

The 34th Americas Cup in 160 years



The Yacht America – The boat that started it all in 1851

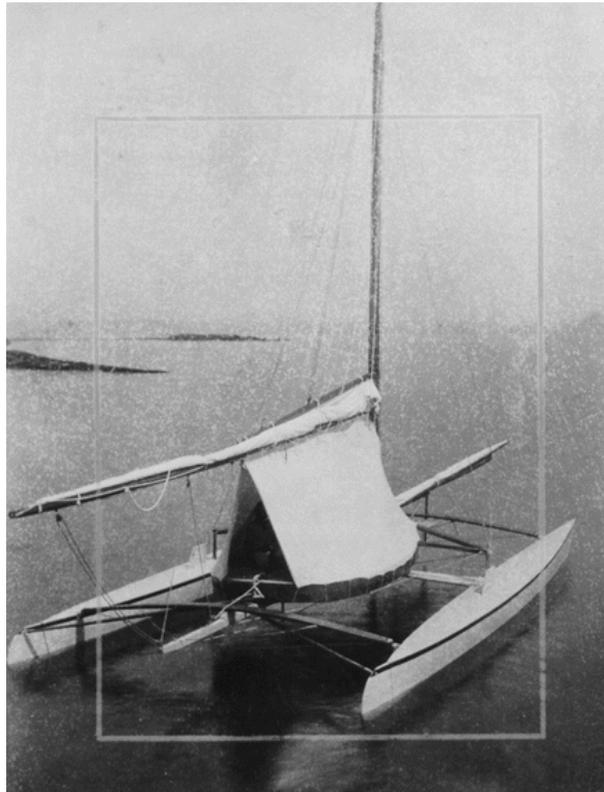
Brief Australian & Multihull History of the Cup

- Australia first Challenges in 1962 in Gretel
- 1967 Dame Pattie
- 1974-1980 Alan Bond
- 1983 Successful Australia 2
- 1987 Australia is a Defender
- 1988 DOG Match 60ft wing cat
- 1995 Challenger One Australia sinks
- 2010 USA 17 & Alinghi 5 “duke it out”
- 2011 Multihull Yacht Club of Queensland Challenges (6 deg of sep)

- The Future??



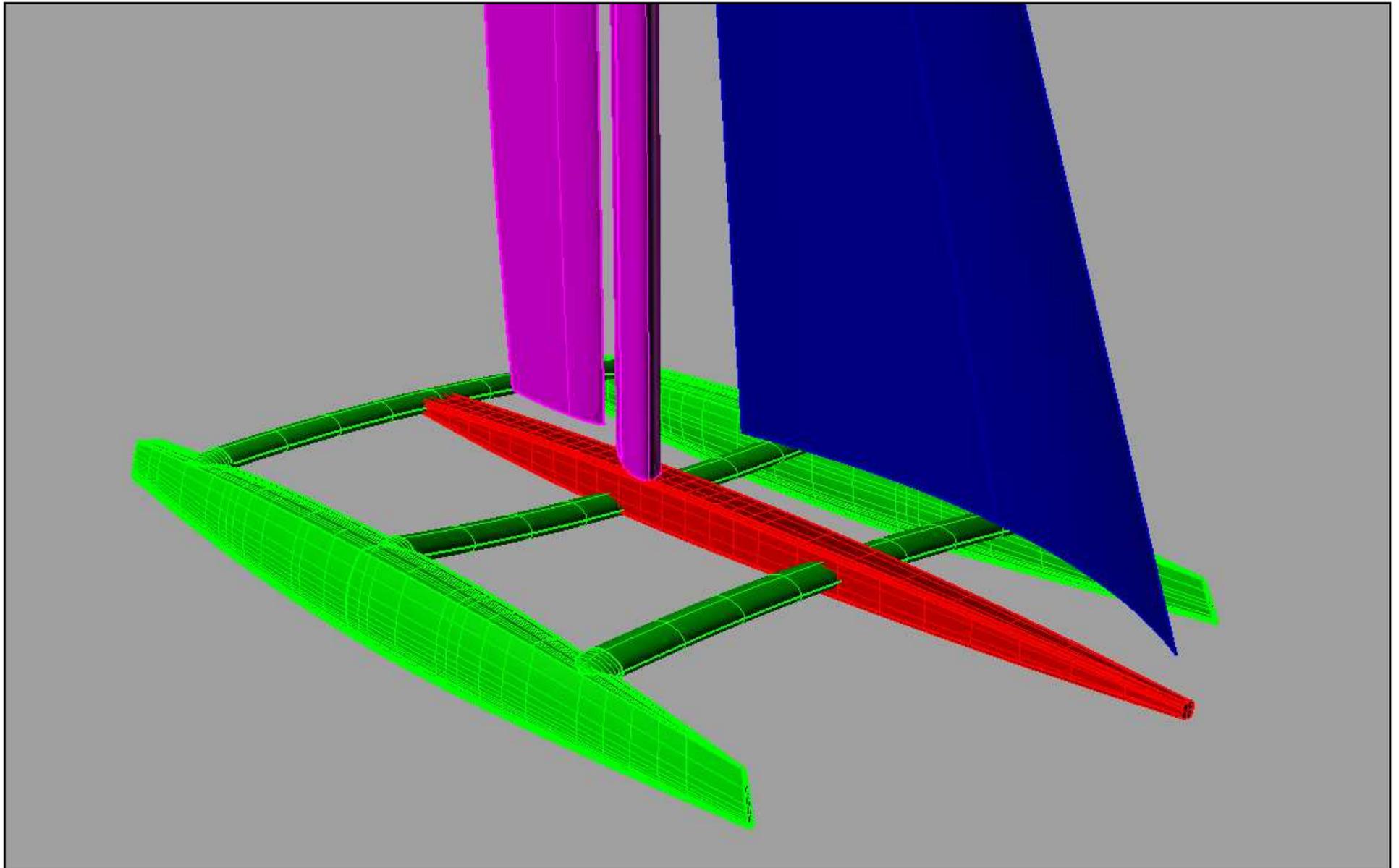
- In form the entry seems to have been perfectly fair, since the yachts were taxed only according to length, and were permitted as much extension in all other directions as their owners chose. But in fact, it is clearly unfair to race boats of radically different models, and built for entirely different purposes, against each other. The model of the Amaryllis evidently would not do for a sea going vessel, and nothing in the way of the practical 'improvement of naval architecture' which yachts and yacht clubs are supposed to promote, can come out of a flying proa. But on the other hand, none of the boats engaged in the race with her are supposed to be good for much except to engage in such races. The tendency of yacht-racing is everywhere to-produce 'racing machines;' in ENGLAND by narrowing, deepening and ballasting yachts out of all reason, and here by making broad and shallow 'skimming-dishes.' In either case the result is not a good type of sea-going vessel. So the owners of racing-machines have really no reason to complain that somebody should invent a racing-machine to beat them. This the inventor of the Amaryllis has done. It behoves the owners of the large schooners, however, to take counsel together lest somebody should build an Amaryllis a hundred feet long and convert their crafts into useless lumber. **It is a matter quite as important as keeping the America's Cup, and may demand quite as ingenious and elaborate devices as were put in force against Mr. ASHBURY.**
- *Source: Anon. (Editorial). "A Revolutionary Yacht." The World, June 24, 1876, p. 4. 135 years ago*





1988 – Dennis Conner Stars & Stripes 60ft winged cat (23 years ago)

Peter Schwarzel: AC72 Project Villa



Any general Q's about the Cup? Or technical sailing questions



Larry Ellison, 5th wealthiest person in the world, current “holder” of the AC.



Deed of Gift (DOG)
or Mutual Consent
& Money



The Auld Mug

AC45 – 5 crew, Cost \$1.1M

One Design Class

- LOA 13.45m, Beam 6.9m
- Displacement 1400kg, mast ht 21.5m
- Upwind wing 85m² Jib 48m²
- Gennaker 125m²

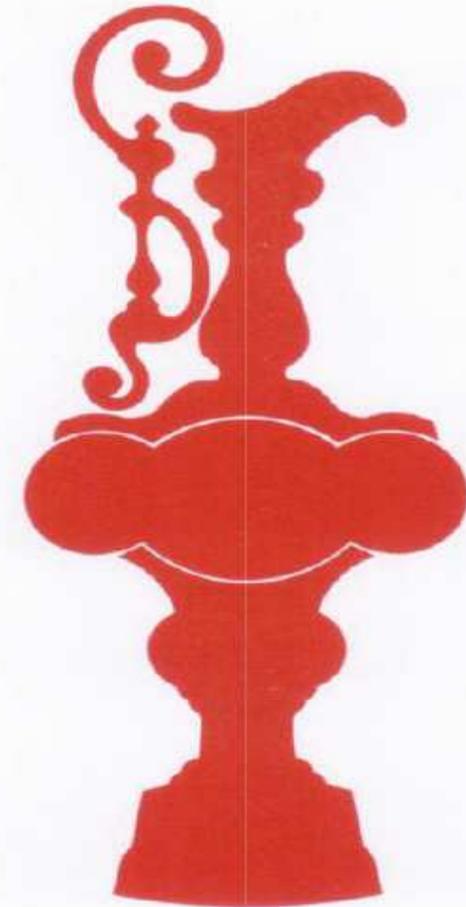


AC72 – 11 crew, Cost \$10M Plus

- LOA 22m, Beam 14m
- Displacement 8500kg,
- Upwind wing 260m²
- Code zero 255m²
- Mast ht 38m

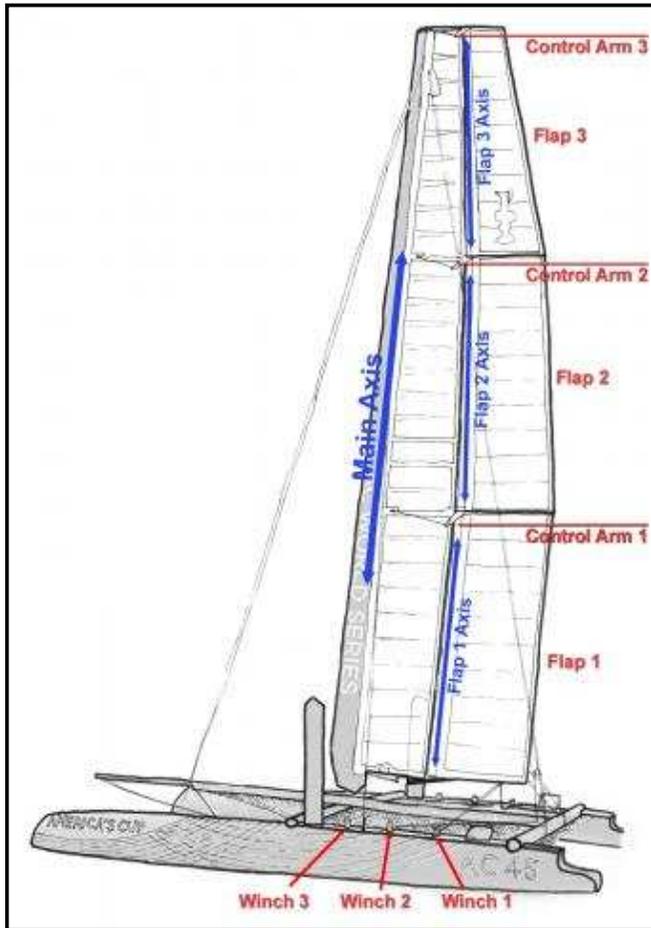


- What we shall discuss or Question Time
- Briefly the AC72 [Class Rules](#)
- The Hull:
[Hydrodynamics](#) & structures
- The Platform:
[Structures](#) & [Materials](#)
- The Wing: Aerodynamics & [Control](#)



AC72 Class Rule Version 1.1

Why Wings?...



AC45 Catamaran

Why is an AC45, 45 foot long?

What do Cole sausages and the AC wing have in common?

Ideas for next talk

Controls & Twist

Quick Points

- **Wings**

- If the Class rules allow them Wings are faster than soft sails, therefore racers will use them. This has been proven in C-Class cat racing
- They are currently under-developed but will get better over time
- They are easier to trim and are especially easy to depower
- The ideal aero shape can be designed into a wing
- They have far less drag and much more lift. This means the boat can point higher
- Given a fixed sail area rule the wing is faster downwind & upwind
- Lift Coefficients 2.0 to 4.0
- They are made from carbon fibre and shrink wrap usually used for wrapping food and goods

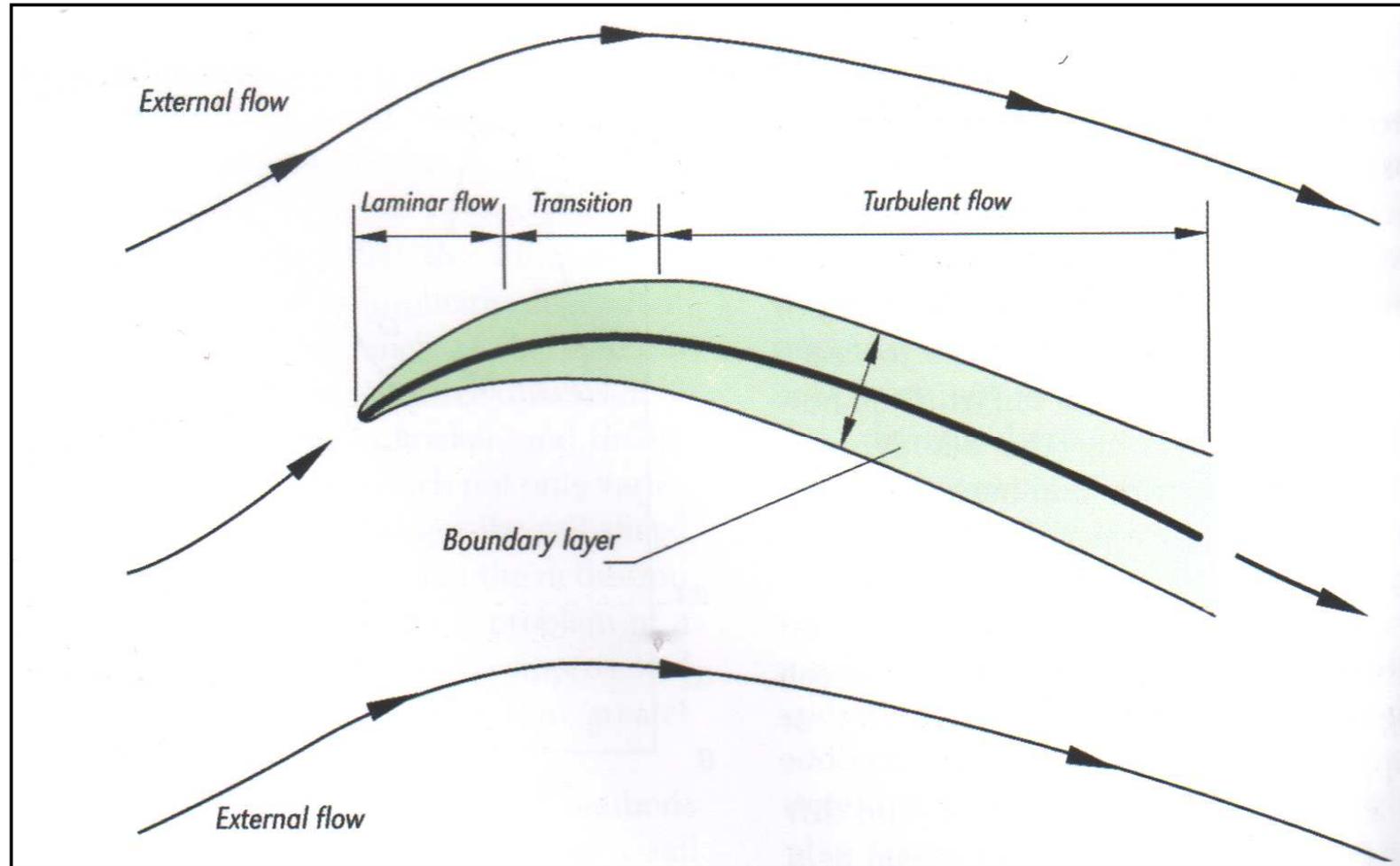


34TH AMERICA'S CUP

- **Soft Sails**

- Large soft sails produce huge loads which are beyond the sailor's ability to control manually. They require hydraulic controls. USA17's soft sail had 35 tonne mainsheet loads. Its wing sail had 3 tonne sheet loads.
- Change shape under aero loads and become difficult to control in high winds
- Flutter when hove too and create considerable drag and potential damage
- Cannot create as much camber as a Wing. The more camber, the more power
- Lift Coefficients 1.0 to 2.0

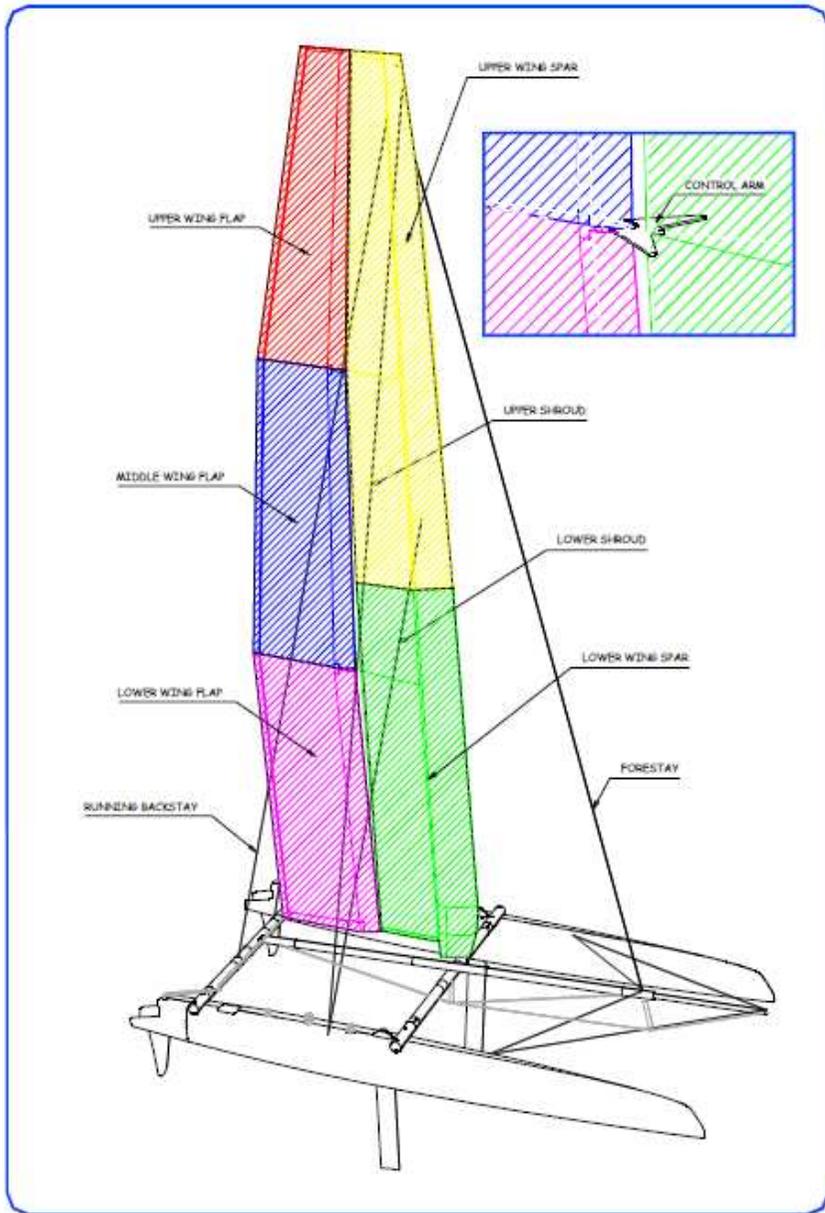
Wing Aerodynamics



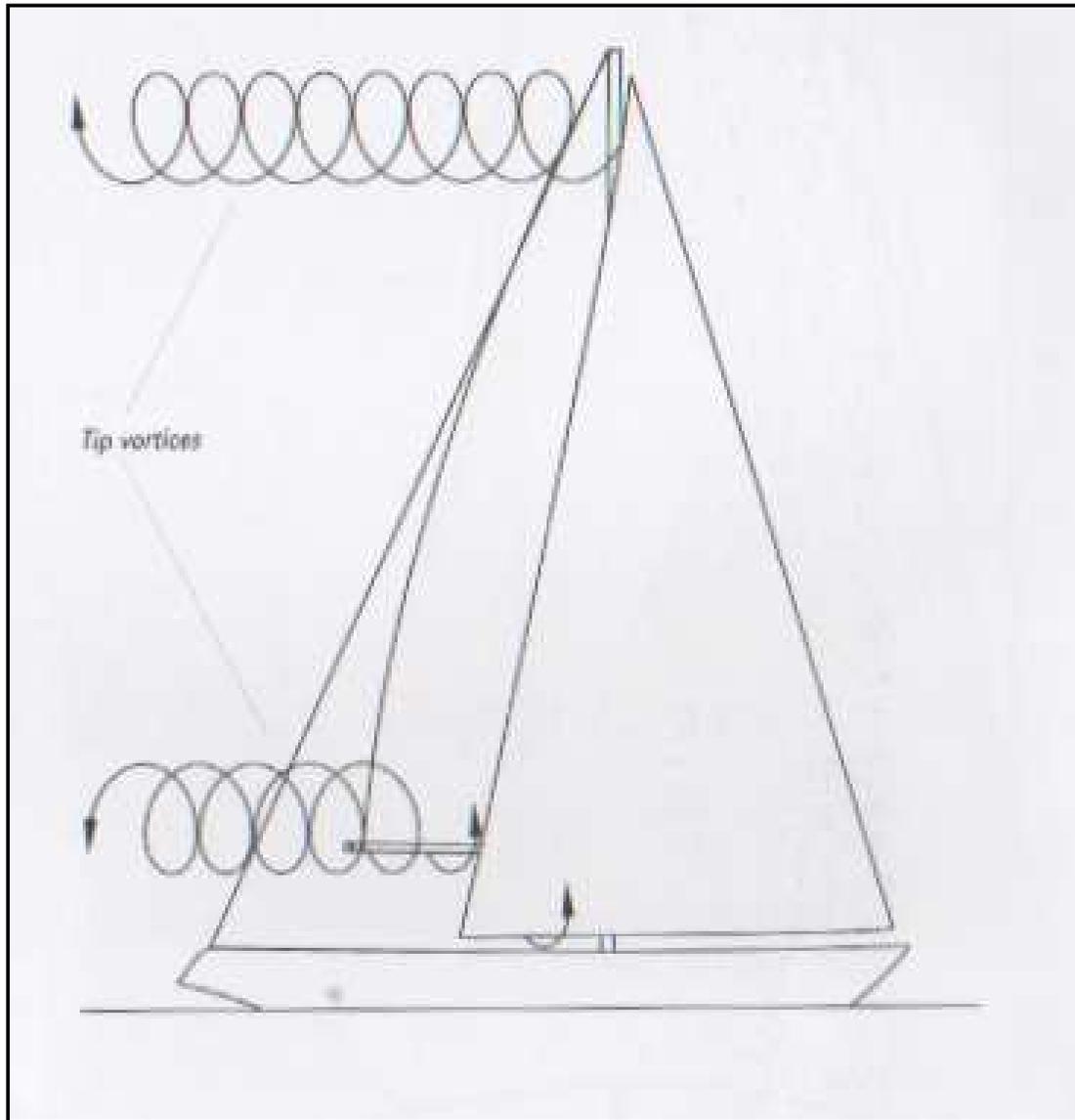
Boundary Layer Effects: wind or water

sail aspect ratio – make chord as short as possible, minimise BL thickness

profile or viscous drag – improve aerofoil shape



Two panel wings halve the chord length & increase the AR of the sail
 Grant Dulton – Team NZ 3 panel, containerisation



End Losses or tip losses – Triangular sails have very poor planform shape and produce lots of turbulence at their ends. The high pressure air is trying to climb around the sail to the low pressure side (lee side) and it sheds forming a vortex.



Volvo Fleet leaving Barcelona in a fog. Great visualisation of tip vortex

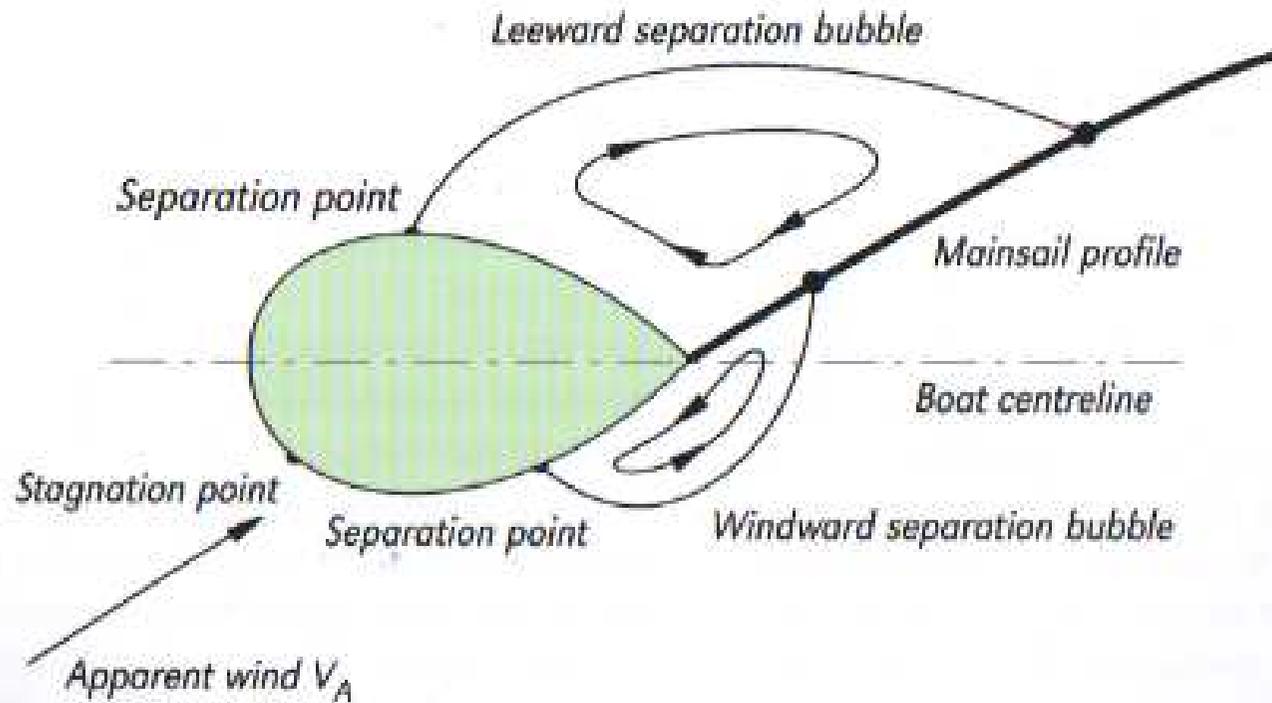
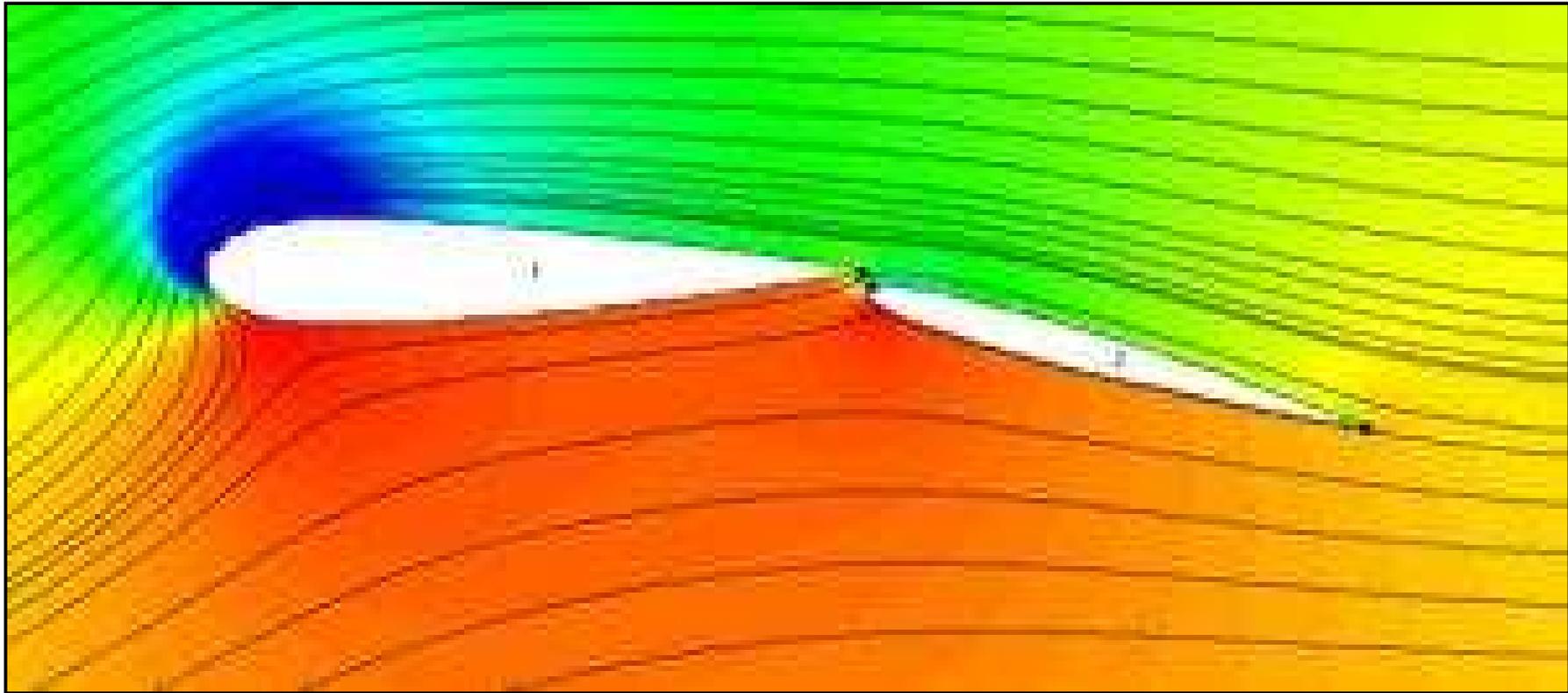


Fig. 5.25 | Separation bubbles along the luff.

Conventional Mast Sail Combination produces vortices which lose considerable energy. Vortices absorb energy and occasionally uncouple then upset airflow as they slid along the sail.

Called a Vortex "Street"



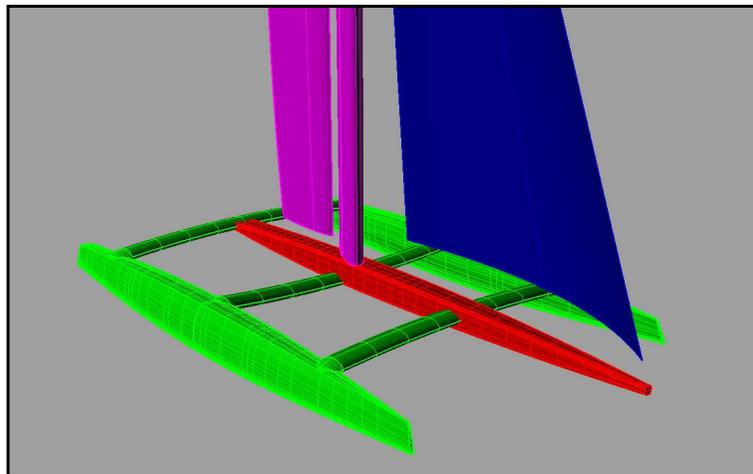
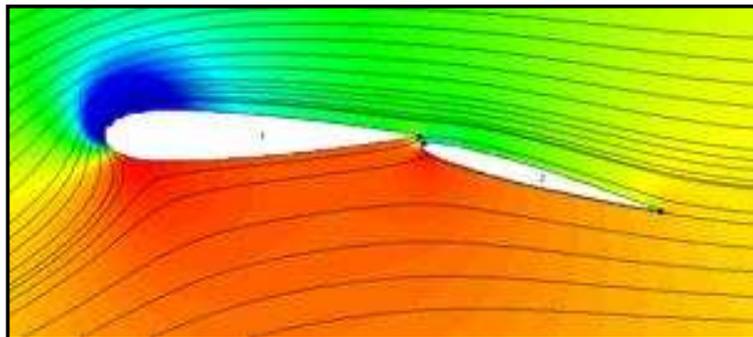
Aerofoils produce very few vortices. This improves lift and decreases drag. Wings can be cambered more than soft sails and as they hold their shape, keep producing lift through the entire camber range. The slot is not a Venturi.

Plus they can be sailed very flat yet still produce lift.

Why 45 foot long? And sausages?

Summary

- Increase aspect ratio of sail by making narrower (reduces induced drag)
- Increasing AR also decreases BL thickness (reduces viscous drag)
- Improving plan form shape decreases end losses (reduces induced drag)
- Using an aerodynamic LE eliminates LE vortices
- Using rigid construction removes soft sail variations
- All these add up to a very large improvement in lift and reduction in drag



- What we've discussed
- Briefly the AC72 [Class Rules](#)
- The Hull – Hydrodynamics
- The Platform –
Structures & Materials
- The Wing – Aerodynamics



The End

Thank you very much for listening

I'm very happy to answer any questions you may have
Peter Schwarzel peter@carbon-works.com.au

*ideas for next talk?

*AC45 length? The Deed of Gift states that a Americas Cup boat must be more than 44ft in length

* The shrink wrap used is the same as Coles use to wrap their sausages in