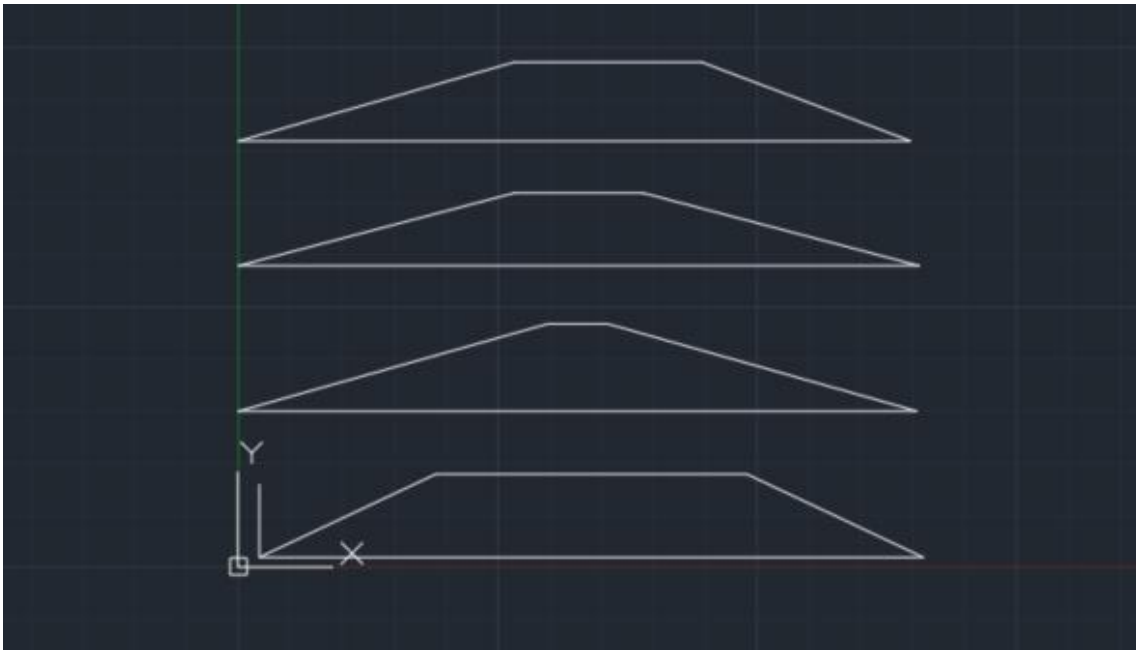
The Sail Piece

What is the sail piece? What does it do? What are the basic “Styles or family”?

The sail piece is a trapezoidal shaped piece of material used in the construction of competion pole vault poles. In the diagram below the right side is at the bottom of the pole and the left end goes towards the top or handle of the pole.

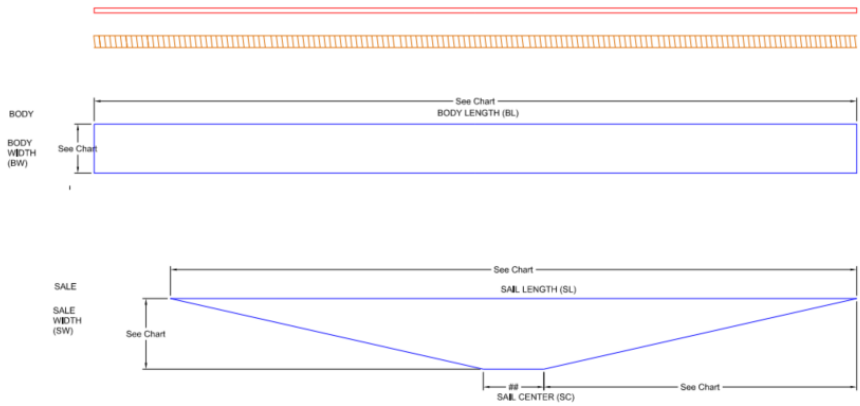


More information can be found at:
www.decamouse.com/sitebuildercontent/sitebuilderfiles/polepaper20110127.pdf

That document was written in 2011 – most information still holds true – the Skypole line has been discontinued by Gill

Comments directly below pertain to the sail patterns above (examples of 15’ (460) pole). Since the sail is one portion of the pole – it is the complete composite of all the material and orientation that defines the pole:

The above four sail pattern examples will be discussed in detail on the following pages.



- Bottom pattern is from late 1970's Pacer - below is a snippet from the 2011 Pole Paper. This concept leads to longer short side of the sail – top of the trapezoid shown on above diagram of four different sail pieces. This concept is currently used by Spirit:

Some might keep the "top sail length" the same and vary the height while others might vary the top sail length but always keep the height (width of material and resultant home many wraps on the pole) the same.

- Original Pacer and Spirit want the Sail to start and stop on a rail (Neutral axis) - so to add stiffness without changing mandrel size – make the top sail length longer.
    - Since there is a limit to how long the top can get, relative to overall sail length, otherwise it becomes a training pole –
    - Option is then to increase mandrel diameter – but if that would then make the tops sail length to short (for guidelines you use) to achieve the desired flex – your option is to drop a mandrel size and add a body wrap. Look at the Spirit tables and you can tell what they do.
    - I will go into this more when discussing individual poles

- The top pattern is a Skypole pattern, and the center of the sail is lower. The two sloped section are unequal lengths with the shorter being at the bottom of the pole. Makes the bottom stiffer and a softer handle end of the pole
- The middle two patterns are from the FX design project at Gill, headed by Henry E. Cardenas, now currently a Professor at Louisiana Tech University. The upper of the middle two represents a Pacer FX and the lower the carbon version.

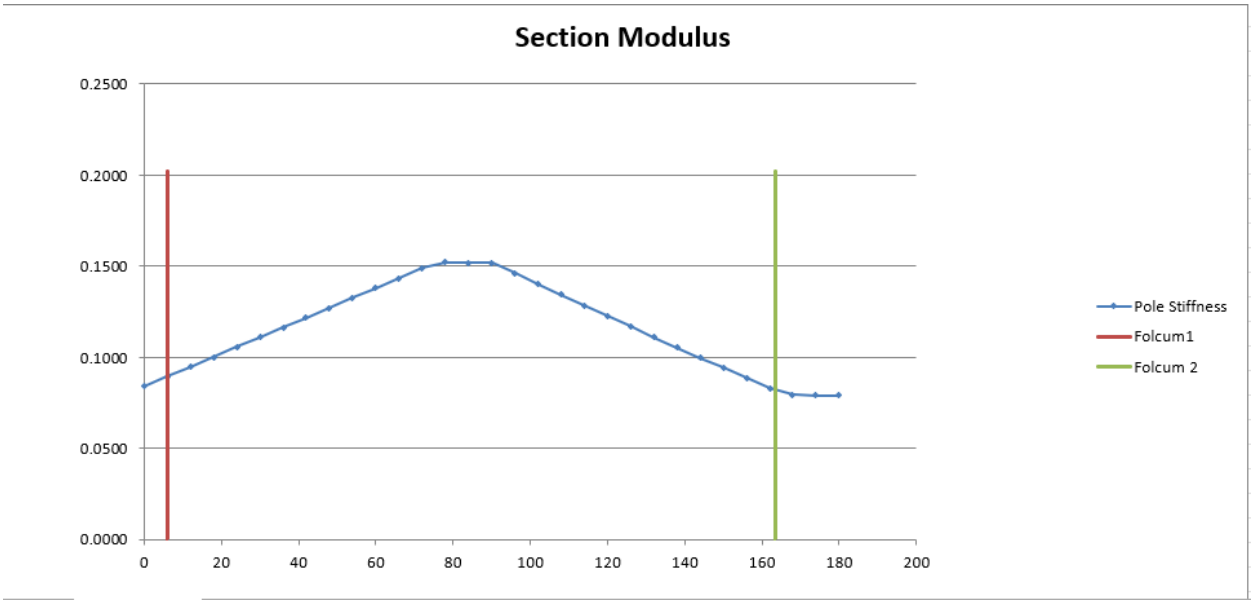
Before we go much further, we need to recognize that the brilliant Herb Jenks started this all about 1950. Pacific Laminates, the original brown Skypole, leading to Jenks US Patent 3,969,557 issued in July of 1976. This patent on fiberglass vaulting pole, which is a should read contains much of the earlier thoughts. Material types, epoxy resins, and woven fabric have improved markedly since then.

Just a few notes from that Patent: “By weight of the pole what is meant is the weight of the pole vaulter” – I have written about end loads and how they compare. Especially to the earlier sizes of poles and, end load did correlate well to ratings. Another passage “That is to say, to the greatest extent possible, woven tapes and cloths are avoided”. Advances in how material is currently made or woven along with resin improvements has allowed a move away from that statement.

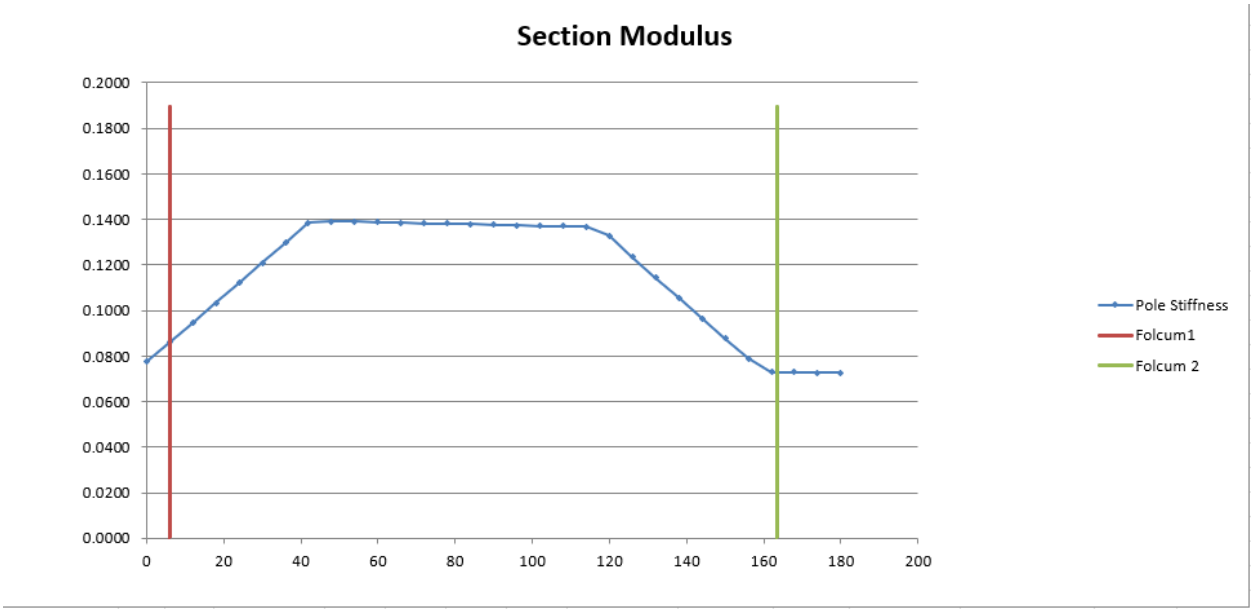
Let’s get back to looking at sail design and impact on the finished pole. We will look at Section Modulus since most poles are circular and elastic until larger bending or shortening of the chord length. Basically, the higher the section modulus the more force required to bend the pole in that area. Section Modulus of a pole is constantly changing because of tapered mandrels and Sail pieces.

The following Section Modulus diagrams for a 460 pole with 82kg rating (about16.4 flex) – this were created in a program Jake Whitaker and I tinkered with.

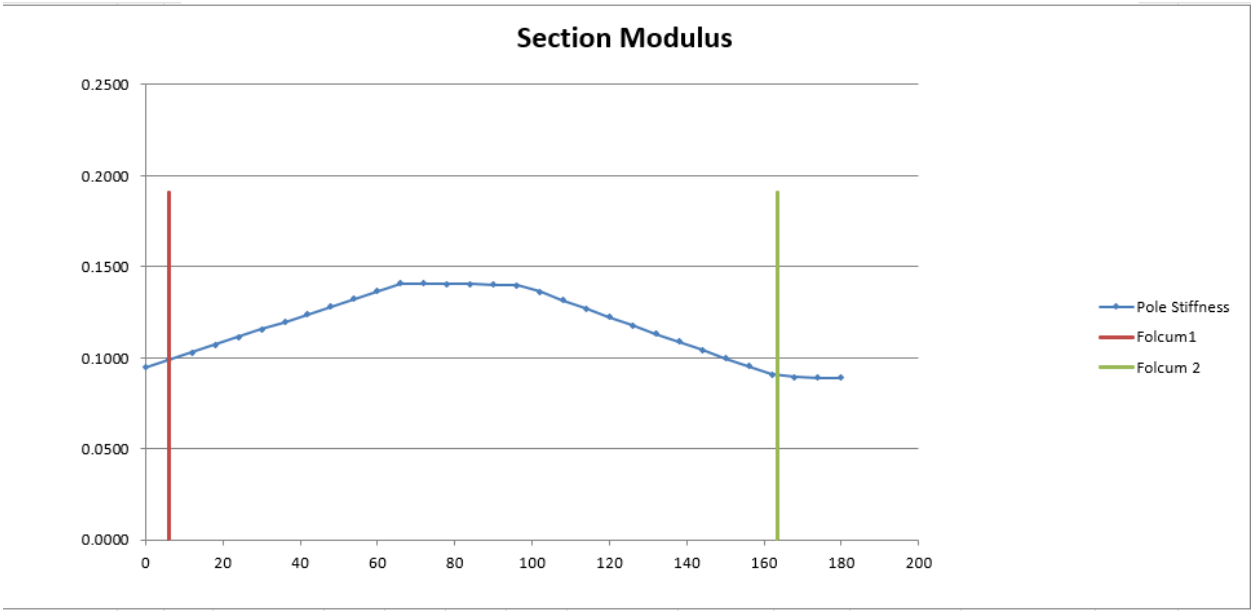
The pole below is an example of a 4B design



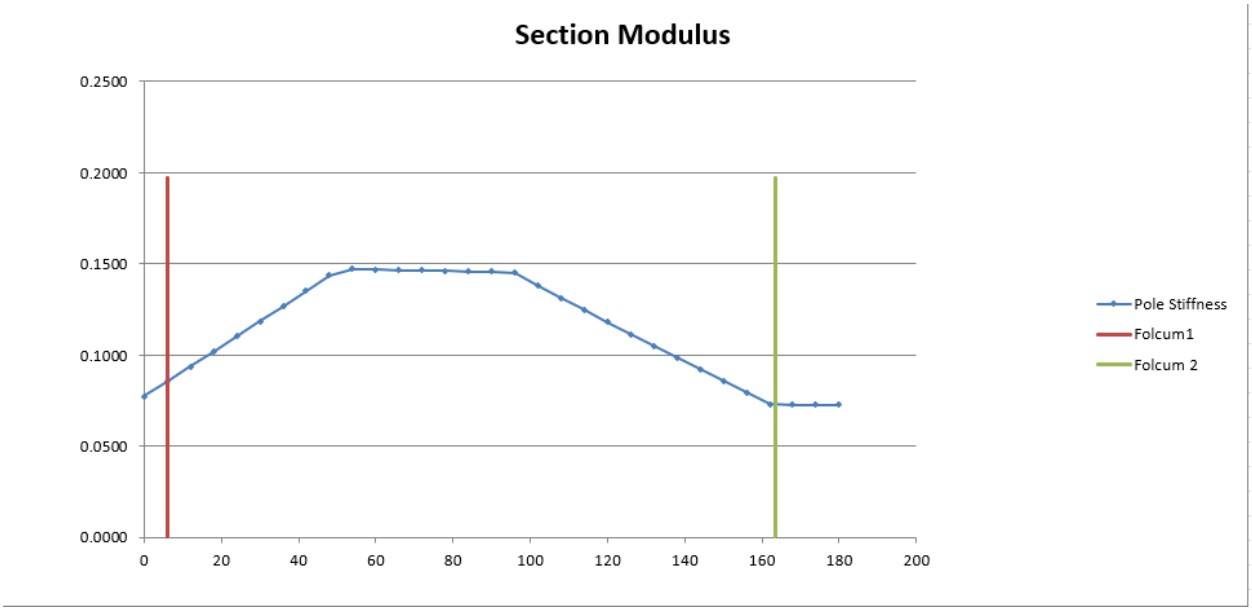
Below version illustrates an Old Pacer/Spirit type sail pattern. Does not have as high of peak as above, but the longer value near 1.4 that starts lower on the pole and decreases slightly due to decreasing mandrel diameter.



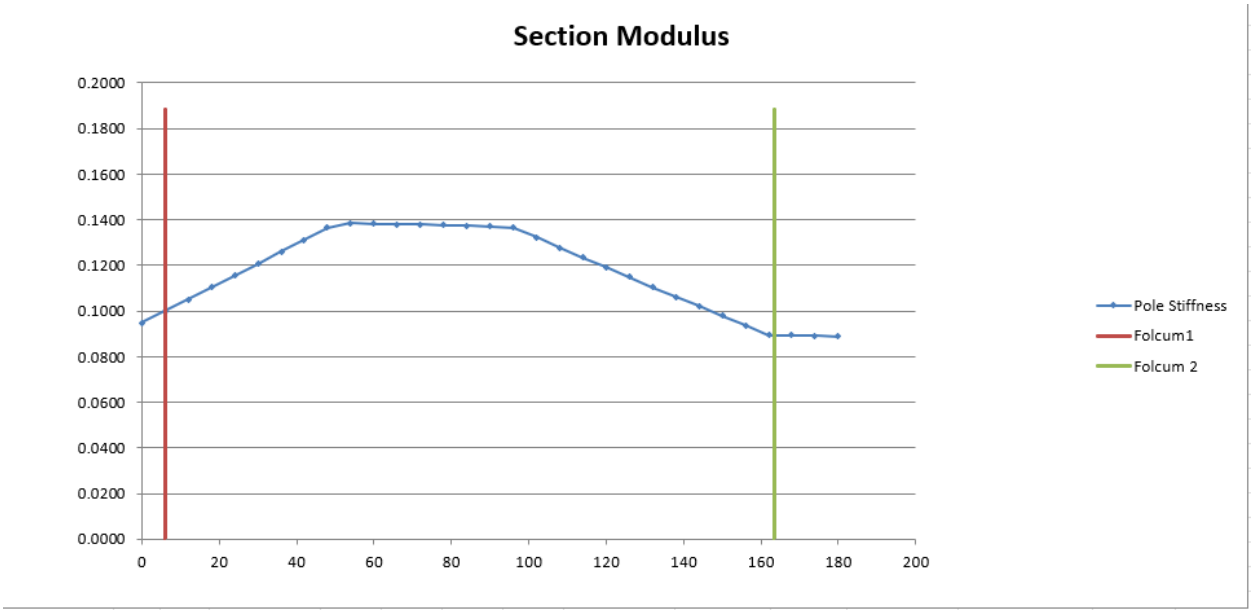
Pacer FX example shows the symmetrical sail pattern with a wider short or top side than the Carbon versions



Skypole Sail Design shows a lower center than the symmetrical designs and a longer softer portion at the handle end

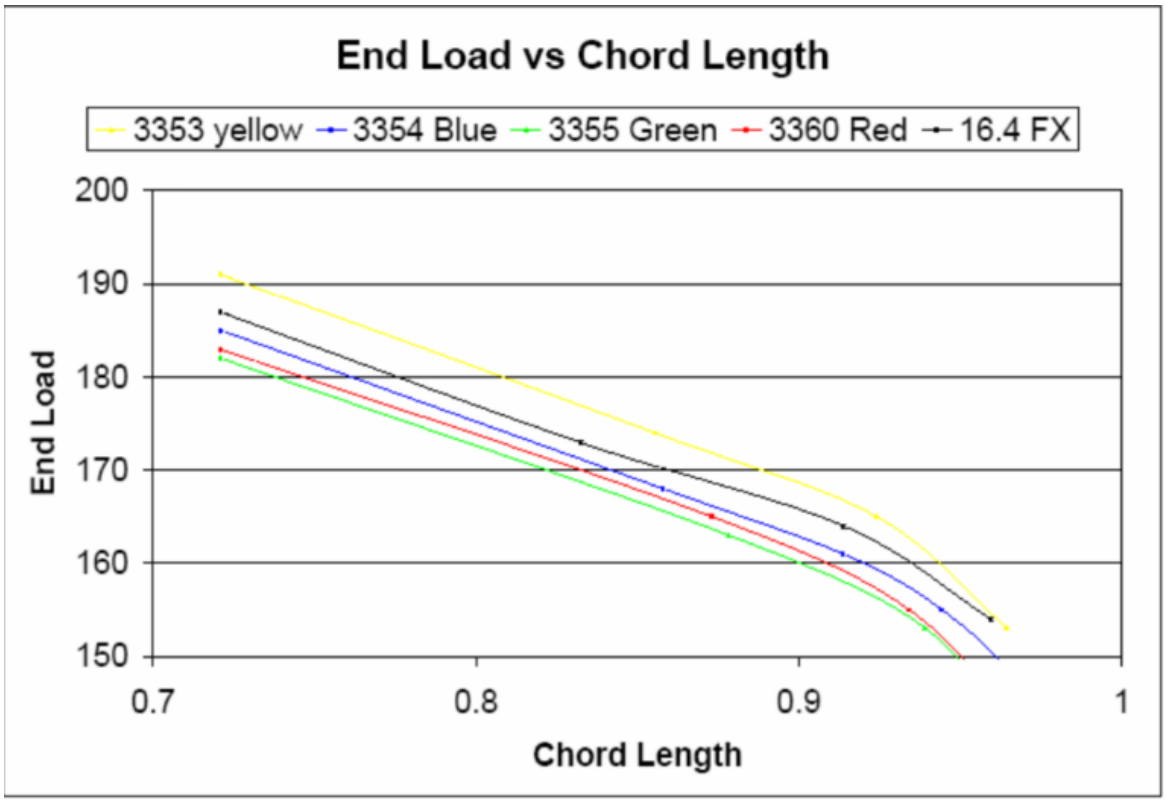


You can also shift or flatten this SM curve by added a body wrap and decrease sail height to get the same flex



This illustrates how the sale portion effects the distribution of material. Since this is only a part of the pole and less than 50% when you consider initial layers (roving, spiral wrap, or veil piece) and the body wraps of the pole.

When you then consider fiber orientation, using of unilateral material, woven material, it becomes a much more complicated process. The different mechanical properties of fibers, e-glass, S-glass, carbon fiber in its various forms, resins all contribute to the final product. Flex number is the simplest bare measurement of a pole's stiffness. In my opinion, end loads would be a more accurate measure. This was done with a set sent to Steve Rippon.



This was done with all carbon poles with a 16.4 flex. Doing this with a Skypole, Spirit, current Essx Carbon, Gill Composite and if you could find the same Weave 4B and 2002 version of the white Carbon FX would be an interesting comparison –

The load cell was attached at the right end in this picture – the carriage that the pole end was inserted into was on a roller bearing set up

It all gets down to how do you distribute the material along the pole length so you have a light easy to carry pole the bends and returns is a manner that a vaulter can complete a successful vault. They also need to be sturdy enough and durable enough to minimize breakage.

How it performs is a direct result of the vaulter. The run, plant, and swing – two arms moving the vaulters mass around the pole – the vaulters mass applying forces, moment's - style and technique.

Finding the combination of materials and applying to the mandrel to end up with the right tool for the right vaulter.