An Analysis of Board Breaking:
Which side of the board should I hold towards the boardbreaker?

by
Jon Friedl
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At the 1999 Leadership Seminar hosted by Voorhees Taekwondo, Inc., I was asked to write up an analysis of the physics of board breaking by Master Larry Voorhees and Master Jennifer Emery. Specifically, the question was , “To break a board, which side of the board is it better to strike due to the alignment of the grain in the wood?” It has been assumed that the board does not contain “knots”.

There are two basic wood grain alignments of a board used for board breaks. The following figures are edge-on views of boards with the grain lines shown. Figure 1 represents a board cut from the center of a tree, where the grains are such that one face is the mirror image of the other. The amount of force needed to break the board by striking the top face would be the same amount of force needed to break it by striking the bottom face.

Figure 1

The second kind of wood grain alignment is shown in Figure 2. This board has been cut slightly off-center from the center of a tree. The top edge is closer to the center of the tree than the bottom edge. Once we accept that either side of the board in Figure 1 can be broken with the same amount of force, then intuition tells us that the board shown in Figure 2 requires more force on one side of the board than the other to break it. The question is, which side of the board do we strike if we want to use the least amount of force needed to break it?

Figure 2

The answer is as follows: Striking the top face of the board as it is shown Figure 2 will cause the board to break more readily than striking the bottom face of the board. But, why? Of course, the pattern of the wood grain on the upper face is different from the pattern on the bottom face of the board. Since this is the only difference between the two faces, this must somehow explain the difference in the force needed to break the board depending on the side struck.

Imagine a board with a grain alignment like that shown in Figure 2. It is being held on the edges by a boardholder. On the other side of the board, someone is just beginning to strike it. Analytically, what is happening? There are three forces acting on the board. Two of the forces are from the boardholder pushing back against the board along the edges

(one force for each arm) and one is from the boardbreaker who is pushing against the board in, hopefully, the center. What happens to the board, before it breaks, as a result of these forces? Before it breaks (if it breaks), the board bends.

The curve of the upper and lower faces of the board caused by bending leads to an interesting effect. Imagine bending something more flexible than a wooden board, such as a thick sheet of plastic or a large sheet of plywood. What happens on the inner surface of the flexible material as it is bent? What happens on the outer surface of the flexible surface when it is bent? The inner curved surface develops wrinkles. The outer curved surface stretches. Once the outer surface is allowed the relax, it may have been stretched so much that it now has wrinkles in it.

In the case of the board, the grains on the side being strike are compressed or, in other words, being squeezed together. The grains on the other side, the side with the boardholder, are under tension or, in other words, being pulled apart.

Now, we do this to a board with a grain alignment as shown in Figure 2. Take the grains on the top face as being squeezed together while the grains on the lower face are being pulled apart (i.e., boardbreaker above and boardholder below). When we do this, the grains themselves bend as the wood is being bent. If fact, the grains appear to become straighter. The grain alignment shown in Figure 2 becomes more like the grain alignment shown in Figure 1 when the top edge is struck in the center by a boardbreaker while the bottom edge is being held at the edges by a boardholder. As a result, a broad with a grain alignment as shown in Figure 2 becomes easier to break the more that it bends. (This is, in fact, a good argument for follow-thru when breaking.)

If a broadbreaker attempts to break a board with a grain alignment as shown in Figure 2 *from the bottom side* while a boardholder is holding the board from the top side, then the grains become *less like* those in Figure 1. Visually, the grains become more horizontal rather than more vertical. In this configuration, the more the board bends, the more difficult it is to break. Imagine trying to break a board where the plane of the grains run parallel to the faces of the board. This configuration corresponds, of course, to the hardest kind of board to break in terms of grain alignment.