockBats sweet spot, toward the end of the barrel. The region between these two low points is commonly referred to as a "sweet spot zone". Therefore, when using a RockBat and evaluating the ball marks on the barrel, the best hits should arise when contact is made in the 2- to 3-inch wide "sweet spot zone", which is occupied entirely by the RockBats logo, plus approximately 1 extra inch towards the barrel.

Another important observation is the difference in magnitude of the secondary vibration peaks. Lightweight bats have much greater vibration response than heavy bats, which results in higher likelihood of breakage. Figure 1 shows that dashed line is below 0.05 for approximately plus or minus 2 to 3 inches from the sweet spot in the heavy bat, whereas the lightweight bat stays below the dashed line for approximately plus or minus 1 inch from the sweet spot (Figure 2). What this means is that heavier bats have a larger noticeable sweet spot compared to lightweight bats.

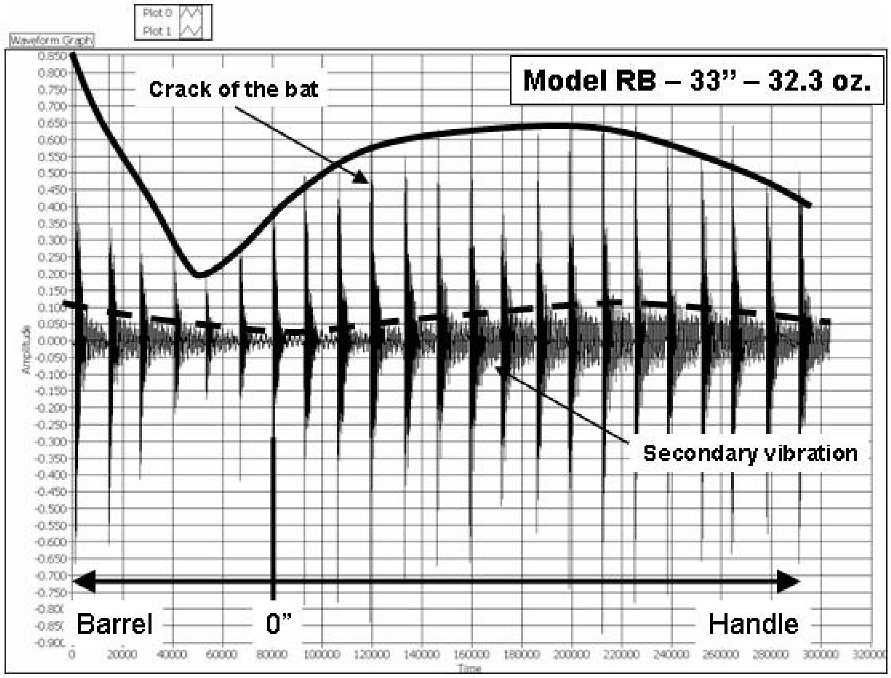

Figure 1. Vibration test results for 32.3 oz. RockBat (Heavy bat).
Vibration measured 6-inches from the end of the knob, and impact made at 1-inch increments along the barrel

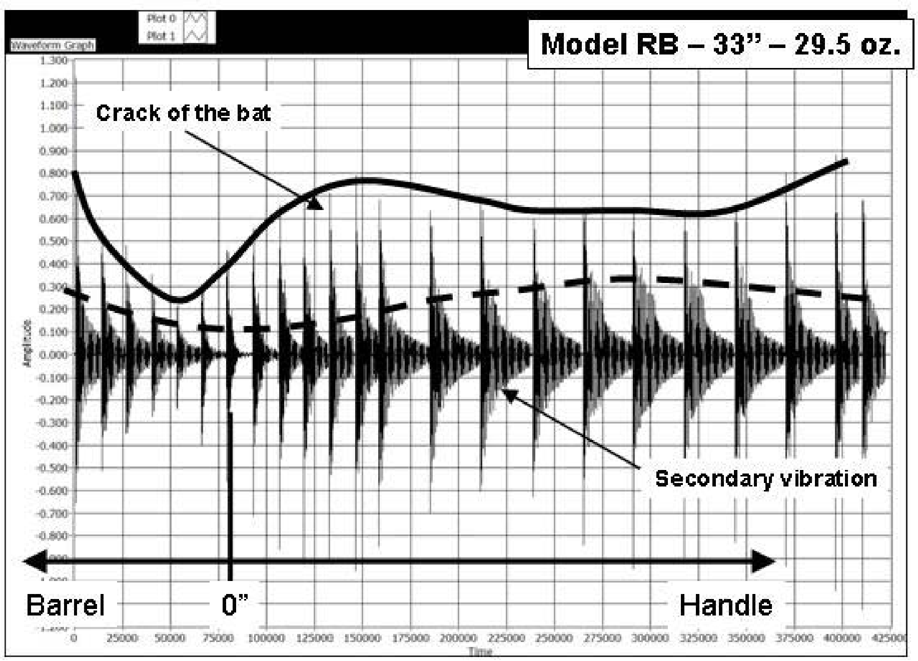

Figure 2. Vibration test results for 29.5 oz. RockBat (Lightweight bat).
Vibration measured 6-inches from the end of the knob, and impact made at 1-inch increments along the barrel