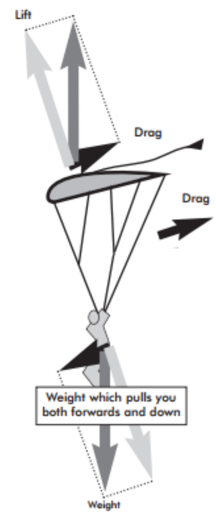
Open up an e-book or manual about parachute flight and you almost certainly see a variation on the same photo that I have put on the right. It will then go on to talk about airfoils that can create lift and what contributes to drag. And then we move on, because all of that was super simple to understand.



But, what if it wasn't?

Let's revisit these terms so that we can have a clear understanding of what is going on, and start off as easy as possible:

The **weight** is you, the canopy pilot. Or, even better, you plus all of the stuff you have on. And if you are unfortunate enough to be a military jumper, then that can add up to be almost another person. If you are a small jumper and use a weight belt, then you had better add that weight as well. This is a variable that a canopy pilot can easily change.

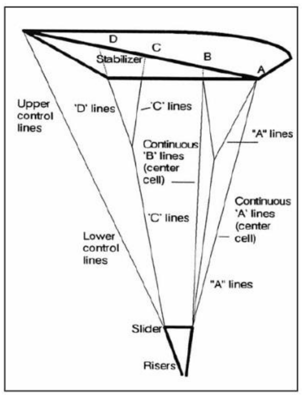


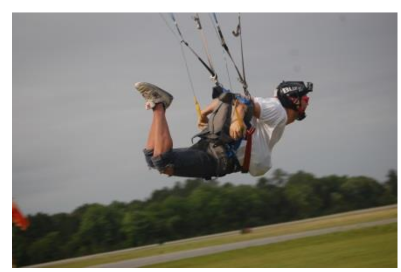
Figure 5-23. Ram-air canopy layout and nomenclature.

On an airplane there are engines to move it forward, providing thrust. But, we have no engines on a sport parachute. Instead, parachutes have been designed to angle slightly downward so that gravity can be used to "power" our sport parachute. If you were to measure the line groups of your parachute (A, B, C, and D) you would notice that the C lines are shorter than the D lines, the B lines are shorter than the C lines, and the A lines are the shortest of them all. Depending on which parachute you jump, the trim angle (the tilt that the manufacturer has built into the wing) can vary by quite a bit. In the end, though, it is the weight (you and your gear) that pulls the wing down and forward.

Next up, drag:

Drag is the force that wants to hold us back from moving forward, and some people call this air friction. An object with more surface area will encounter more air molecules and therefore have more drag. So, race cars and airplanes are built with streamlined shapes that allow them to go faster, as they have less drag.

If we look at the skydiving discipline of swooping, those pilots typically have sliders and pilot chutes that they can remove after opening, thin lines on their parachutes, and they change their body position during their swoop…all in an effort to reduce drag and go faster/farther. This is another variable that can be changed, sometimes easily and other times only after handing over cash to a manufacturer for a removable deployment system.



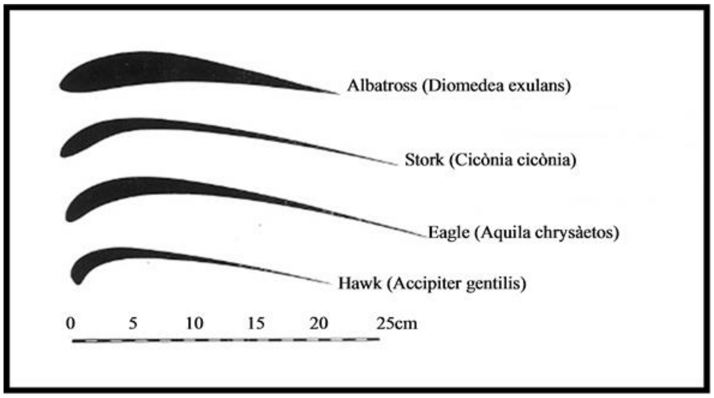
Finally, what is lift:

When we are talking about parachutes, **lift** is the force that is opposite of weight. It's what keeps us from plummeting to the Earth with an eternal outcome.

And this is when we need to start talking about airfoils:

An airfoil is a structure that has curved surfaces that will give a favorable ratio of lift to drag in flight. We won't get into why lift is generated as it can become a mathematical mess, and there really isn't a good explanation. However, if you want to appear to know what you are talking about then throw out the term "Bernoulli's Principle" - check your pronunciation and always ask if the person knows anything about aerodynamics first (if they do then don't say anything). Just know that there are lots of different airfoils and new ones are constantly being designed.

Let's look at something familiar. We all know that birds can fly, and they do a fantastic job with it. If you were to look at a bird's wing from the side, you would notice that it has two curved surfaces. If you looked at several different species of birds, you would notice that different birds utilize different airfoils.



From Günther Pfeifhofer and Helmut Tributsch. Engineering. 2014 Vol.6 No.8 http://file.scirp.org/Html/5-8102157_47763.htm#ref8

Same thing with parachutes, or at least that is the best guess from those of us that are not directly involved in the manufacturing process. Unfortunately, manufacturers are not very forthcoming about which airfoil they use or even if they use multiple airfoils in the same design. However, it appears that a good chunk of parachutes out there use what is referred to as the Clark Y airfoil.

And now a brief history of the Clark Y airfoil:

Virginius E. Clark designed this airfoil in 1922. In a "highly unscientific" manner Colonel Clark took a different airfoil used at the time and deformed it so that 70% of the bottom was flat. This flat bottom became a very attractive feature to people since it was easier to make, and it has been used ever since in the construction of multiples airplanes, and (probably) parachutes.

We could go on about airfoils, but we won't. If you are hungering for more about airfoils read the article *Technicalities: A Short History of Airfoils*. Back to talking about how the parachutes we jump work.

We have covered the definitions of weight, drag, and lift. Now on to how this all comes together when you deploy your parachute….but first, a quick trip back in time.

Historically, fabric (linen or silk) was stretched over wooden frames until the early 1900s. People were jumping off of buildings and out of balloons with this set up, mostly at fairs and other places where the pilot could call attention to his bravery/stupidity (more on these "scientific spectacles"). In 1907 a crafty American invented both the static line and the "coatpack" method, thus allowing the parachute to be folded up and worn on the back with no frames necessary. It wasn't long afterwards that the first jump was made from a fixed-wing aircraft.

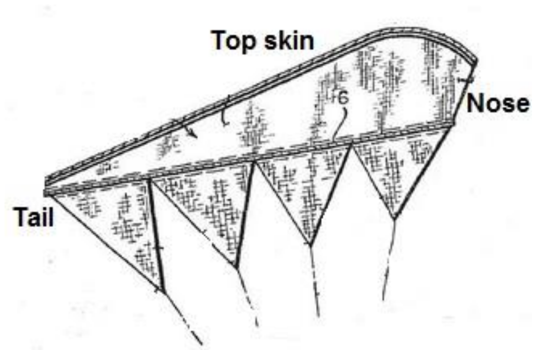
And then two world wars within a span of 20 years convinced several armies that parachutes would be a highly-prized addition to their military. And, as I hope you know, the D-Day invasion of World War II sees the use of round parachutes in an unprecedented manner. But, as many of those poor paratroopers found out, you are at

the mercy of the wind and the person spotting when you jump with a round parachute; many of the paratroopers died in fields flooded by Germans and the majority were scattered about the Normandy countryside. Even with today's technology, re-enactors and military jumpers are scattered about the landing area when jumping round parachutes. There had to be a better way.

And there was!

A kite maker to the rescue:

Jalbert was a Canadian kite maker that moved to America, and he ends up inventing the ram-air parafoil in the years of 1957-1963. The ribs of the parachute are the airfoil shape that we talked about earlier, and they are sandwiched between two layers of fabric: the top skin and the bottom skin.   These two layers of fabric are sewn together at the tail of the canopy and on the sides, but left open at the leading edge (nose) of the parachute. During inflation air enters the nose of the parachute and is trapped. Now we had a fairly rigid wing that could be flown by a canopy pilot. There was greater steerability, greater control over one's descent, and this wing would glide further than a round canopy could ever dream of. Only one (major) problem: the opening shock was horrendous.



A few years later NASA and the US Air Force worked out that a slider was needed, and our modern-day parachutes were born. Skydivers would eventually use and adapt this technology to design wings with a variety of characteristics: some were good for students, some for highly advanced pilots, some for the military guys lucky enough to jump ram-air technology, and many for us that fall in between.

Hope you enjoyed the combo history and physics lesson. Still confused or have more questions? Let us know.