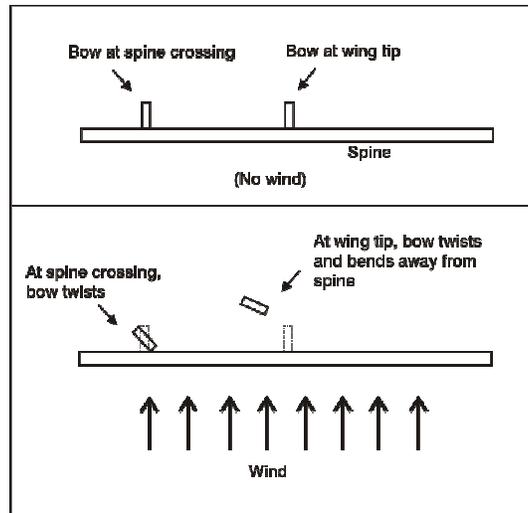


Experimenting with a flat carbon bow in a fighter kite.
Scott Bogue 10/1/06

After the strong wind we experienced in the 2006 World Cup, I decided I needed a better kite for those conditions. I find that, with an 0.05" bow, a kite stiff enough for strong wind is too small to easily control. On the other hand, a strong wind kite with an 0.06" bow is so big that it pulls really hard (which I don't like). Two possible solutions to the problem are to add vents to a larger kite with an 0.06" bow (to reduce the pull) or to find a bow that is somewhere in between 0.05" and 0.06" in stiffness. I have also been wondering if there is an easy way to make a carbon fiber bow that acts more like a tapered bamboo bow – stiff in the center and softer out by the wing tips.

Looking for such a bow, I recently tried making a kite with a flat-carbon bow using piece of "small" flat carbon. (Note: In this account, a "small" piece of flat carbon -- i.e., carbon fiber rod with a rectangular cross section -- means one that is .034" x .121". A "big" piece is .040" x .121". These are the two sizes I have around for making spines.). Because of its rectangular cross-section, flat carbon pieces can bend easily in one direction but hardly at all in the other direction. In its easy-bending direction, small flat carbon feels (to me) very similar to 0.05" rod in stiffness. It is of course very stiff in the other direction.

After making the kite, I tried to see how the flat carbon bow would bend by flexing the wingtips, flapping it in the air, and other half-baked procedures. I assumed that as the wind pushed on the sail, it would try to make the bow bend in the hard direction and so the bow would act very stiff. Wrong! What happens instead is that as the load on the sail increases, the carbon (especially out at the wing tips) twists so that it can bend the way it wants to – in its easy direction. When the sail is heavily loaded the bow, where it crosses the spine, tilts forward (toward the nose) and goes from being perpendicular to the spine to being more like 45 degrees. Out at wing tips it gets twisted close to 90 degrees so the flat direction is nearly parallel to the spine.. Because of this twisting, the part away from the spine easily bends, sort of like a soft 0.05" round bow. I have tried to illustrate what happens in the side-view cartoon below:

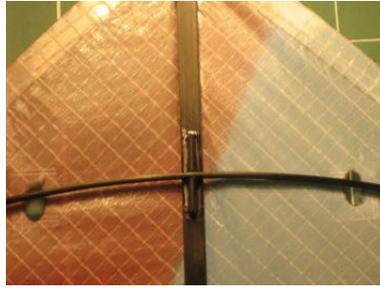


Because of this twisting, the flat bow did not feel much stiffer to me than an 0.05” bow. The next thing to do was to find a way to stop the twisting. What I did is cut a short (1/2”) length of big flat carbon. Then, using the little cutting disc on my cordless Dremel tool, I cut a slot almost all the way through the piece. I also ground the bottom edge of the piece flat (for gluing) and rounded off the top corners. The photo below shows what the little piece looks like. It took about a minute to make it. The slot on this one isn’t particularly straight!



Next, I glued this piece onto the spine where the flat carbon bow crosses. The bow fits into the slot, and I dropped some more glue in to keep it there. The next two photos shows what this all looks like.





The bow can no longer twist forward where it crosses the spine. The effect of this is to make the central section of the bow act very stiff (in the direction of the wind stress that is pushing on it.) Away from spine crossing, the bow will still twist so that it bends more easily (in the direction of the wind stress). So, the bow is now kind of acting like a tapered bamboo spine which is stiff in its center and more flexible out near the tips (in the bending direction that matters)! I know that Bruce, Manny, and others have experimented with other ways of making a carbon fiber bow act this way (e.g., by attaching thinner rod tips to the ends of a 0.06" bow using shrink-fit tubing or Manny's cool little drilling guide thingy).

Notes:

- 1) Once the kite is bridled and flying, the yoke will actually be pulling the bow and the little stiffener onto the spine – helping the glue due its job of keeping the stiffener fast against the spine. Or so I hope.
- 2) To make the bow a little softer, it would be interesting to cut a triangular notch (instead of a slot) into the little cross-piece so that the central part of the bow can rotate forward a small amount.
- 3) I haven't flown this kite yet, so don't really know what is going to happen!