

## MAXIMUM SAIL POWER

### CHAPTER 4

#### A PRIMER ON PANEL LAYOUTS

##### Different Layouts for Different Fabrics - Part 2



### DIFFERENT LAYOUTS FOR DIFFERENT FABRICS

In this chapter we will look at radial sails and how laminated fabric is used to build a much better engineered sail.

#### Radial Sails

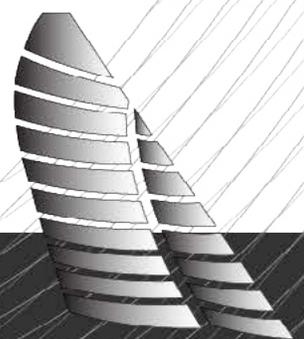
While cross-cut sails were built from woven Dacron, laminated fabrics allowed sailmakers to build both cross-cut and radial sails depending on how the fabric was engineered. When the fabrics were laminated the scrims were laid so that the strength in the fabric could run in the warp direction, the fill direction or both. Fill-oriented laminates were still used to build cross-cut sails, while warp-

oriented laminates were used to build radial sails, i.e., sails in which the panels were not just stacked up parallel to the foot. Sailmakers had been building tri-radial spinnakers for some time so the concept of orienting the panels along the load lines was not new. It was just that this was the first time they could build working sails with a tri-radial panel configuration.

One of the principal benefits of radial sails is that the sail designer can engineer sails with different fabrics in different areas of the sail to address specific loads. In other words, heavier fabrics can be used along the leech of the sail or at the head and clew where loads are highest, while lighter fabrics can be used in lower load areas like along the luff. These fabrics can differ in terms of overall weight and specific lay-up. They can also differ in terms of the types of fibers and yarns used to carry the load. For example, the sailmaker can design the sail with low-stretch Kevlar yarns in the high-load areas and a regular polyester in the rest of the sail. In doing so, he can keep the cost of the sail to a minimum while still gaining the maximum benefit from the exotic fibers. If the sail is going to be used on a race course, the sailmaker can add durable, chafe-resistant panels through the foot area to take the abuse handed out each time the boat tacks. If the sail is going to be used for long cruising passages, similar patches can be used in other high-chafe areas, for example, where a mainsail rubs against shrouds or spreaders. The same can be done for woven cross-cut sails but the patches are added on later. Incorporating them in the original design is a more efficient way to build a sail.

### **Mainsails and bi-radial sails**

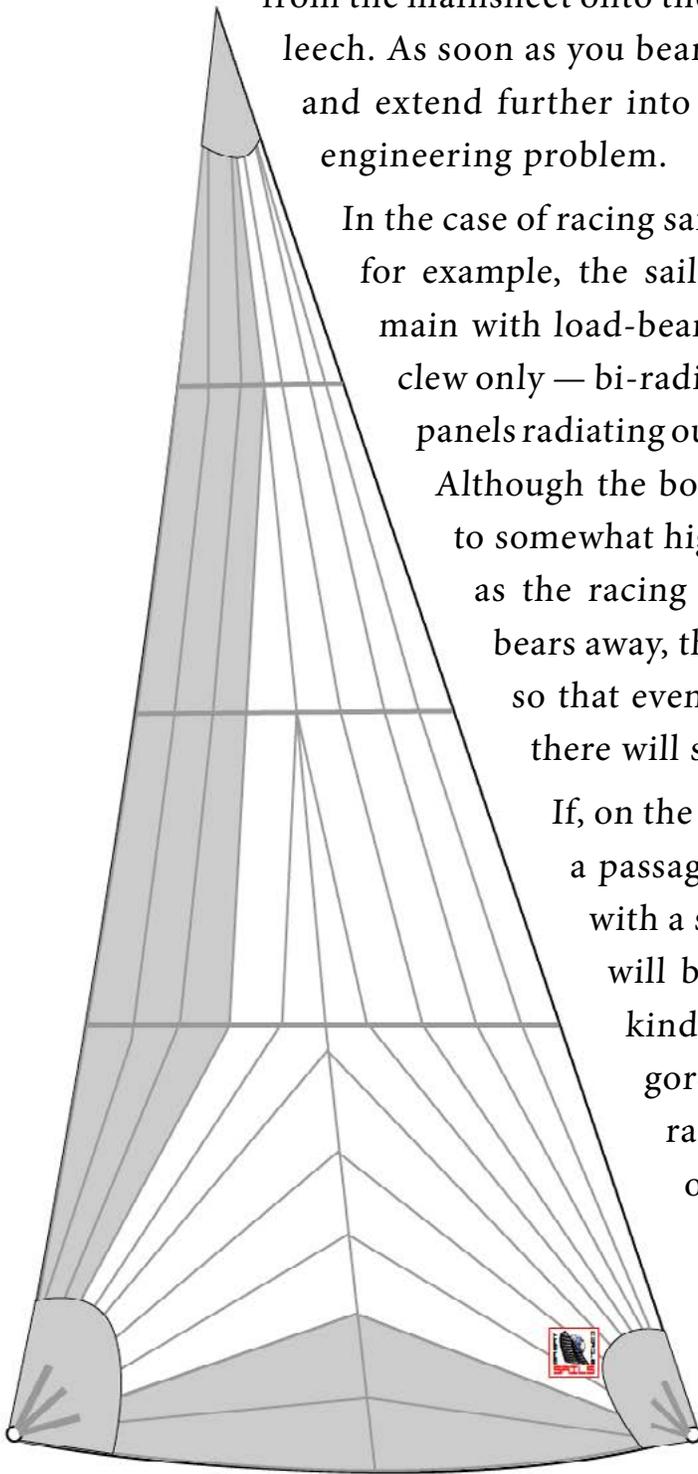
Of course, sails are used not only for sailing upwind, but on reaches and runs as well. Mainsails in particular have to be able to perform on every point of sail. Some boats, like those that compete in Olympic events, the America's Cup, or other inshore events, spend most of their time sailing either hard on the wind, or sailing deep off the wind, while others, like those that compete in long-distance offshore events spend much of their time reaching and running. Much like headsails, when sailing hard on the wind the principal loads on a mainsail go directly



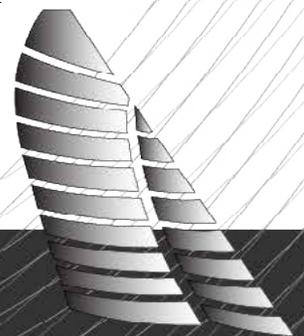
from the mainsheet onto the clew of the sail and then straight up the leech. As soon as you bear away, however, the loads are decreased and extend further into the body of sail, creating a whole new engineering problem.

In the case of racing sails used on an upwind/downwind course, for example, the sailmaker may choose to build a bi-radial main with load-bearing gores radiating out of the head and clew only — bi-radial meaning that there are only two sets of panels radiating out from the corners, i.e., the head and clew. Although the body and tack of the sail will be subjected to somewhat higher loads on the downwind leg, as soon as the racing sailor reaches the windward mark and bears away, the loads on the sail immediately decrease so that even though the loads may be redistributed, there will still not be any need for tack gores.

If, on the other hand, the sail is being designed for a passagemaker, the sailmaker will want to deal with a significant load on the tack since the sail will be used for reaching and running in all kinds of conditions. Therefore strong tack gores are necessary and the sail will be tri-radial in construction. In the beginning of this book it was made clear that your sailmaker needs as much information about your sailing plans as you can give. This is a perfect example of how different sailing styles can result in a need for different sails.



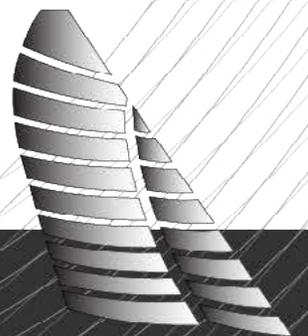
Shaded areas show heavier fabric in the high load areas of the leech and foot





### **Aligning fabric along load lines**

Thanks to continuing research and development, many racing sails are no longer tri-radial in the true sense of the word. Sail designers now have very accurate load plots to work from and it's their job to make use of fabric in the best possible way to accept those loads. Loads are not linear and they do not change direction uniformly and at convenient places. In fact, not only do they bend around a catenary, the curve changes when the heading of the boat changes relative to the wind. Many sail designers now use panels that radiate out from the corners of the sail and then bend the panels within the body of the sail as best they can to match the anticipated loads. In many ways, the more bends in the fabric, the better the sail, although building such sails is quite labor intensive and the more panels needed for construction, the higher the cost of manufacturing the sail. Again, it is a balancing act between trying to make an effective sail and keeping prices reasonable.

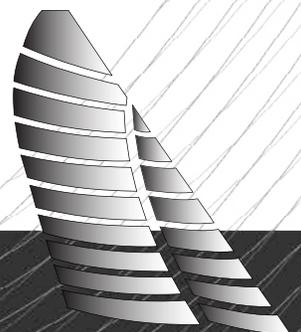


## Asking good questions

The sailmaker's choice of fabric styles and weights are vast. How he uses them to his best advantage is equally infinite. The combinations are endless. It always comes down to the single most important part of the sailmaking process: an understanding between the sailmaker and customer. You need to be clear about what kind of sail you have in mind and how you plan to use it; you also need to be sure to give that information to the sailmaker even before he works up a quote. Otherwise, it's up to him to guess, which is why sailors often get different quotes from different sailmakers who recommend different sails and fabrics at vastly different prices. It's no wonder customers get confused if the sailmakers themselves are working in the dark. Below are some points to think about when talking with your sailmaker about a new sail.

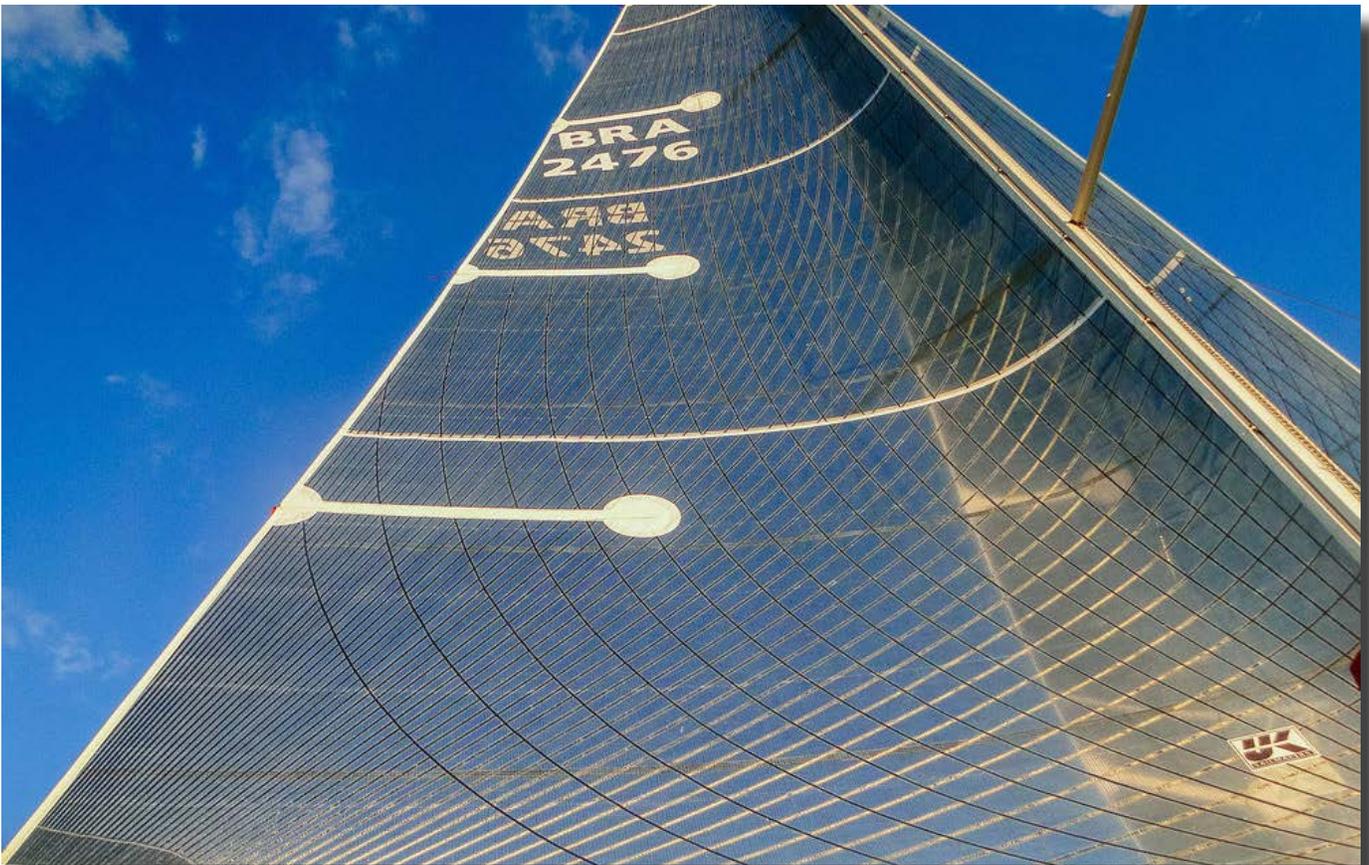
- Do you plan to race or cruise?
- If both, what is the balance between racing and cruising?
- What is your level of expertise?
- Do you really know how to trim sails?
- Is longevity more important than performance?
- Is sail handling important or would you sacrifice that for performance?
- Do class rules limit the number of sails you can have on board?
- Are you planning on coastal cruising or are you going transoceanic?
- If you are going offshore how many people will be on board?
- Do you like to sail short-handed?
- Is stowage an issue on your boat?
- Will you be in an area where it's easy to get a sail repaired?

Armed with information and dozens of fabrics to choose from, the sailmaker can design and build you a custom sail that meets your needs. It's true that two sails built from two different fabrics with two different panel layouts can do the job for you equally well. Sailmaking is an inexact science; there is still plenty of room for art and interpretation. But that doesn't mean that all sails will perform equally well for your style of sailing.

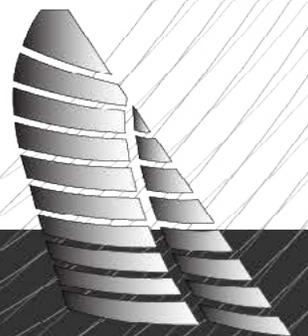


## A new generation of sailmaking

Of course, now that you have finally figured out how the fibers and fabrics are used to make sails, the sailmaking world has taken another giant leap forward leaving you behind once again. The days of cross-cut and radial sails are slipping into the past as new sailmaking technologies find a foothold in the industry and become more widely accepted. Once the exclusive domain of the racer, exotic construction techniques like North's 3DL, UK's Tape Drive, and Doyle's D4 have become mainstream. In fact, they are being built and marketed to the weekend sailor and offshore passagemaker as well as out-and-out racers.



We will look at these technologies in more detail in the next chapter, but remember one thing. Newer or more expensive is not always better, especially in the case of sails. If weight aloft is of no consideration to you or your sailing plans, then you do not need the latest high-



modulus, low-weight wonder fabric. In fact, if durability and ease of onboard repair are important, then you should definitely think twice about buying that fancy 3DL sail, since you might very well be better off with a high-performance Dacron. If, however, performance is king, then it most certainly makes sense to look at the latest sailmaking technologies, decide which one makes the most sense to you, and then go for it. An educated consumer is in a powerful position. Know what you want by knowing how you plan to use the sails, and you will be satisfied with the result.

Note: The next chapter of Maximum Sail Power is Chapter 5 and we will take a look at molded and membrane sails and see what all the buzz is about.

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BRIAN HANCOCK  
Owner Great Circle Sails

