Arne’s Chain Calculator or…

How I do to make guessing on camber a little less inaccurate…

This method is used to find the needed rounding $R$ which will produce the desired camber in a horizontal batten panel of a junk sail. It works quite well within the camber/chord range 5-10% at least.

Note: A much simpler and only a bit less accurate method can be found on page 3.

1. See fig 1 on page 3. Decide where max camber point should be (A - B). I have used 34-40% aft of the luff, works ok.
2. Decide how deep camber you want at (A - B). (e.g. if you have a sail with 5m chord and you want 7% camber/chord, then the absolute camber should be 35cm)
3. Mark the distance $A'$ - $B'$ (=A-B) horizontally on a wall and hang a chain on nails in $A'$ and $B'$ (fig 2a).
4. Adjust chain-length until you get a bight as deep as the desired camber you decided in # 2.
5. But!! A real sail will take the flatter shape of fig 2b, not the ‘chain-shape’ of fig 2a. Therefore you must make the bight or ‘chain camber’ in par.4 about 20% bigger than the sail camber you really want. If you want a real camber/chord deeper than 10% I guess you will have to increase the correction factor from 20% to 25 or even 30%. A test-panel will here be required. The reason for this oddity is, I believe, that the stretch in the sail-panel from C to D (fig 1) will resist the bulging of the sail-cloth.
6. Measure how much chain you used between $A'$ and $B'$. Then you can calculate the rounding you need along each batten to get the desired camber. See fig 3.
7. The calculated rounding $R$ can then be used when drawing the panel. Use a wooden batten on the floor; fasten it with a few well placed nails to get the rounding you like. I prefer to cut out a template for the rounding in thick paper first, and use the template on the upper and lower side of the panel. Now I guess you understand why I prefer to make 4 or 5 identical panels! As the batten-rise increases above 10°, everything gets a lot more complicated, and in the top panel everything is guesswork. Just remember that in the top-panel the wind will blow across the panel more than along it. For that reason the camber must be small. The rounding along the yard should be guesstimated to about ¼ or 1/5 of the rounding in the lower panels.
8. This is rough engineering, but don’t worry. Compared to the flat junk sail it will be far superior.
Fig 1  Batten Panel

Fig 2A  Chord

Fig 2B  Camber

Fig 3  Batten Panel cut with rounding along battens

Round, "barrel shape"

\[ R = \frac{\text{chaintight} - \text{battledistance}}{2} \]
Simplified method of finding the rounding R (also called round)

After having used my chain calculator and checked the resulting camber in some sails, I have found that there is a fairly constant ratio between the rounding $R$ and the resulting camber in each batten panel. The rounding varies between 54% and 57% of the camber.

If you don’t want to fiddle with the Chain Calculator, you may skip step 3 – 6 on page one. Instead you simply calculate the needed camber in cm/inches (step 1 – 3) and then find the rounding $R$ by saying that..

**Rounding $R$ is 55% of the desired camber**

As simple as that!

For better accuracy I still recommend the Chain Calculator, but for a “normal” sail with “normal” camber/chord ratio (say 6 – 9%) you will hit closely enough.

Confusion:

Somehow some of the readers have ended up mixing *camber* with *round/rounding*. I try once more: The *camber* is the final (horizontal) curve that the sail takes when it is filled with wind. In the photo above I have tried to draw the dept of the camber at one single point in the sail.

The *round/rounding/”barrel shape”* is the curve to which each batten panel is being cut along the battens to give the desired camber. In Fig 3 of p. 2 the round R is showing the max point of that round curve. This $R$ which in the end hopefully produces the desired *max dept of camber* is what these calculations are about. Sorry folks, this is the closest I get in my Stavanger-English.

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PS1:

**Wrinkles and broadseams.**

To make the panels bulge well, you may tie the sail with a bit slack along the battens, about 1-2% of the batten lengths with 8% camber. This may result in some “smiling wrinkles” along the battens (see photo of Johanna’s sail which I slackened 10cm on 5.8m battens), but I reckon that they do little harm. If you are put off by the look of them, you could always install 3 broadseams along the rounded (batten-) edges which will crimp the edges about 2% of the batten length. The joining of the batten panels along these batten edges should not be much more difficult than without the broadseams fitted. When a sail with broadseams is rigged, you will not need to keep it slack along the battens.

.. Johanna, wrinkles along the battens clearly visible in evening sunshine. I could have stretched the sail just a bit along the battens to get rid of most of them without losing much camber, but I never got around doing it as the boat performs so well...

PS2: The leech of the two top panels is cut with about 5cm hollow to avoid a hooked leech and fluttering.

PS3: 2003 06 18. I have mostly aimed for 8% camber/chord in the horizontal panels. That is a modest camber compared to many conventional sails. My idea is that the boat shall carry almost as big sail upwind as downwind with moderate camber.

PS4: 2006 06 18. In heavier boats where the size of the sails or height of the mast become a problem, I would start experimenting with more camber, say 10, 12 or even 15%!