



Material Sciences

FLYwithMIKI.COM

Warm up

<https://kahoot.it>



History of Paragliding



Equipment



FLYwithMIKI.COM

Equipment

- Paraglider
- Harness
- Rescue
- Other equipment



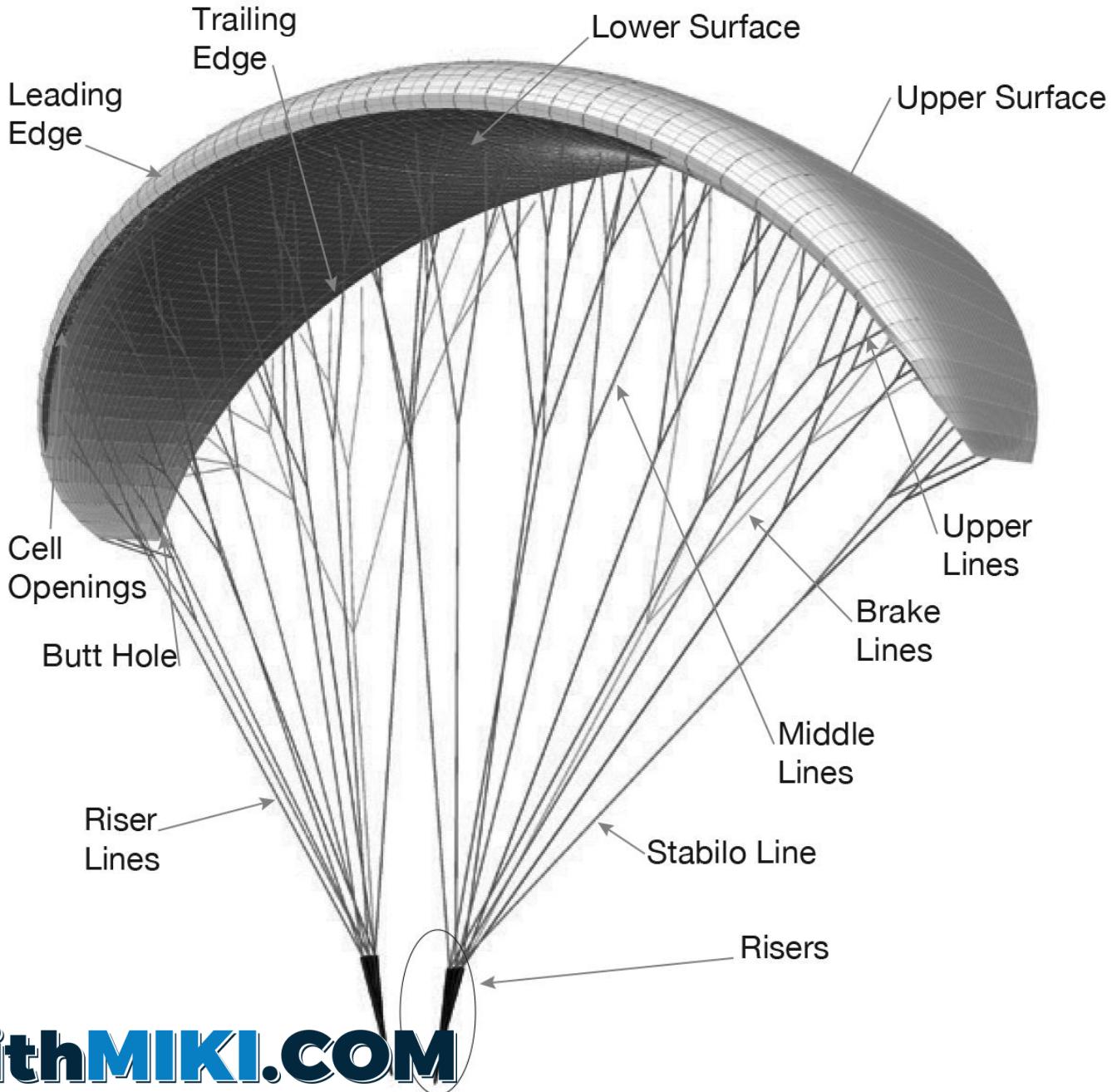
Equipment

- Paraglider
- Harness
- Rescue
- Other equipment



Paraglider

- Canopy
- Lines
- Risers
- (Speed system)
- (Harness)



Paraglider - canopy

Polyamide (Nylon) / Polyester

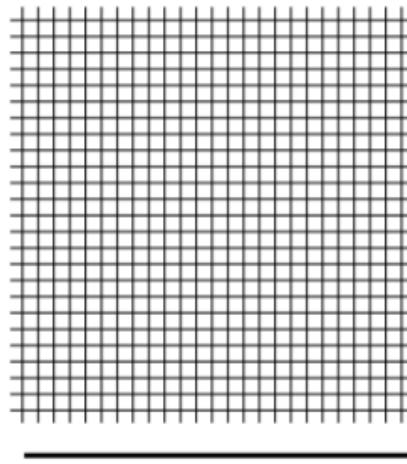


Paraglider - canopy

Polyamide (Nylon) / Polyester

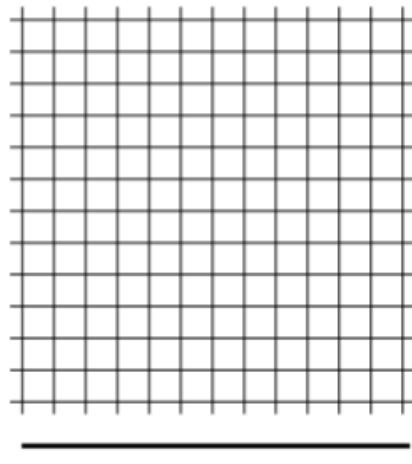
Rip-stop material

Paraglider - canopy



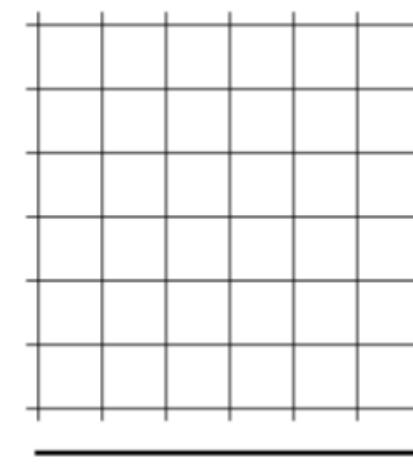
Weft
 $\frac{1 \text{ cm}}{50 \text{ thread}}$

Warp $\frac{1 \text{ cm}}{50 \text{ thread}}$



Warp $\frac{1 \text{ cm}}{40 \text{ thread}}$

Weft
 $\frac{1 \text{ cm}}{40 \text{ thread}}$



Warp $\frac{1 \text{ cm}}{35 \text{ thread}}$

Weft
 $\frac{1 \text{ cm}}{35 \text{ thread}}$

Durability \leftrightarrow Weight

Paraglider - canopy

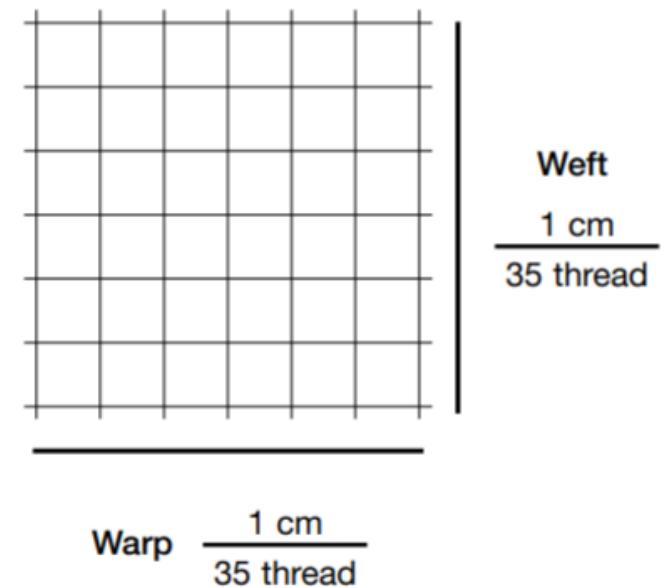


Paraglider - canopy

Polyamide (Nylon) / Polyester

Rip-stop material

Coating



Paraglider - canopy

Coating (acrylic, polyurethane, silicone, etc.)



Criteriums:

- Light
- Has a certain elasticity
- Resistance (aging, delamination, etc)

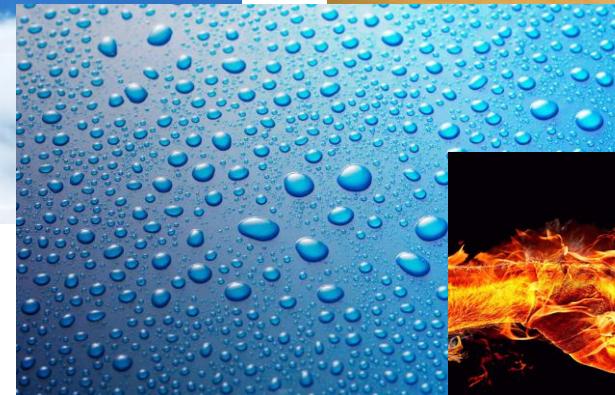
Goals:

- Minimise Porosity (air permeability)
- Optimal weight (but no free lunch!!)
- Minimise elasticity (but not rigid - without cracking)
- Reduce UV sensitivity

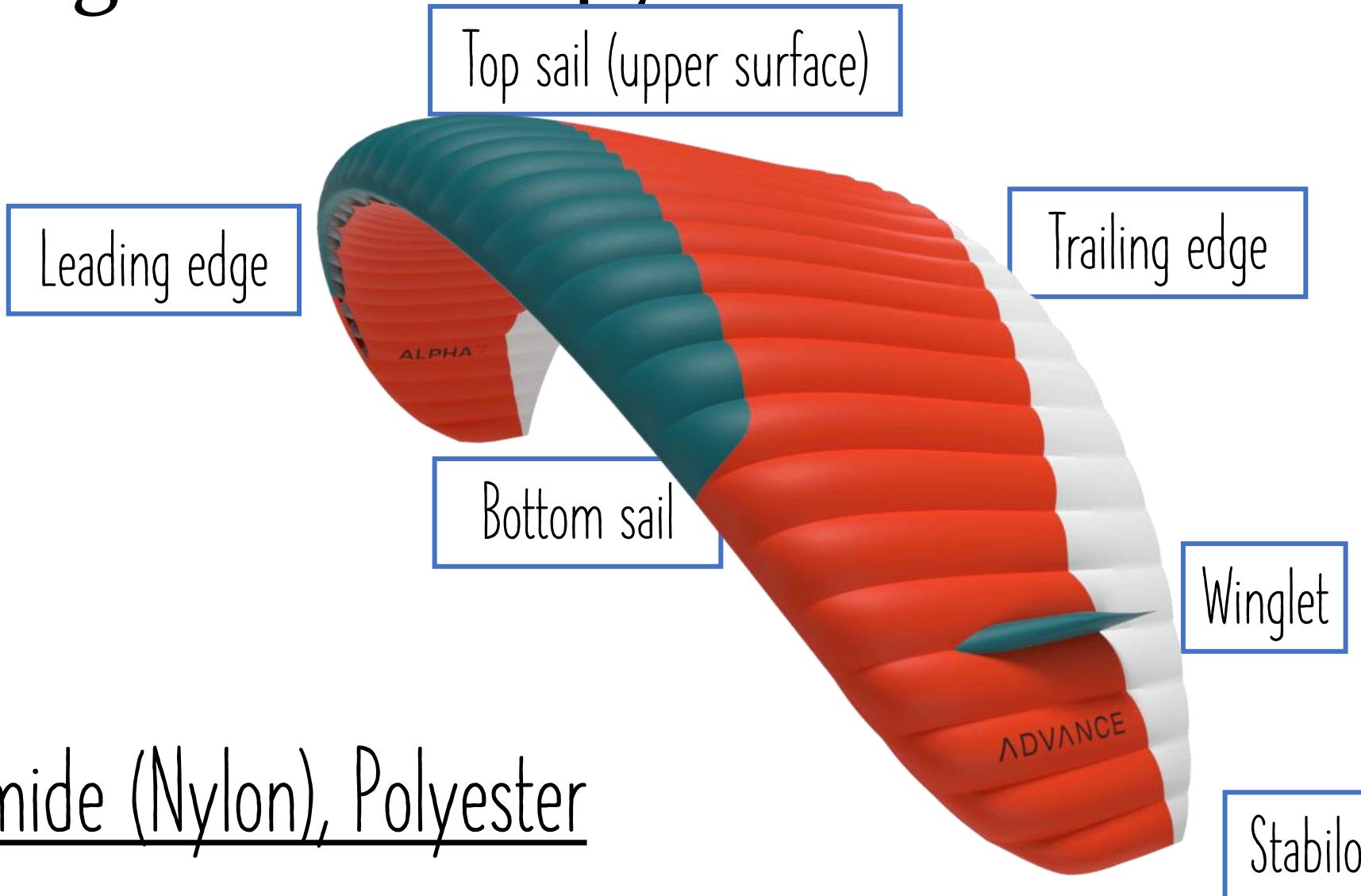
Protecting the coating

Damage

- Mechanical (tar, concrete)
- Chemical (detergents, salty water)
- Exposure to sun (Ultra violet radiation)
- Moisture + temperature changes

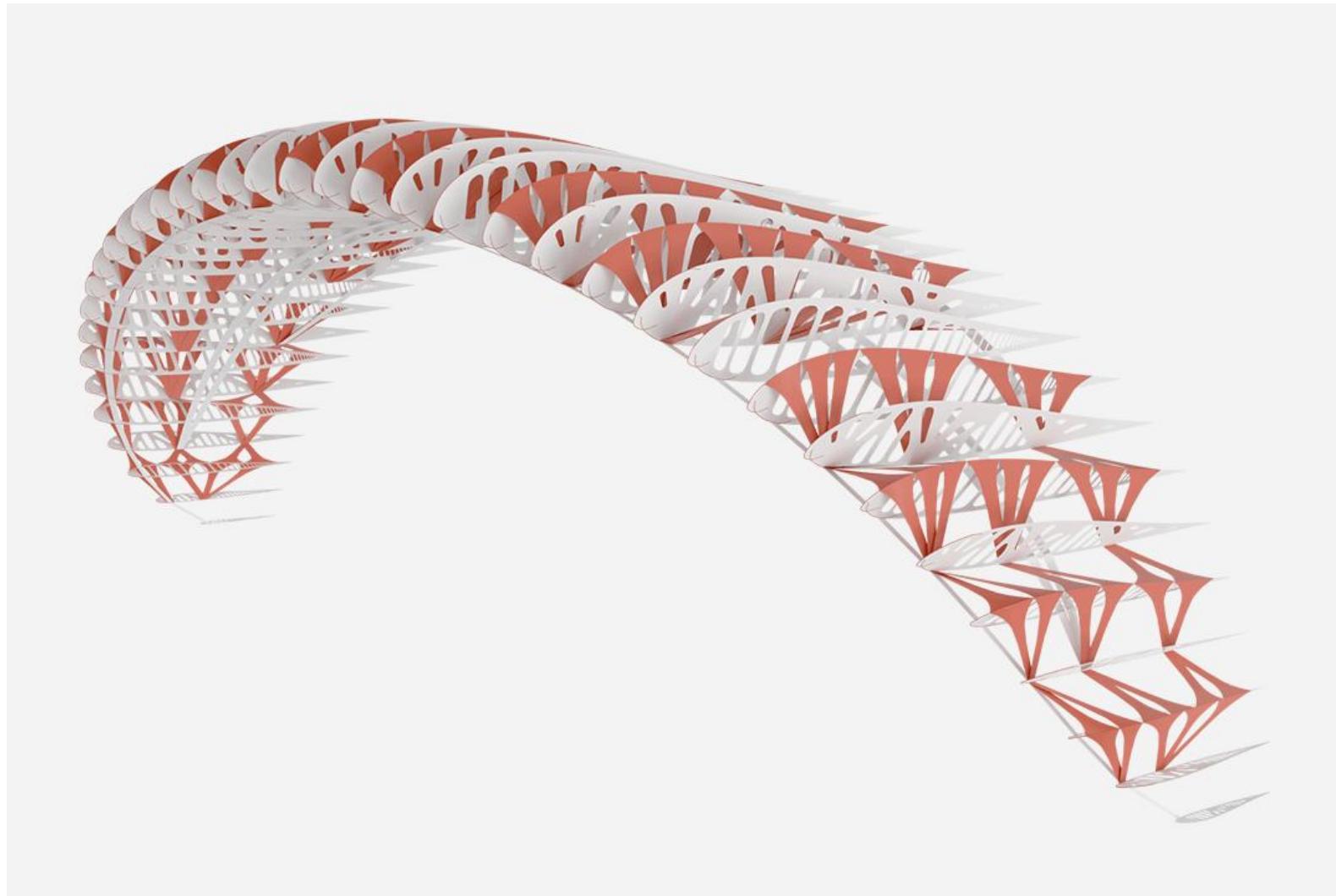


Paraglider - canopy



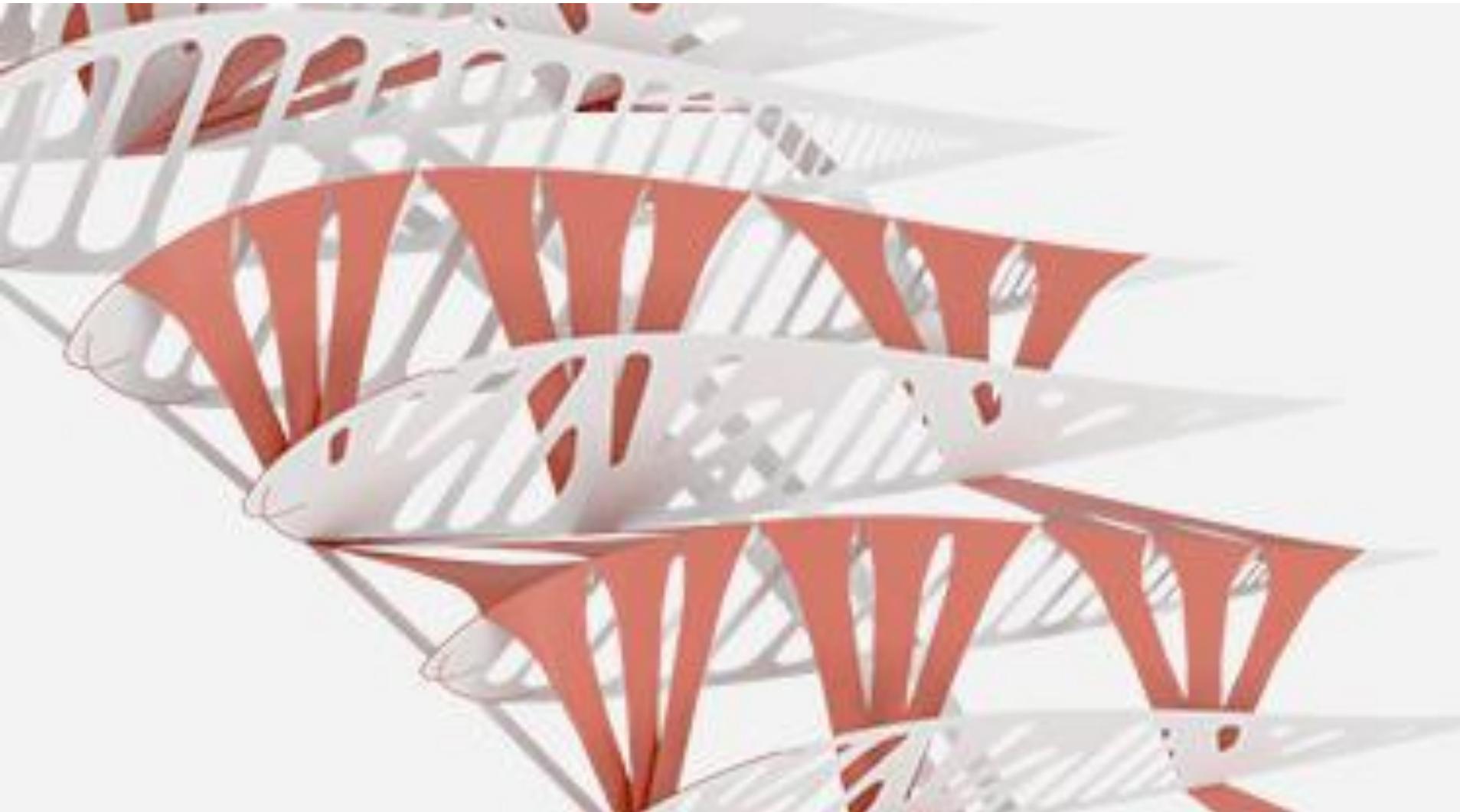
Polyamide (Nylon), Polyester

Paraglider - canopy



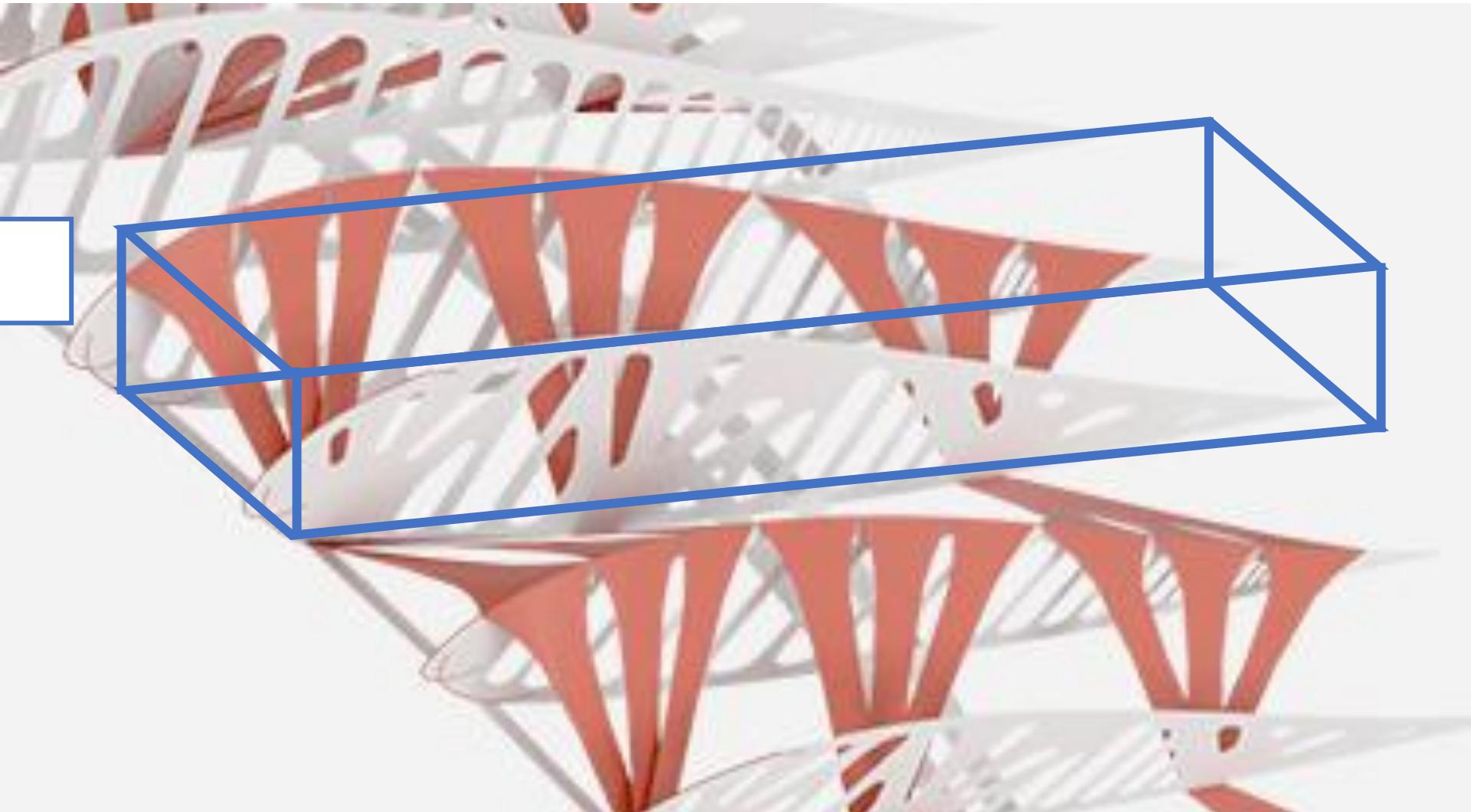
FLYwithMIKI.COM

Paraglider - canopy

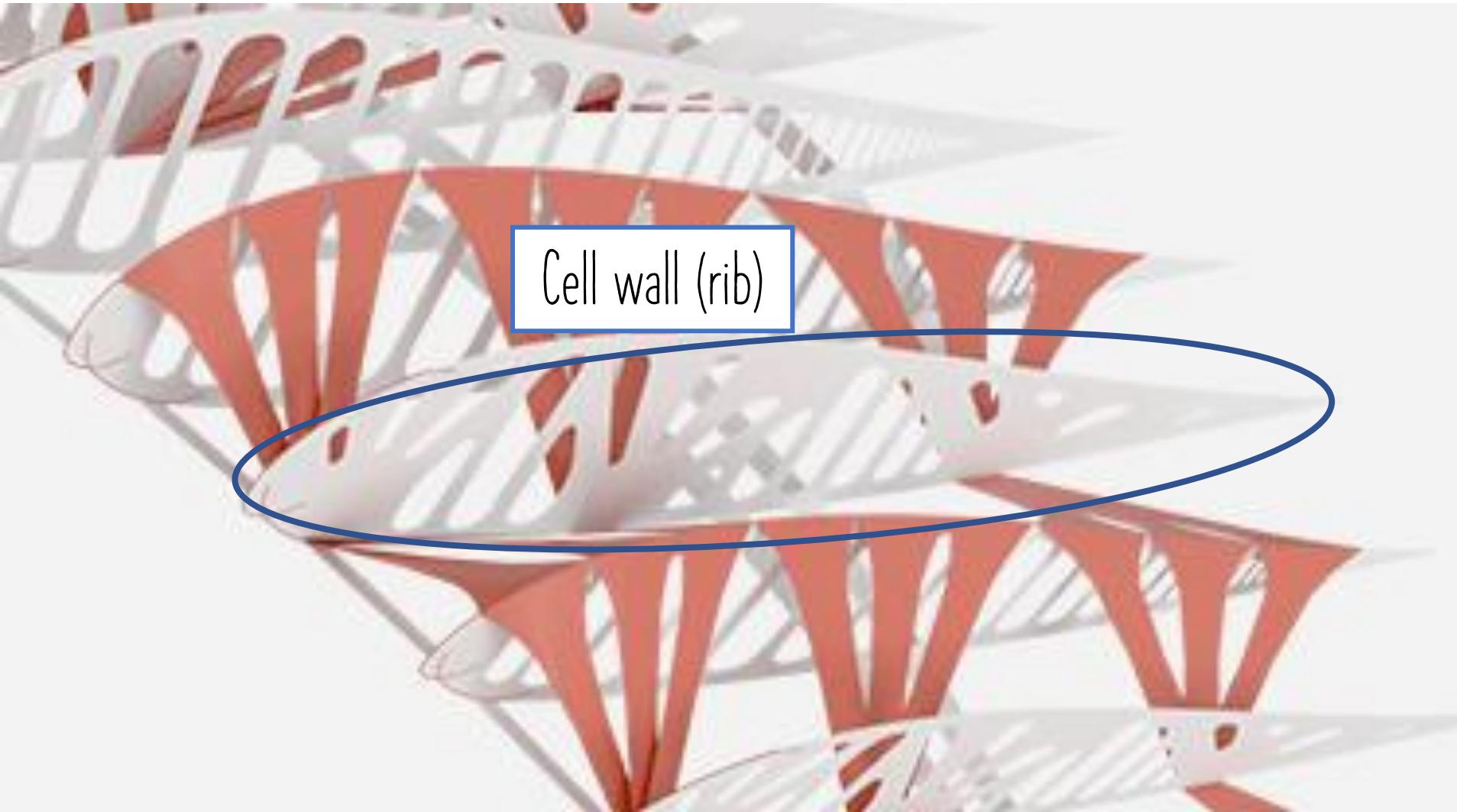


FLYwithMIKI.COM

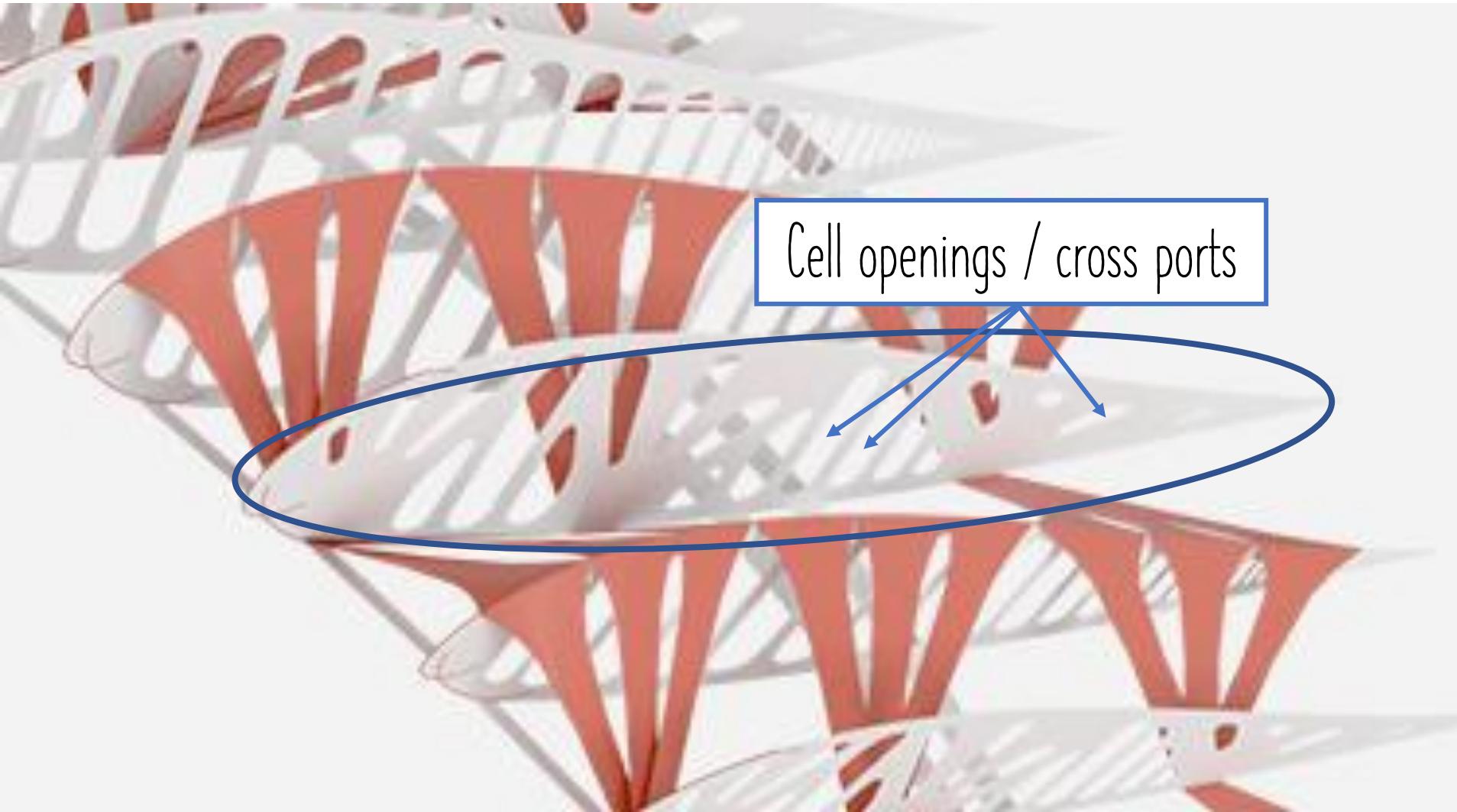
Paraglider - canopy



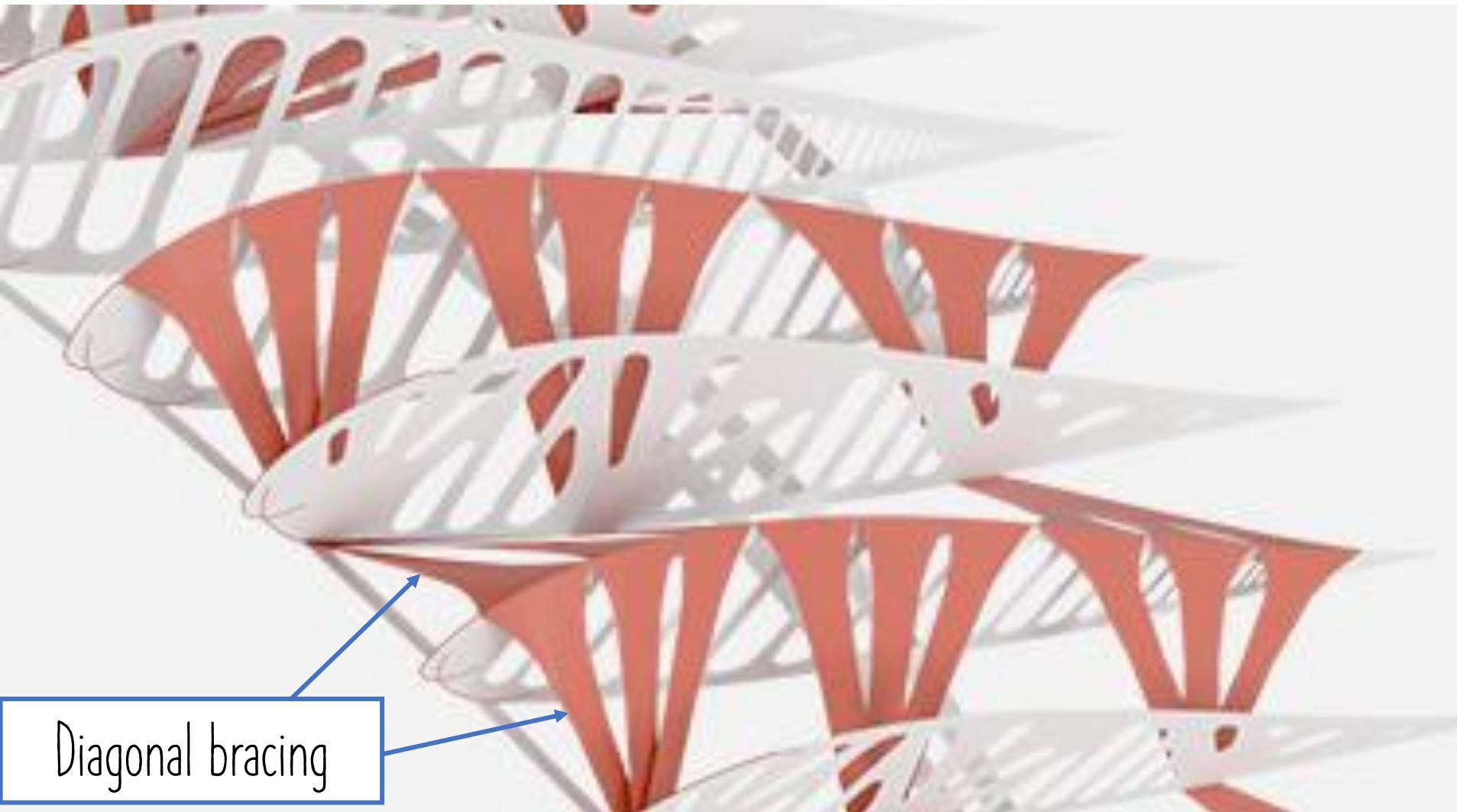
Paraglider - canopy



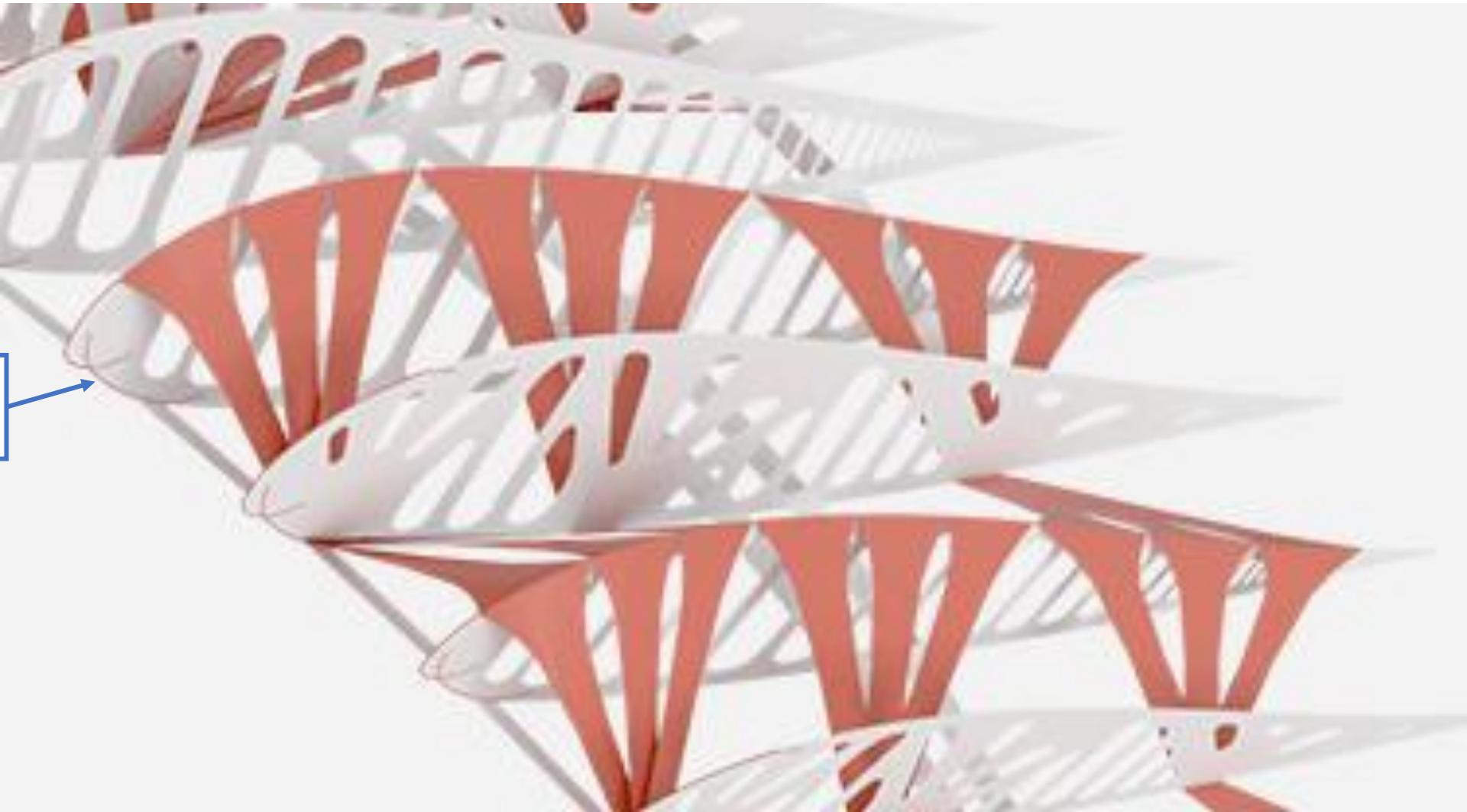
Paraglider - canopy



Paraglider - canopy



Paraglider - canopy



Paraglider

- Canopy
- Lines
- Risers
- (Speed system)
- (Harness)



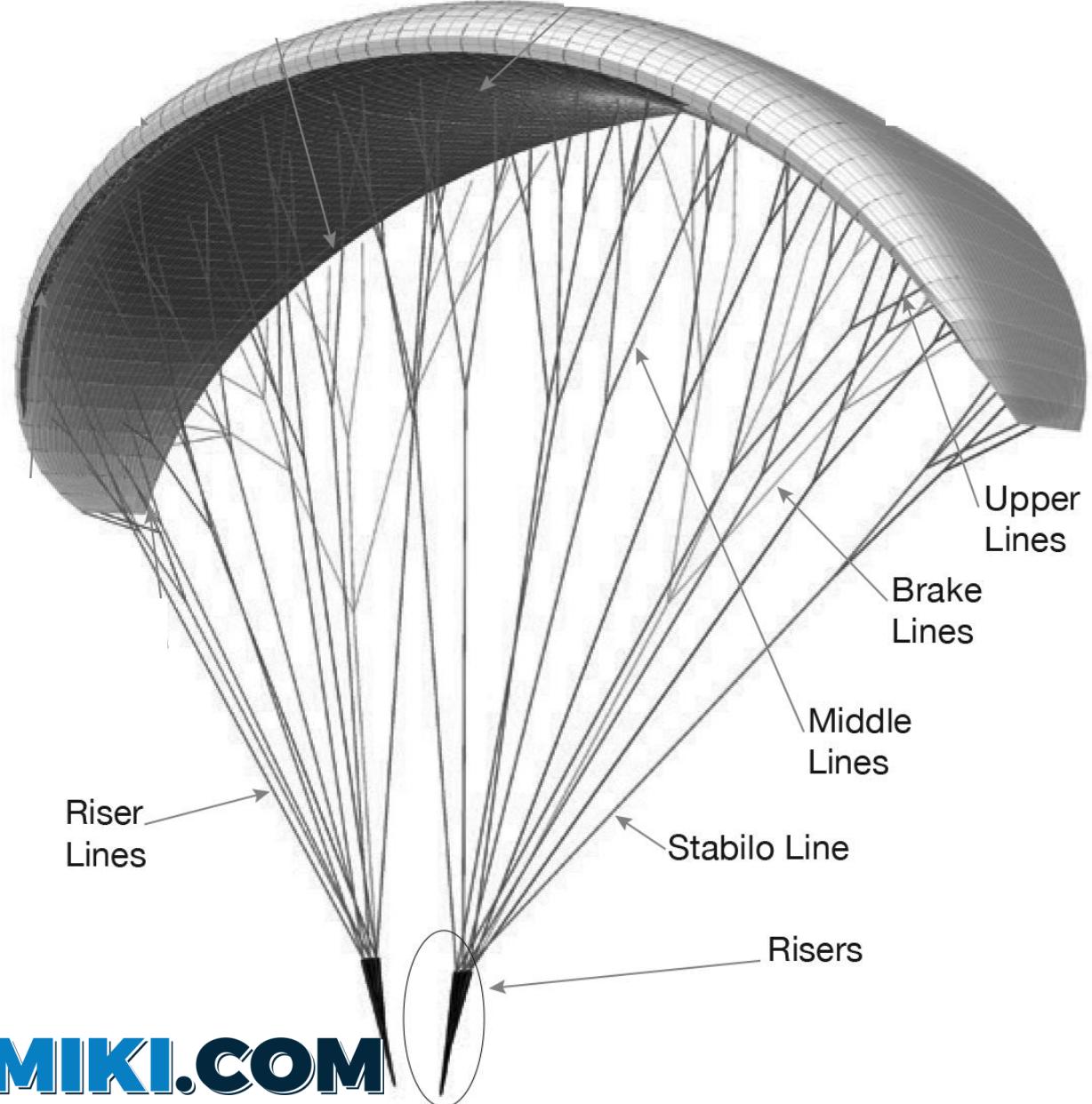
Paraglider - lines

Material:

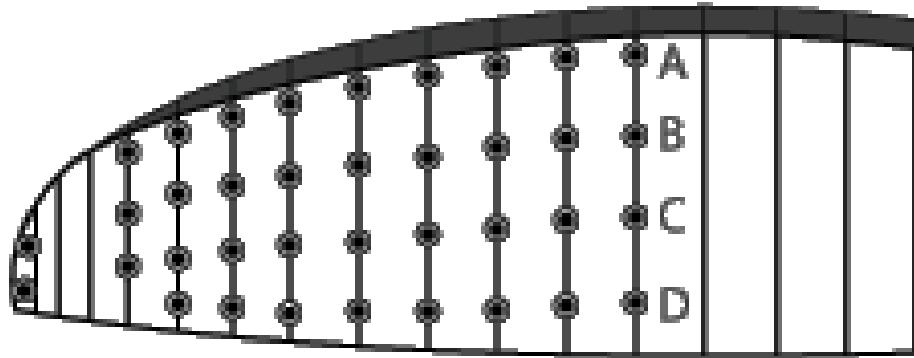
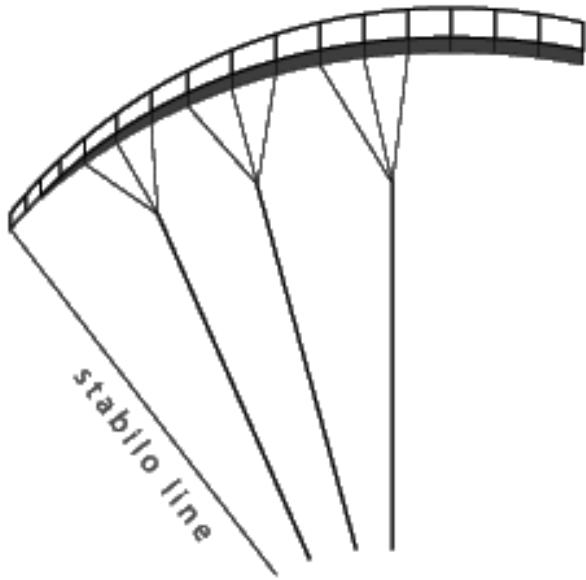
- Polyethylene (Dynemma, Spectra)
- Aramid (Kevlar, Technora)
- Liquid crystal polymer LCP (Vectran)
- PBO (Zylon)

Paraglider - lines

- Upper (cascade) lines / gallery
- Middle (cascade) lines
- Main lines (riser lines)
- Stabilo
- Break

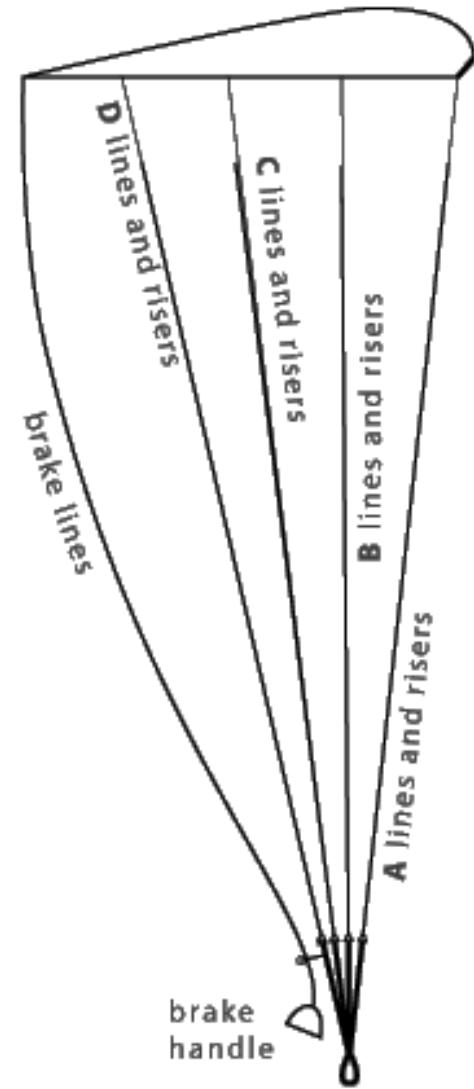


Paraglider - lines



A, B, C и D rows
of attachment points
of right lines

Paraglider suspension elements



Paraglider - lines

REQUIREMENTS:

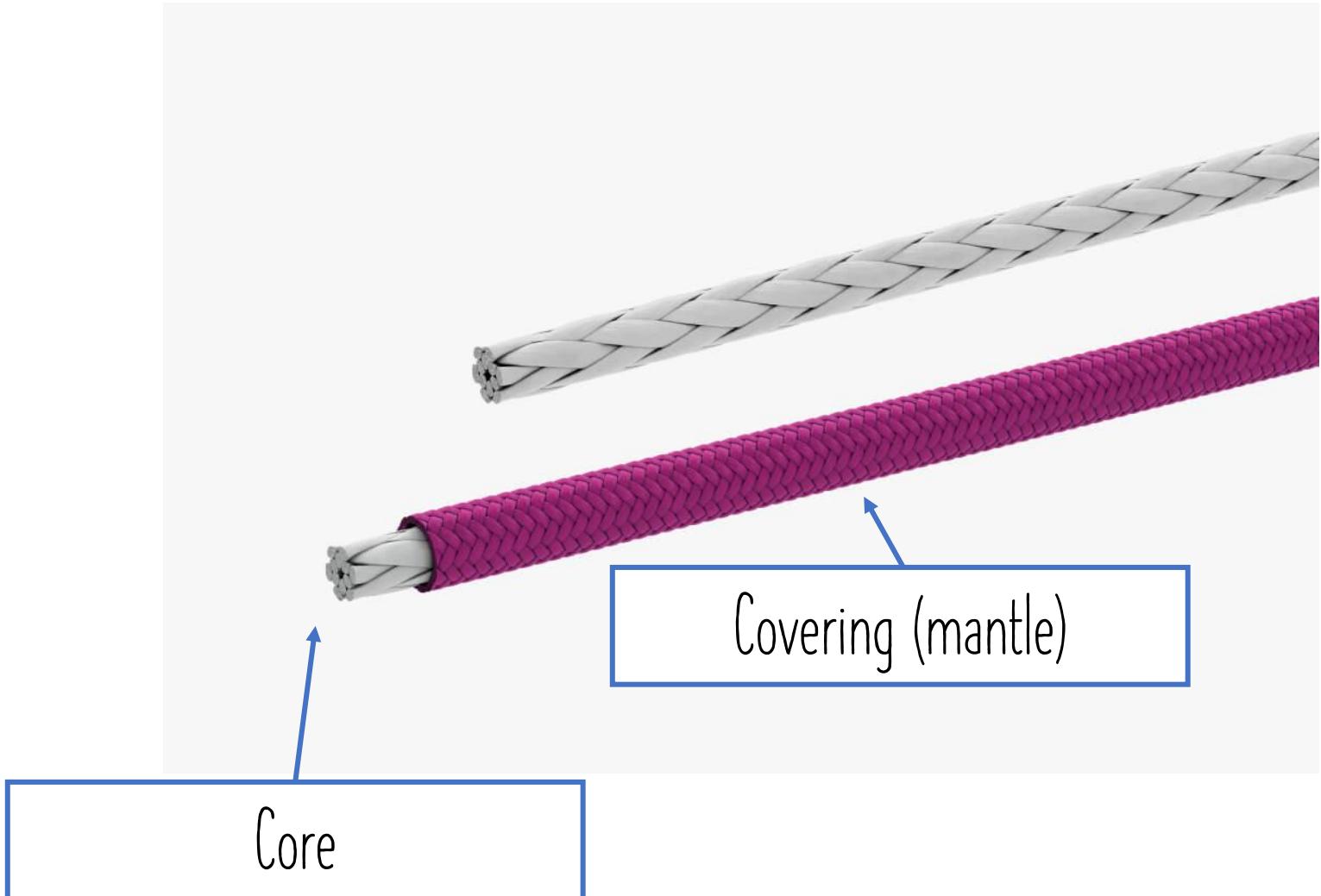
- Low elasticity
- High load capacity
- Minimum diameter



Paraglider - lines

REQUIREMENTS:

- Low elasticity
- High load capacity
- Minimum diameter



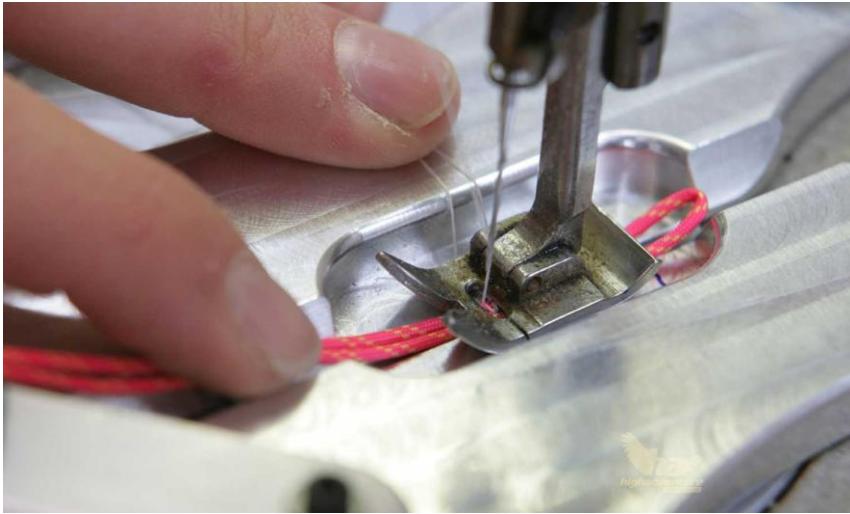
Paraglider - lines

Durability  Drag

Thinner line: less drag, but higher
tendency for knots

A-B lines takes more than double the
load of C-D lines

Paraglider - lines



- Sewing
- Splicing



Paraglider - lines

To the glider: looped



To the riser:

Maillone (quick link)

Softlink



Paraglider - lines

Damages:

- Shrinking / shortening
- Lengthening
- Damaging the cover



Paraglider - lines

Scenarios:

- A lines (elongation, shortening)
- B lines (shortening)
- D lines (elongation, shortening)

Profile?

Angle of attack?

Inflation?

Speed?

Stall tendency?

Frontal tendency?

Paraglider - lines

5 m lines

- Higher center of gravity
- Smaller magnitude of oscillation



7 m lines

- Lower center of gravity
- Bigger pendulum with sudden direction changes

Paraglider

- Canopy
- Lines
- Risers
- (Speed system)
- (Harness)



Paraglider – risers & speed system



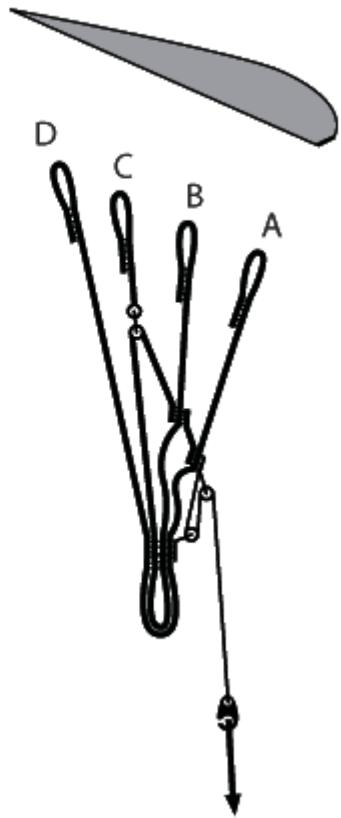
Paraglider – risers & speed system



Paraglider – risers & speed system



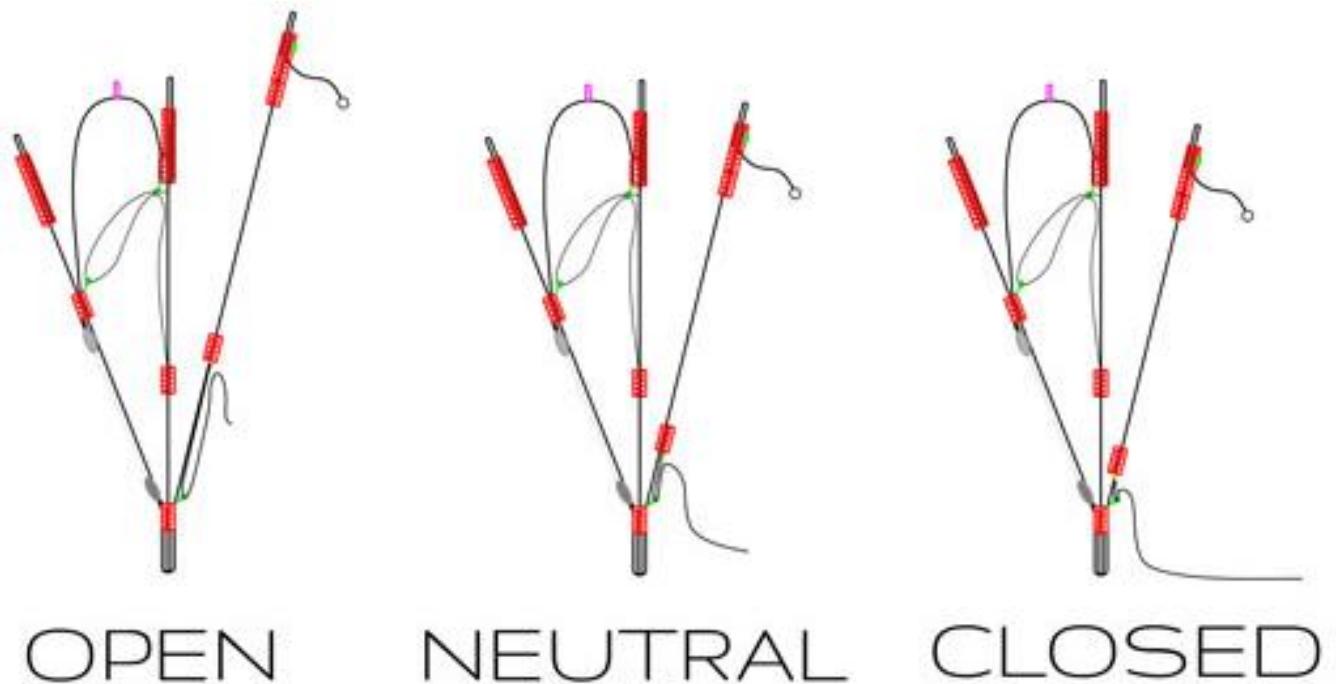
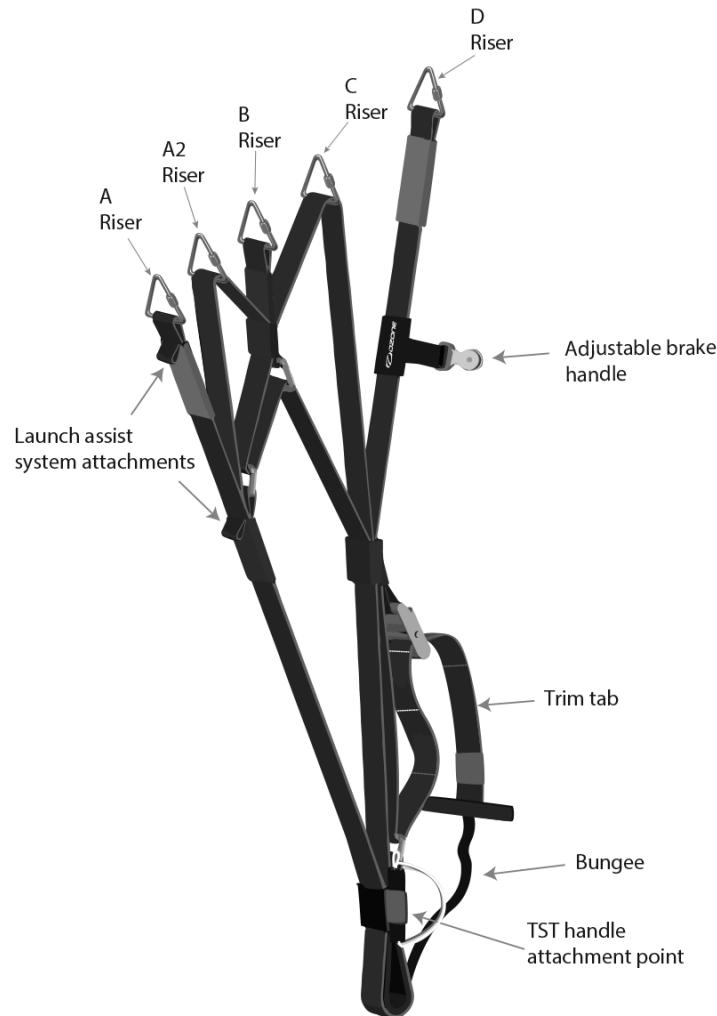
Speed system



Foot accelerator

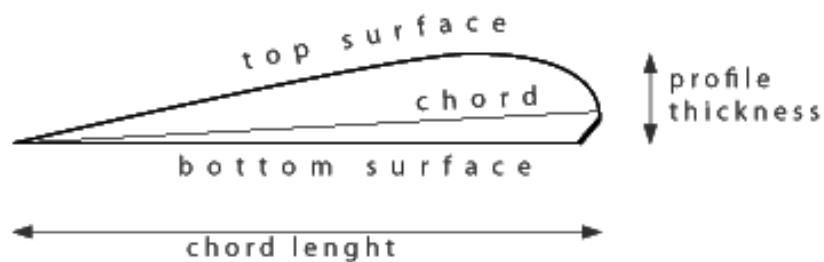
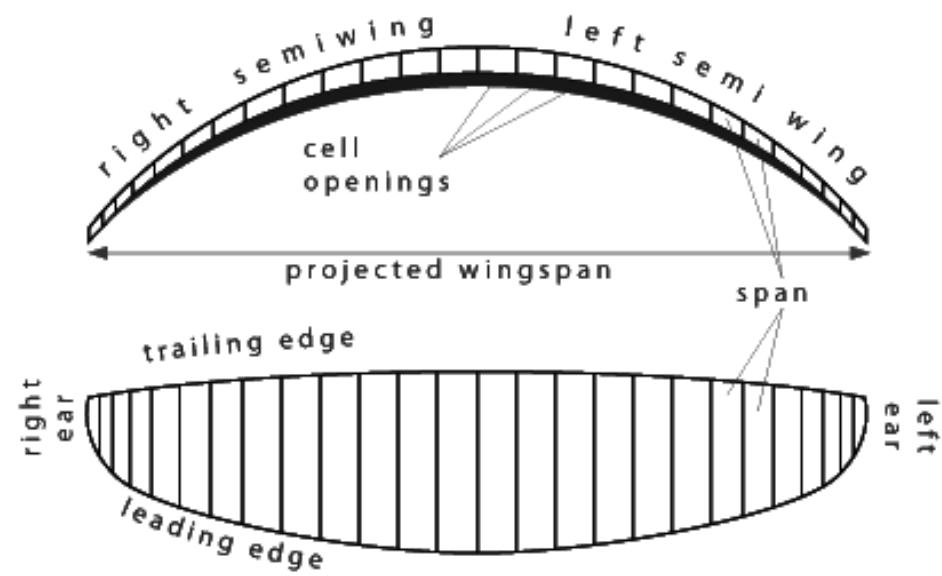


Paraglider – risers & speed system



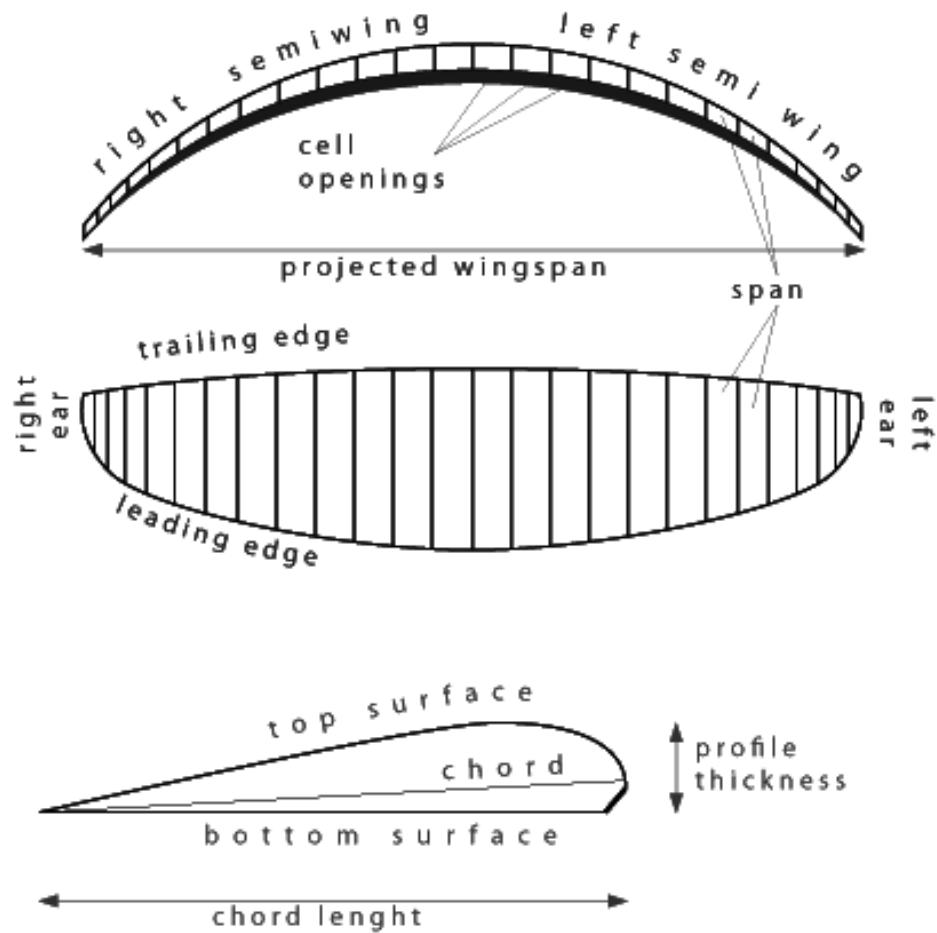
Trim tab

Paraglider - geometry

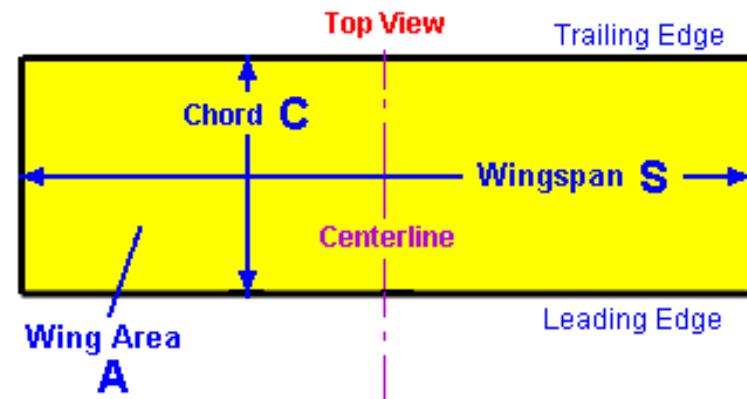


Wing elements viewed from in front, above and a profile section

Paraglider - geometry



Wing elements viewed from in front, above and a profile section



$$\text{Aspect Ratio} = \text{AR}$$
$$\text{AR} = \frac{S^2}{A} = \frac{S}{C}$$

Aspect ratio

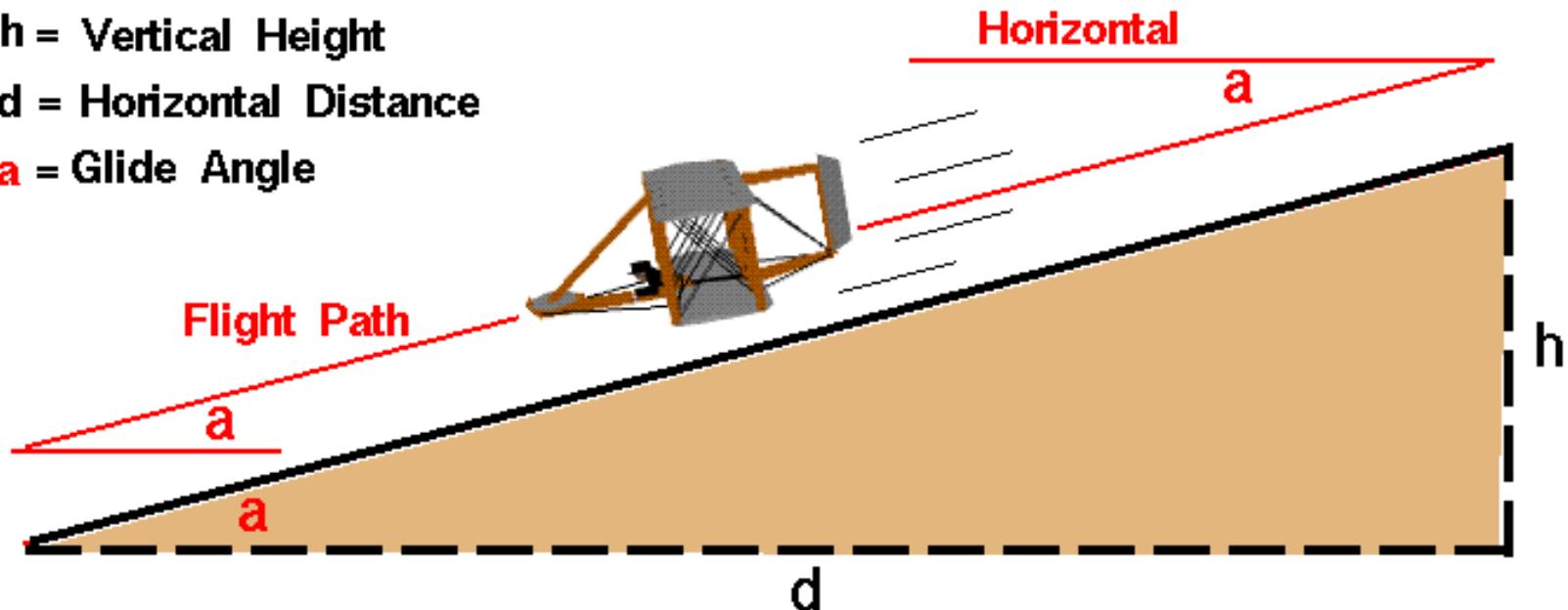
Paraglider - geometry



Glide Angle Glide Ratio

Glenn
Research
Center

h = Vertical Height
 d = Horizontal Distance
 a = Glide Angle



From trigonometry : $\tan(a) = \frac{h}{d}$ ratio = $\frac{\text{Vertical Height}}{\text{Horizontal Distance}}$

Paraglider

Wing loading = Total weight / Surface area



© BRIAN SCHMIDT 2020

Paraglider

Total weight???



Paraglider

Total weight:

Pilot

Glider

Harness

Rescue

Packing (container, backpack, etc)

Helmet

Instruments

Clothes

• • •



Paraglider

Wing loading = Total weight / Surface area

3-4 kg/m²

Effect on the flying characteristic???



© BRIAN SCHMIDT 2020

Paraglider

„Yearly“ check

Paraglider

Lifetime

Handling

Water landing

Repairing

Paraglider – Maintenance

„Yearly“ check

- Visual



Glider – Maintenance

„Yearly“ check

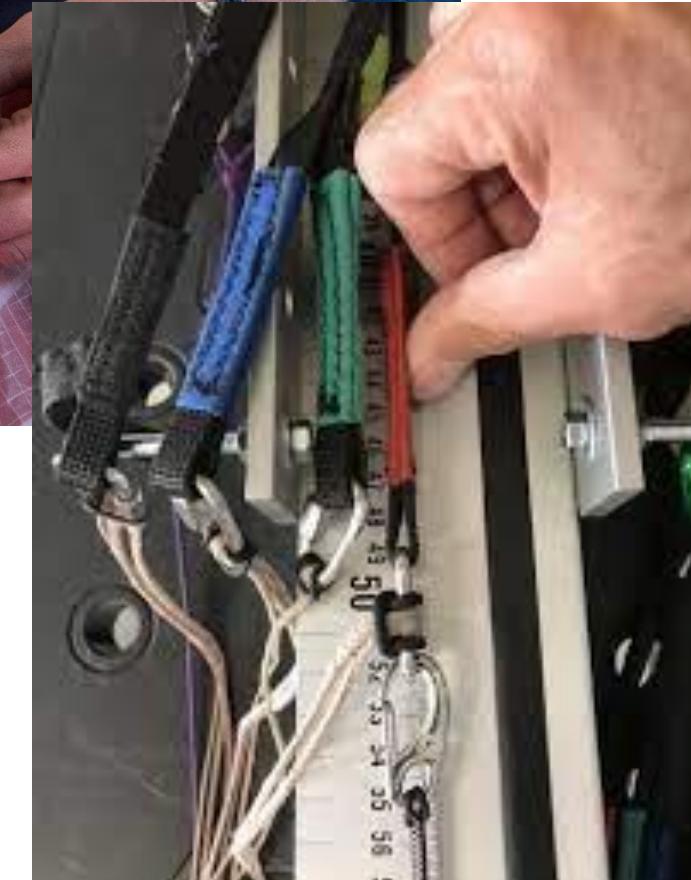
- Visual
- Measure the porosity



Glider – Maintenance

„Yearly“ check

- Visual
- Measure the porosity
- Measure the lines (trimm)



Glider – Maintenance

„Yearly“ check

- Visual
- Measure the porosity
- Measure the lines (trimm)
- Betsometer



Glider – Maintenance

„Yearly“ check

- Visual
 - Measure the porosity
 - Measure the lines (trimm)
 - Betsometer
-
- REPORT



Glider – How to choose

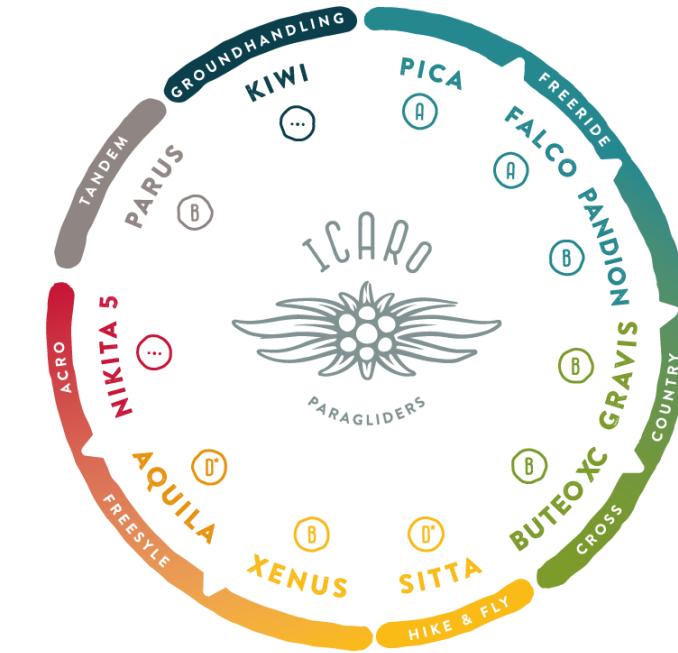
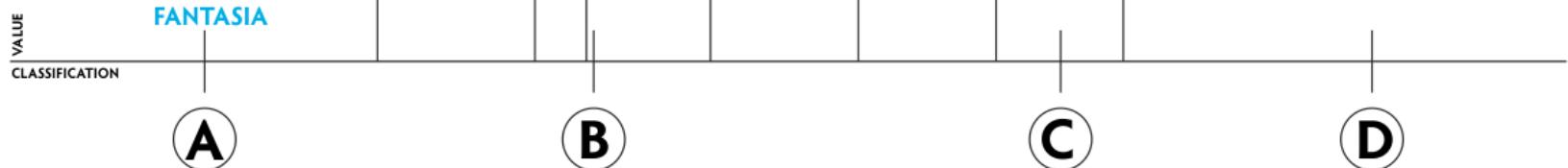
TYPE (A, B, C, D, CCC)



Glider – How to choose

TYPE (pilot knowledge, requirements)

SIZE!!!



Glider – How to choose

Test report

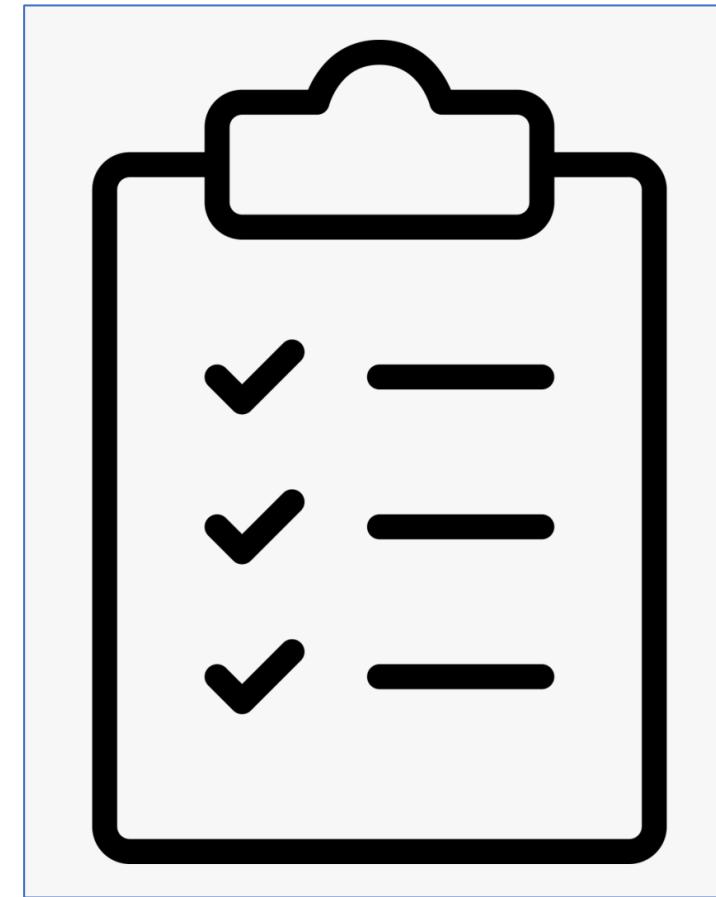


Glider – How to choose



Glider – How to choose

Safety class



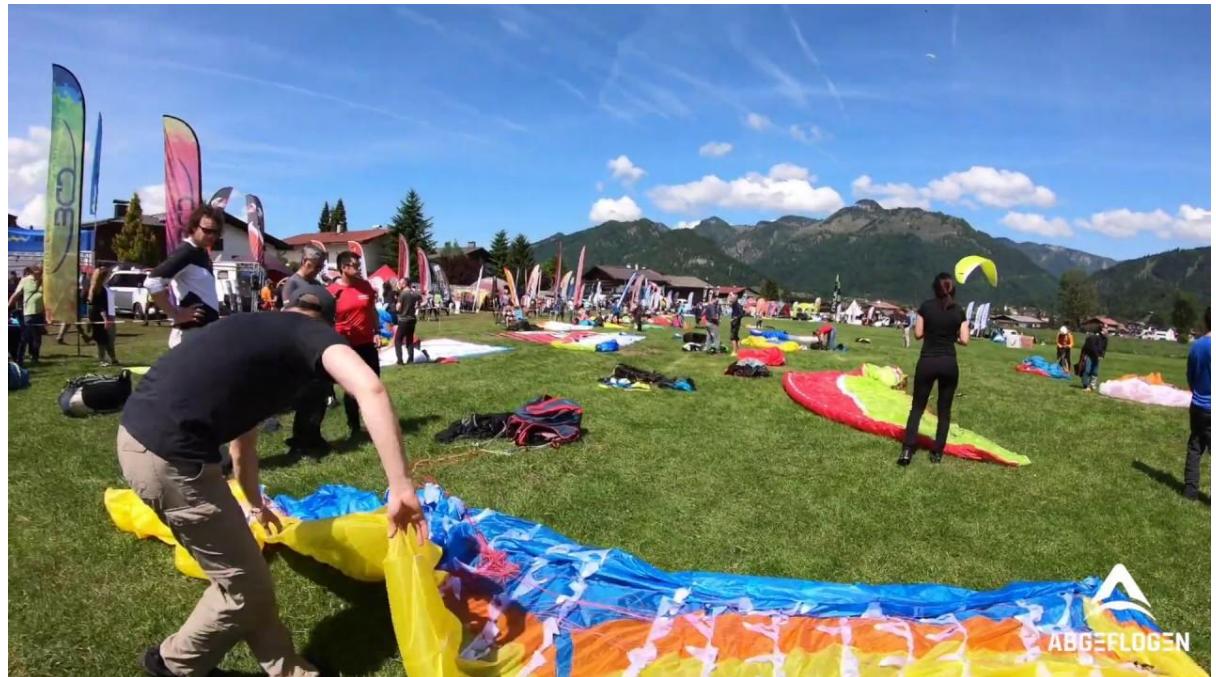
Glider – How to choose?

TYPE (pilot knowledge, requirements)



SIZE!!!

Brand (no importance, test it!)



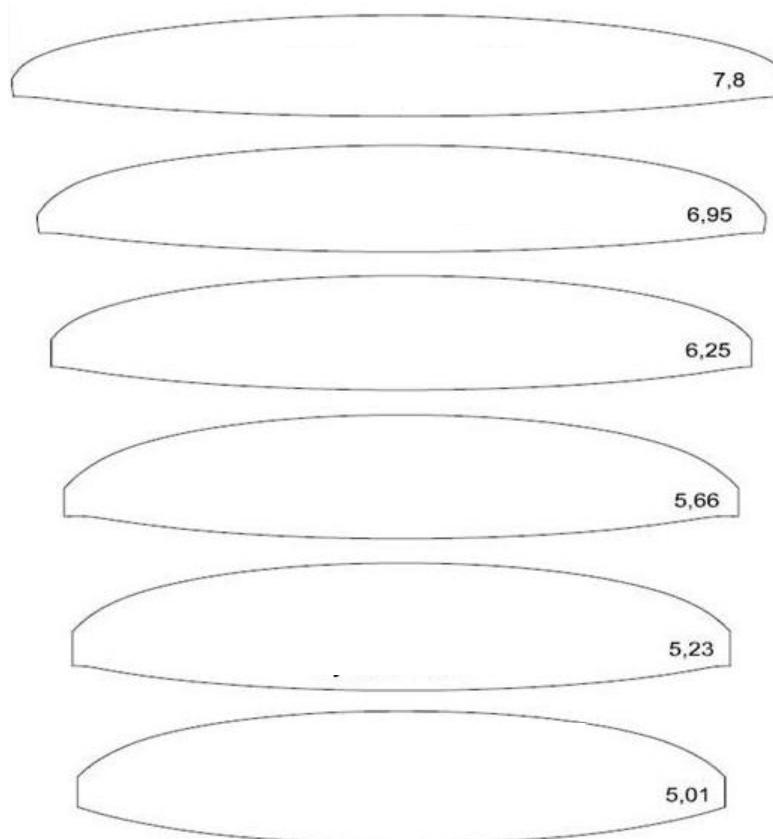
Paraglider - categories

Competition? Acro?

Cross country?

Hike & Fly?

Relaxed weekend flights / soaring?

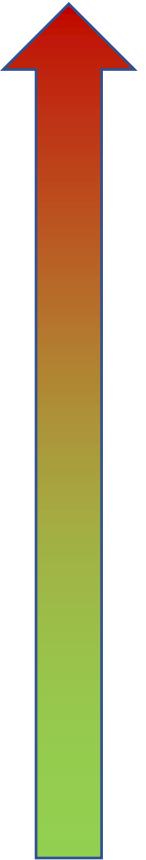


CCC

EN - C/D

EN - B

EN - A



Performance \leftrightarrow Passive safety

FLYwithMIKI.COM

Equipment

- Paraglider
- Harness
- Rescue
- Other equipment



Harness - types



Harness - protection

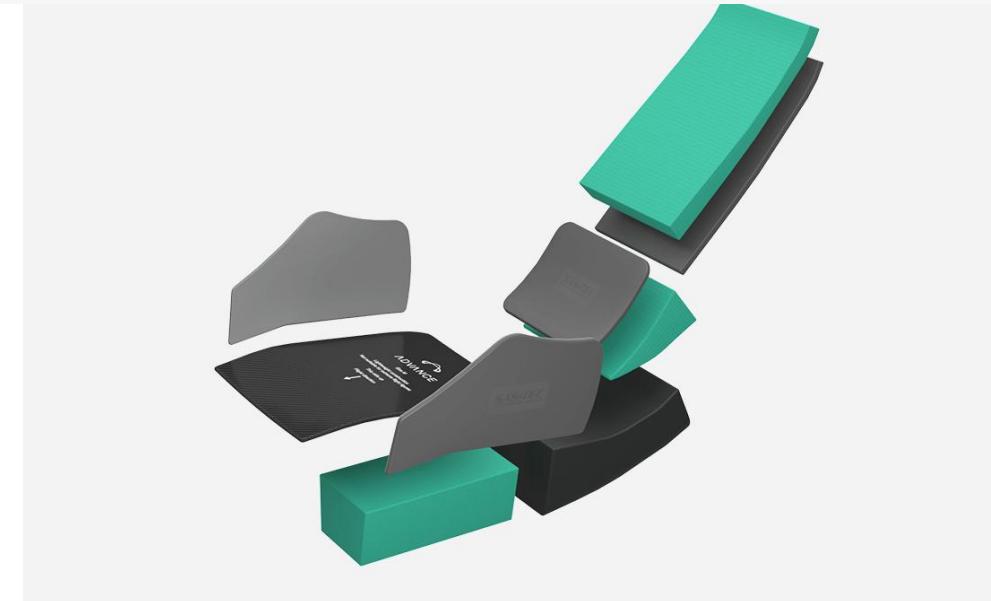
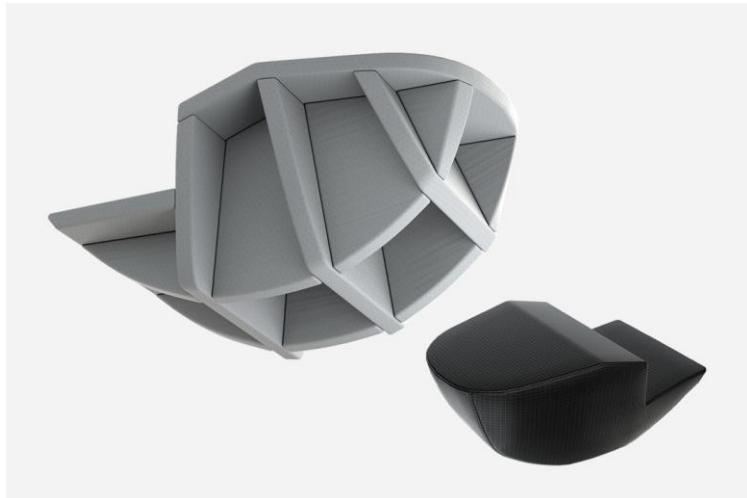


Hike & Fly harness

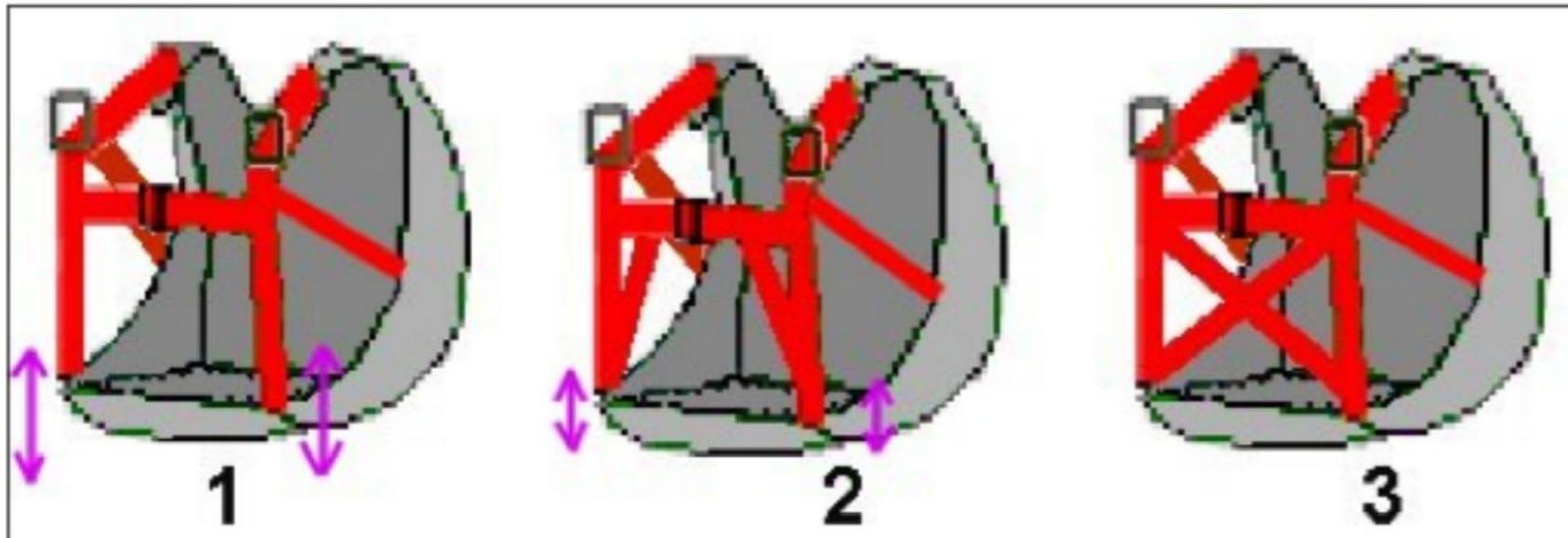


Harness - protection

- Airbag
- Hybrid (Airbag-Foam)
- Foam



Harness - bracing



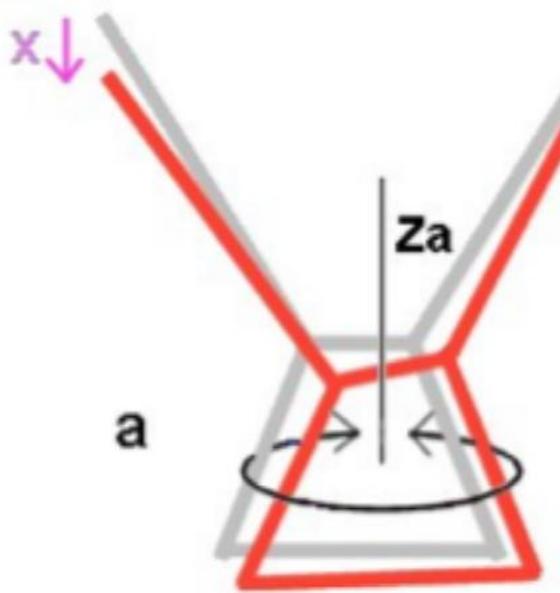
Easy to weightshift

Difficult to weightshift

Feel of Turbulence

Less feel of turbulence

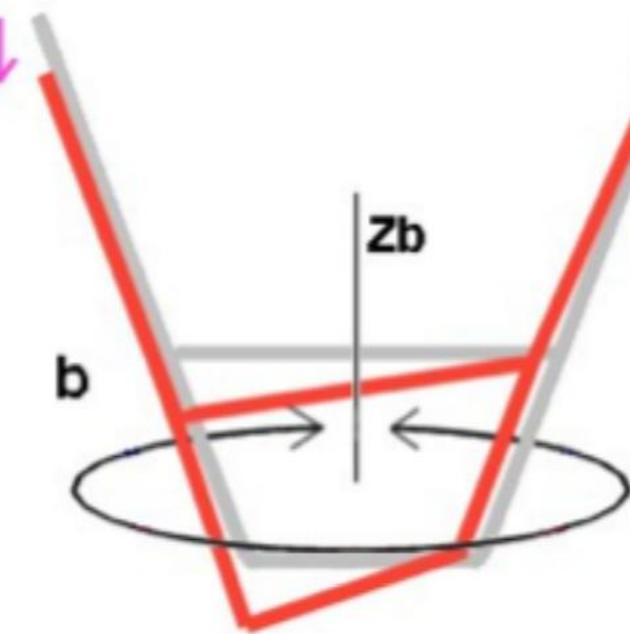
Harness – Carabiner position



a

Higher twist tendency

Less feel of turbulence

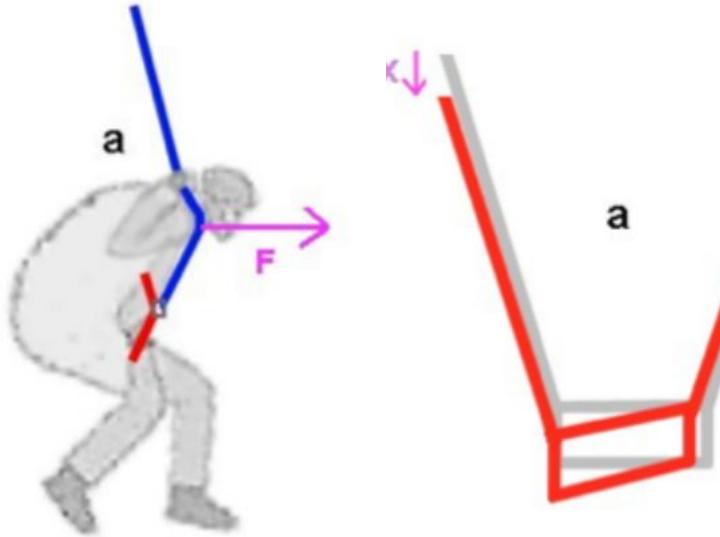


b

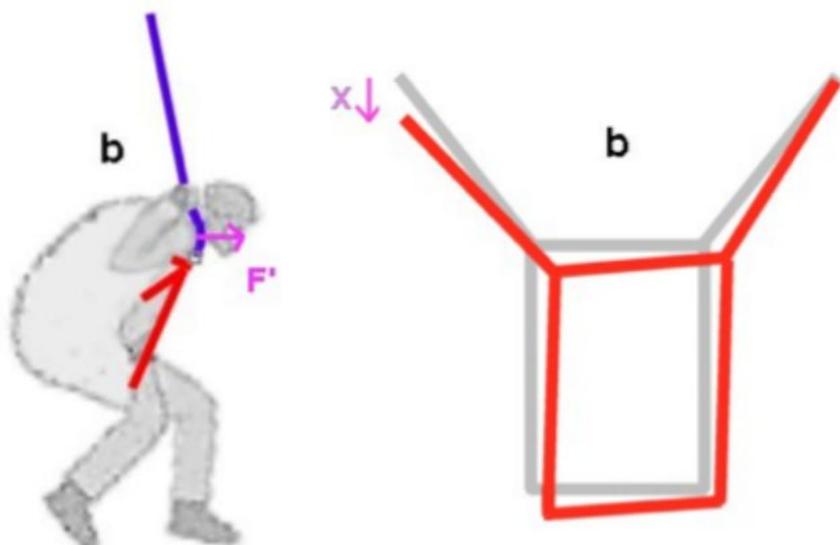
Smaller twist tendency

Feel of Turbulence

Harness – Carabiner position



Easier to takeoff
Bigger feel of turbulence



More difficult to takeoff
Less obvious turbulence

Harness – how to choose

TYPE (pilot knowledge, requirements)

SIZE!!!

Brand (no importance, test it!)



Equipment

- Paraglider
- Harness
- Rescue
- Other equipment

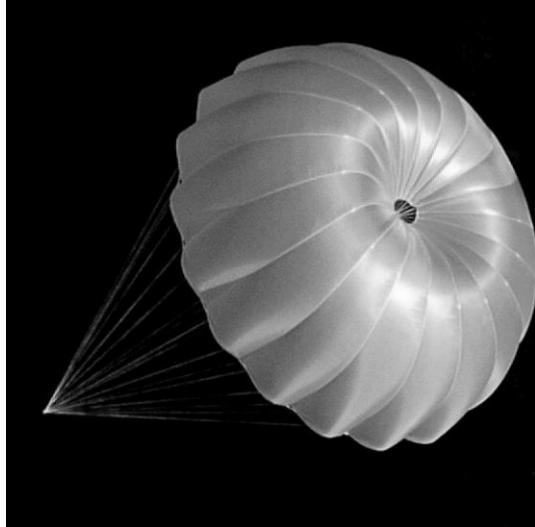


Rescue



FLYwithMIKI.COM

Rescue - types



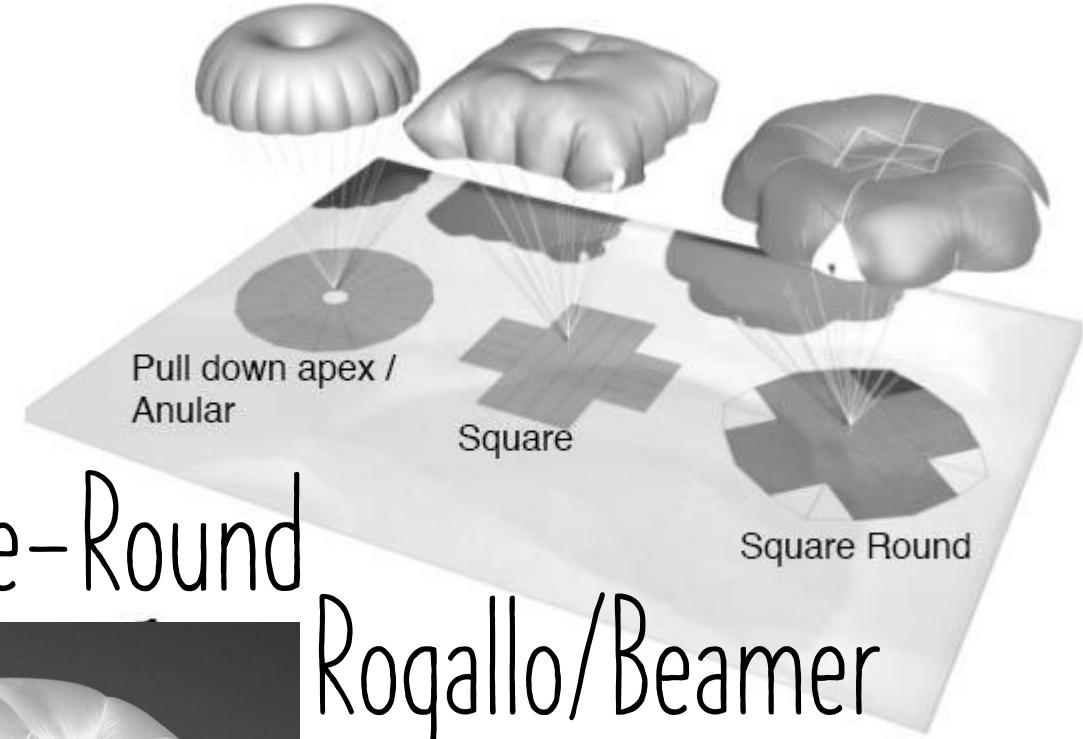
Round



Square

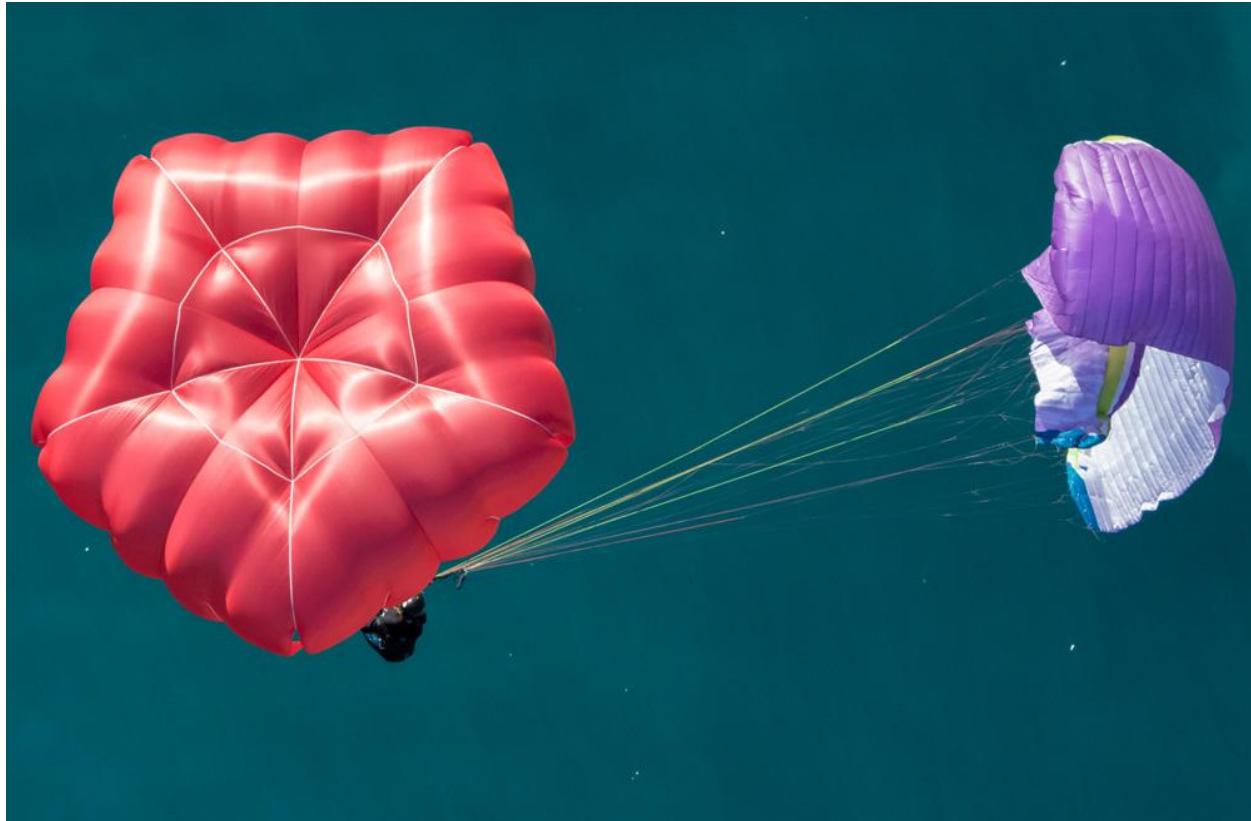


Square-Round



Rogallo/Beamer

Rescue - types



Pentagon



Octagon

Rescue - material

1. Basis / leading edge
2. Canopy
3. Apex
4. Central line(s)
5. Lines
6. Connecting strap / Bridle



Canopy: Rip-stop Polyamide (Nylon)

Lines: Polyester / Polyamide

Rescue - position



Side container



Front container

Rescue – attachment point



High



Low



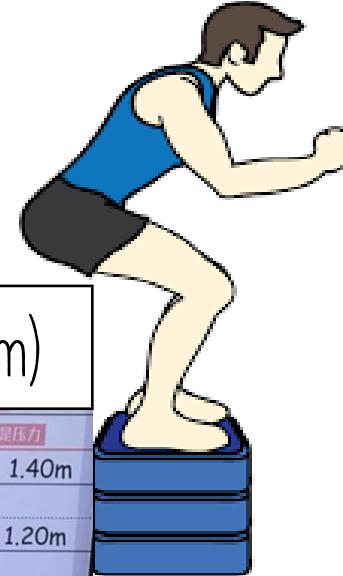
FLYwithMIKI.COM

Rescue – sink rate

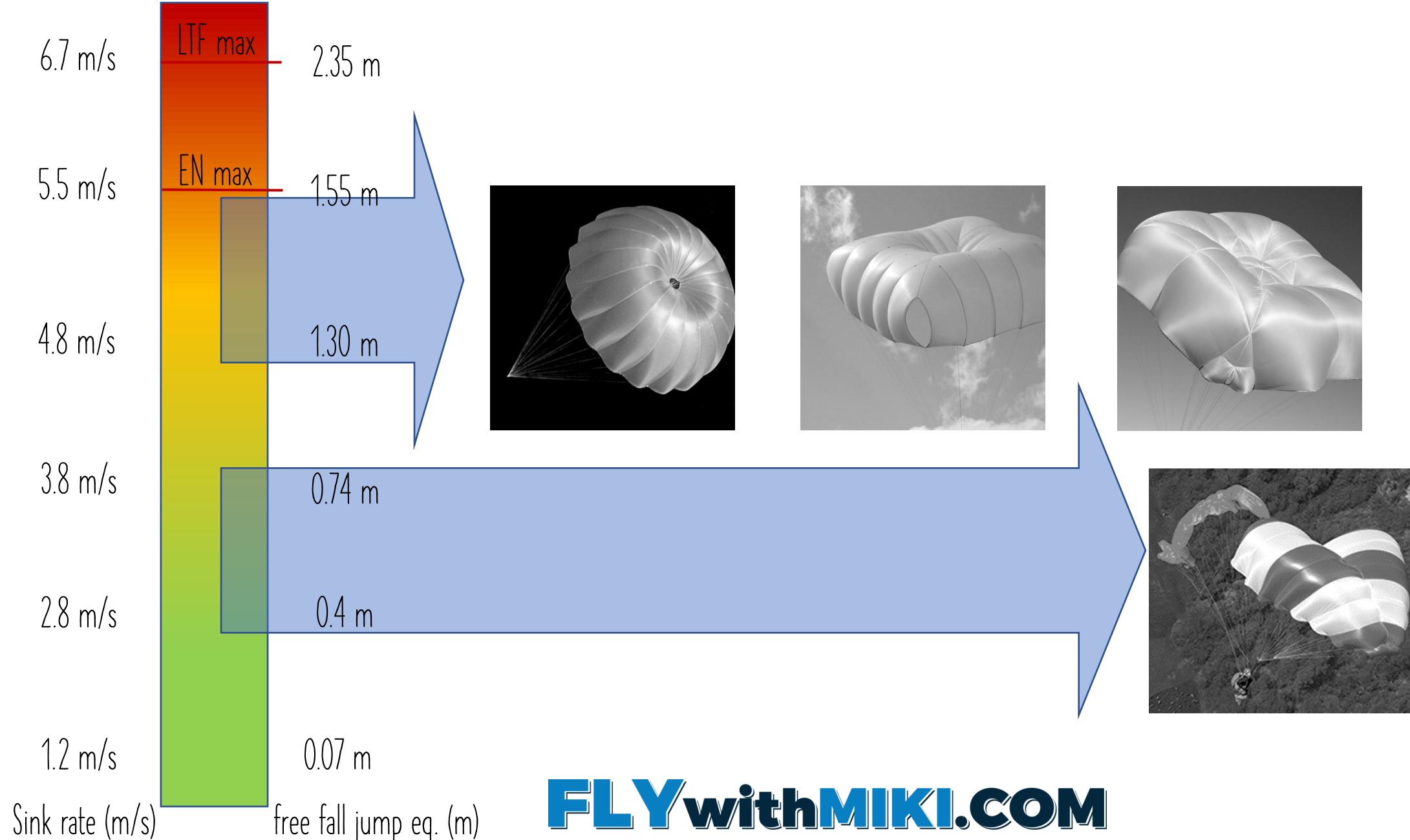


LTF Max 6.7 m/s (~2.35 m)

EN max 5.5 m/s (~1.55 m)



Rescue – sink rate



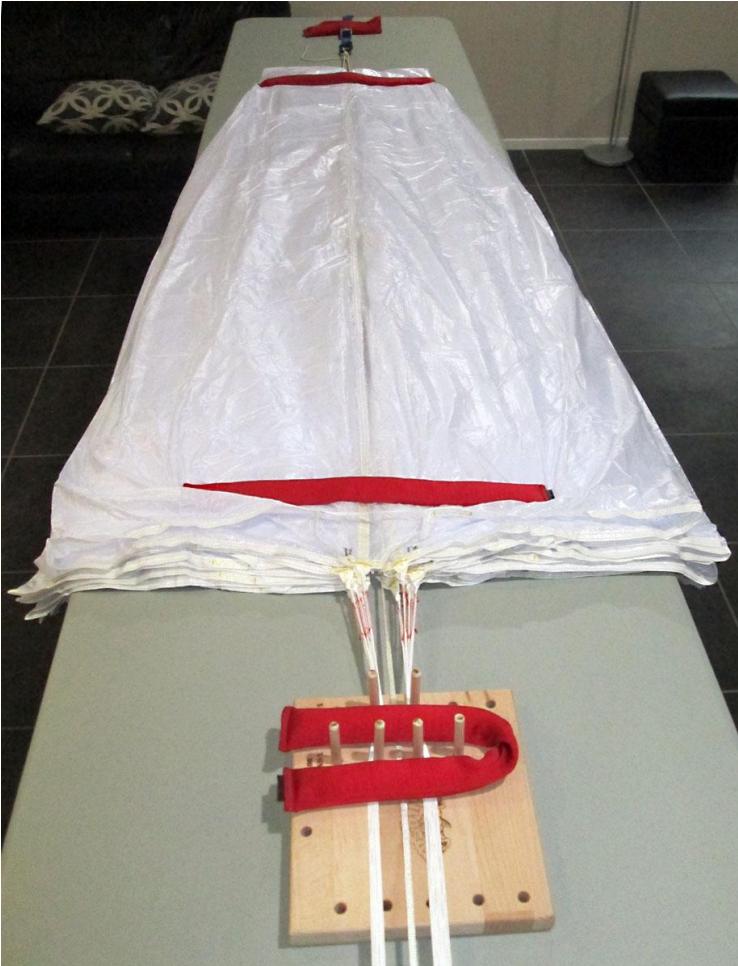
Rescue – Opening time



Factors:

- Porosity
- Packing intervall
- Airflow speed
- Handle position

Rescue - Maintenance



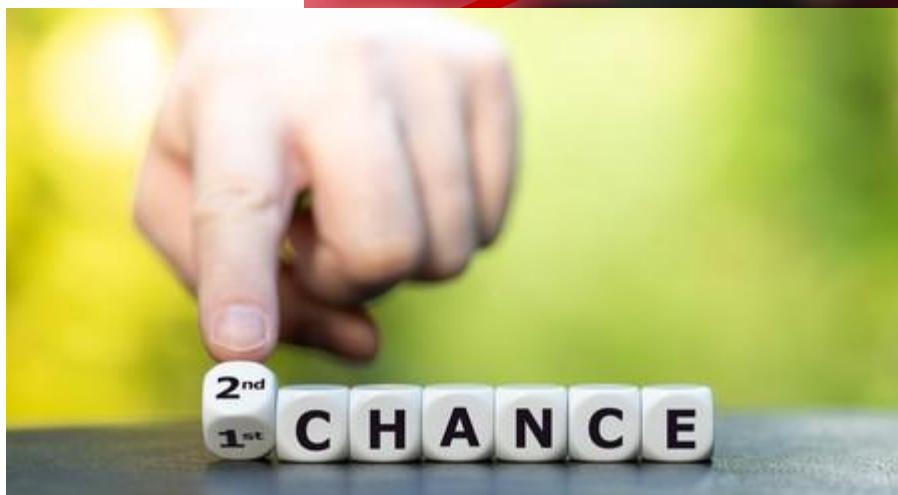
Rescue - Maintenance

Lifetime
Handling
Water landing
Repairing



Rescue - Maintenance

Lifetime
Handling
Water landing
Repairing



Rescue – How to choose

TYPE (pilot knowledge, circumstances)

SIZE!!!

Brand - no importance

Equipment

- Paraglider
- Harness
- Rescue
- Other equipment



Equipment - Instruments



FLYwithMIKI.COM

Equipment – Instruments

Variometer – GPS



Equipment – Instruments

Anemometer



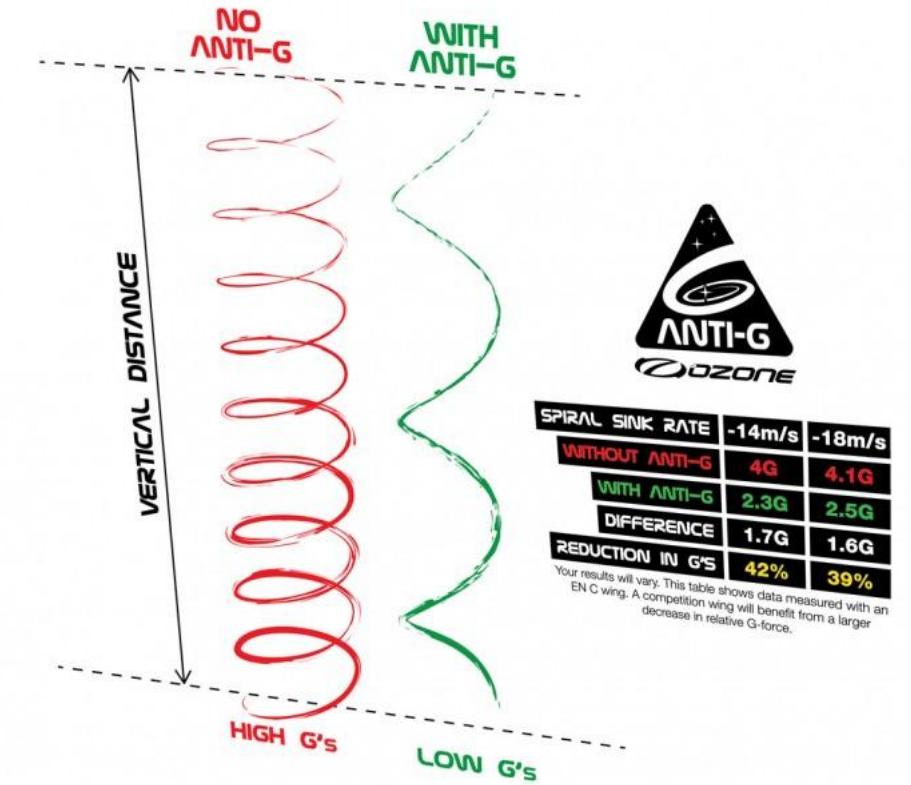
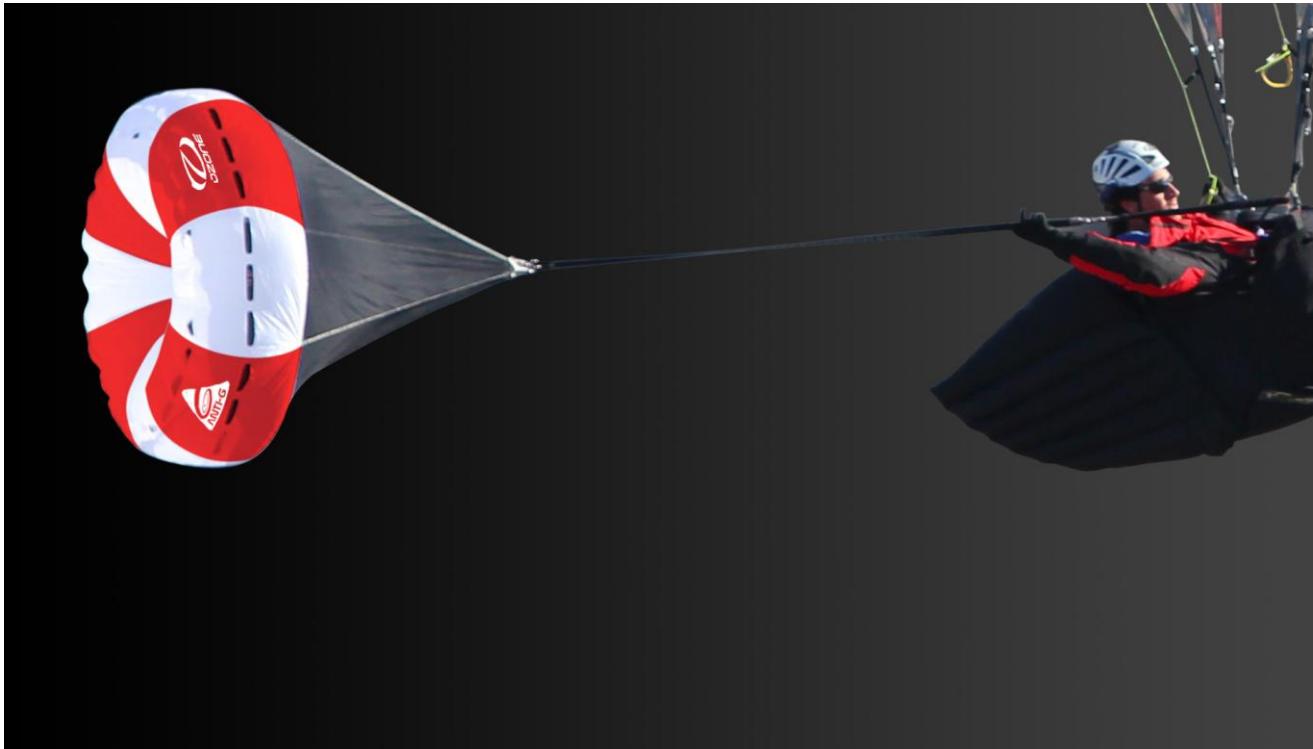
Equipment - Other

Radio



Equipment - Other

Anti G Parachute



Equipment - Other



TOILETTE



FLYwithMIKI.COM

Equipment - Clothing

EN-966



FLYwithMIKI.COM

Equipment - Clothing



FLYwithMIKI.COM

Equipment - Clothing



FLYwithMIKI.COM

Equipment - Clothing



FLYwithMIKI.COM

Equipment - Clothing



FLYwithMIKI.COM



FLYwithMIKI.COM

Additional equipment



FLYwithMIKI.COM

Additional equipment



FLYwithMIKI.COM

Additional equipment



FLYwithMIKI.COM

Thanks for your attention



FLYwithMIKI.COM