Shear CONFUSION

Wind shear can bring the whole crew undone if you are not aware of its unseen effects. By Kenn Batt and Bruce Buckley

REMEMBER those race days when the sail trimmers had an awful time trimming sails, the helmsperson, probably you, being so frustrated because the boat felt better on one tack and not the other and the tactician seemed to be out of phase with the shifts!

All other things being equal, you were most likely experiencing the effects of wind shear.

What is wind shear, you may ask? It is simply the change in wind direction and/or speed with height. We can differentiate between directional and speed shear but, generally speaking, both occur simultaneously hence the term wind shear.

We can have horizontal as well as vertical shear, but it is the vertical shear that creates the most headaches for racing types. Be aware that the vertical shear may also vary rather dramatically in the horizontal!

How does wind shear occur? It normally all comes down to good old friction. The closer you are to the surface of the sea or land, the slower the wind speed and the more the wind direction will be veered (southern hemisphere) in relation to the gradient or the friction-free wind.

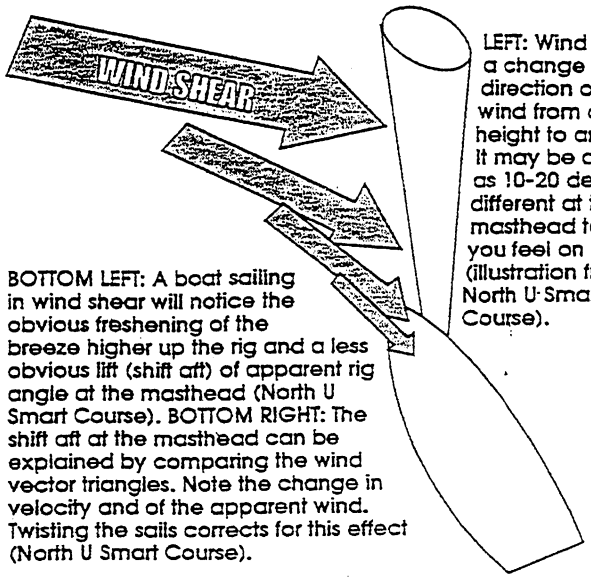
This change in wind speed can be easily detected between the masthead and the deck and even though the direction of the true wind changes ever so little in the lowest 30 metres, it's the direction of the relative wind or the wind felt by you and by the sails that can change quite markedly between the deck and the masthead. It all comes down to the stability nature of the air-sea(land) interface.

Differences in speed range from very little in unstable air (around 5 per cent) to enormous amounts in stable air (up to 300 per cent).

From a directional point of view, differences range from about one degree in unstable air to about 30 degrees in stable air.

On inland waterways, shallow cold air drainage and topographic influences can produce vertical wind shear which can vary considerably in the horizontal. The effects of off-land breezes and their stability is also pertinent in enclosed waters as well as close to a coast.

So the basic rule at this stage is that you need more twist in your sails on stable days and less twist on unstable days. More about this later.



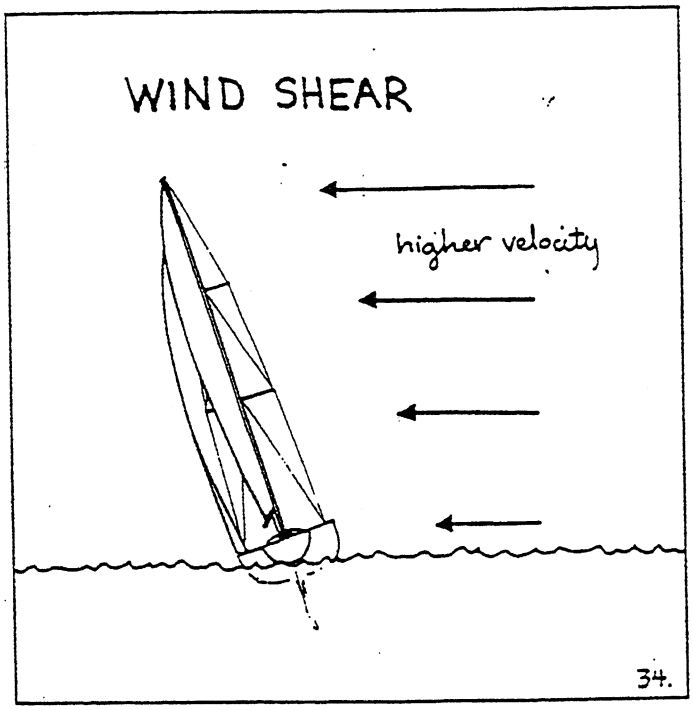
LEFT: Wind shear is a change in direction of the wind from one height to another. It may be as much as 10-20 degrees different at the masthead to what you feel on deck (illustration from North U Smart Course).

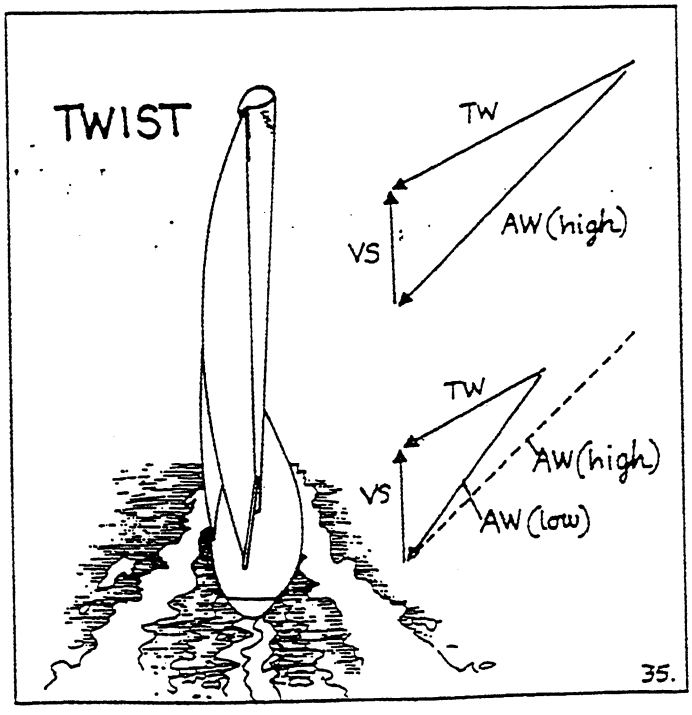
BOTTOM LEFT: A boat sailing in wind shear will notice the obvious freshening of the breeze higher up the rig and a less obvious lift (shift aft) of apparent rig angle at the masthead (North U Smart Course). BOTTOM RIGHT: The shift aft at the masthead can be explained by comparing the wind vector triangles. Note the change in velocity and of the apparent wind. Twisting the sails corrects for this effect (North U Smart Course).

'Weight' of Wind

It is wind shear and not changes to the air density that causes what is widely referred to as the "weight of the wind".

Even though the air density will change with a change in the air temperature, the change in the actual value of the air density likely to be experienced will be very small. It is the





variation in wind speed and hence the wind shear between the masthead and the water surface that is largely responsible for this "weight" phenomenon.

When it occurs, it is this variation in wind speed that can lead to a huge difference in the heeling moment of the boat. In stable air there will appear to be more "weight in the wind" since there will generally be a stronger wind speed at the masthead than at deck or sea level.

In unstable air, there is generally good mixing or overturning taking place in the boundary layer so the wind speed is fairly constant between the masthead and deck or sea-level and hence the heeling moment is less.

What's all this stability stuff? In a nutshell it comes down to the temperature difference between the sea and the air sitting on it. If the temperature of the water is colder than the air then we have a stable sailing layer. On the other hand, if the sea temperature is warmer than the air temperature then we have an unstable sailing layer. When the sea temperature equals the air temperature then we have a neutral sailing layer. Simple eh!? Not really but this will do. We recommend further in-depth reading matter on this matter later.

Apart from temperature considerations, wind shear will generally be experienced during a developing sea breeze situation. It can be very marked while this breeze is building and will drop away to nothing once the breeze has reached maturity. Shear can also be marked when one is close to a towering cumulus or cumulonimbus (thunderstorm) cloud and also if a cold front is close by.

The direction of the wind shear (directional shear) can be indicative of the direction of future shifts (permanent), while speed shear by itself will tell you that you can expect oscillating wind shifts.

Be vigilant and aware of the signs and be prepared

What are the signs of wind shear? Sail trim will vary from one tack to the next. The headsail trimmer has "a dog of a time" getting the luff tufts to break evenly and the mainsail trimmer has a horrible time getting the twist right.

The helmsperson is very frustrated because the boat feels better and faster on one tack (generally port) than the other (generally starboard). The person calling the shots is probably out of phase with the wind shifts. You will notice big differences between the wind speed measured at the mast head to those sensed by you at deck level.

This all adds up to one frustrating day on the water.

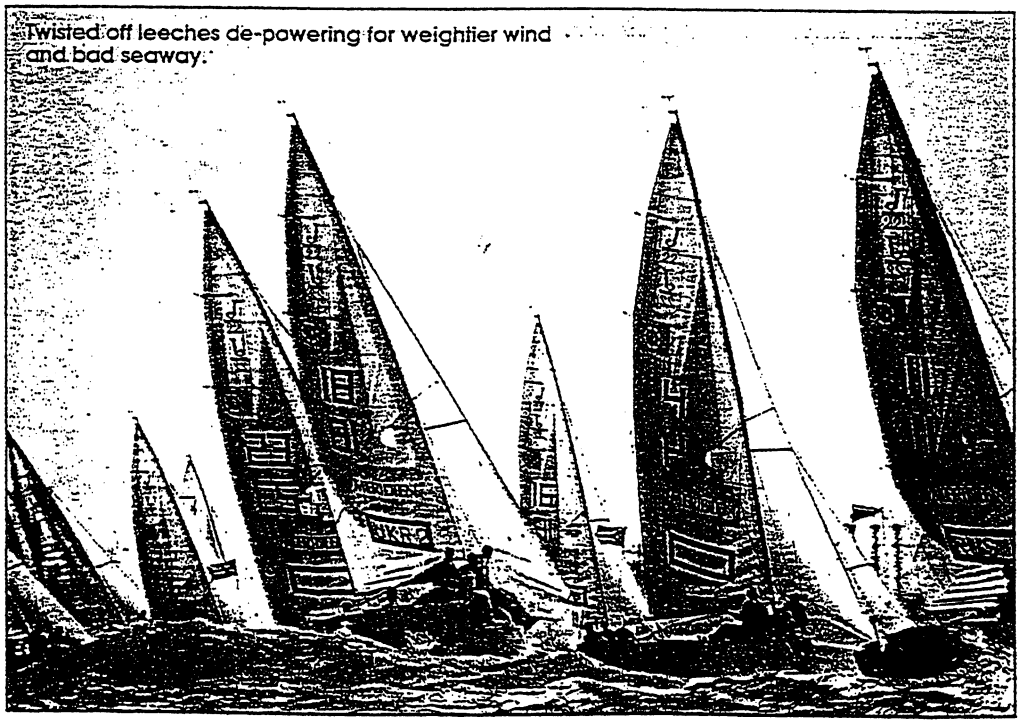
What's happening here is that the tops of your sails are being lifted on one tack (generally port) and headed on the other (generally starboard). The sail tufts will react very differently from one tack to the other.

What are the remedies? Before the race, attempt to measure the actual air and sea water temperature. If it works out that shear could to make adjustments very quickly.

On the lifted tack you will need to have more twist in your sails. On the headed tack your sails will require less twist. Jim Marshall from Ockam (manufacturers of yachting electronics in the USA) suggests that "one should be very careful not to eliminate too much twist. Lack of twist is a sure way to slow the boat down too much."

Be prepared to adjust your targets from tack to tack since the boat will be faster on one tack than the other. Also be aware that your instrument readings, especially the apparent wind angle, will be "over the top". For the apparent wind, it will be very wide on the lifted tack and very narrow on the headed tack.

For horizontally-varying shear, observe any topographic features around you. Also, look out for the shear zone of the arriving sea breeze.



Twisted off leeches de-powering for weightier wind and bad seaway.

We recommend that you try to get your hands on a set of Ockam-U course notes for further in-depth reading on this topic as well as many others. The *North-U-Fast* notes by Norths, *Weather at Sea* and *Wind Strategy*, both by David Houghton, are also great sources for further reading (Boat Books).

Remember that wind speed and direction sensors are usually at the masthead so there will be a big difference at times between what you read on the instruments to what you sense coming across the deck. You can place more emphasis in your instruments during unstable conditions and least emphasis during stable conditions.

Smart sailing!