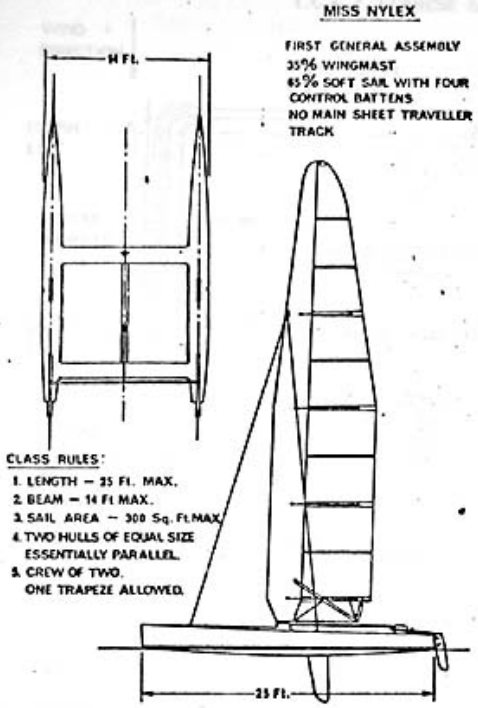


Fig. 1

on a catamaran. In any given boat the weight of the boat itself and crew are fixed. There is then a set maximum total sail force moment which the righting moment exerted by the weight of the boat and crew can resist. It follows that there is a set maximum force which can act on the sail, otherwise the boat will capsize. The drag force figures which are shown (Fig. 3) are related through a simple vector diagram, which we need not concern ourselves with here, to the maximum driving force mentioned above.

We compared our proposal with similar estimates for Quest III as we knew it at the time. In the first proposal the figures are related to the boat as shown (Fig. 1). This is with a rig consisting of a large mast in front of a soft sail with a mast of 1/3rd of the area and the sail 2/3rds. The analysis indicated that we had a proposal which could perform better than Quest III when sailing to windward because the drag forces generated by hull and rig were lower, meaning that the boat could either sail faster on the same point of sailing, or point closer into the wind at the same speed, either of which would result in a shorter time on all windward legs.

## ORIGIN OF SOLID AEROFOIL CONCEPT

From the outset of the design studies I had been worried by a number of factors relating to this type of rig. Firstly, it had its origin many years before and I felt that Quest III represented a fairly high level of development which would be difficult to match in the short time at our disposal. We only had a year in which to completely design, build, and tune the boat.

We knew that in America and in Denmark people had been experimenting with boats on which the soft sail had been completely eliminated. To illustrate the trend of development (Fig. 4) shows the sequence through the different types of rigs used on 'C' class catamarans from 1959 up until 1971. In 1970 in Denmark a boat was built with a solid rig and a plain flap. This broke up only after a short time of sailing, due presumably to inadequate stress assessment, but had proved that it was actually very efficient. Similarly in America Patient Lady II had been built with a rig with a section similar to a conventional section of an aircraft wing but supported by a tubular frame and with a complicated system of wires which enabled it to be flexed from one side to the other, depending on the tack in which the boat was being sailed. Patient Lady II sailed with this rig for most of a season. It was very hard to tune, and eventually broke up when sailing, but when everything was set correctly it could outperform all other competition to windward.

After a long and fairly difficult assessment of the technical situation in relation to the probable challenger from America we concluded that it was almost certain that Quest III would be able to defeat any potential challenger thus giving us the opportunity to pursue something different without jeopardizing Australia's ability to defend and in view of the time at our disposal we began to look at the possibility of designing a rig that would be quicker for us to design and build than one of the Quest III type. I was also very concerned with reliability. Quest III was known to have experienced fairly continuous troubles with gear and equipment. The reason was revealed by a mathematical analysis of the forces acting on the rig.

The relationship between the wing mast and the soft sail is critical for optimum performance. Twist between the top and bottom must be limited, and the camber of the soft sail has to be adjusted for different wind strengths. Loads of many hundreds of pounds were being applied to the numerous control wires, guide pulleys, levers and cams used in the control system. As a result, continuous adjustment was necessary to take up stretch in wires, and there was an ever present risk of wires fraying or damage to the hardware. I then examined a number of different ways of controlling the soft sail in relation to the wing mast. In every case the forces on the control wires, guide pulleys and levers were still extremely high and there was no way I could see of reducing them.

I also began to look to see if there was any reliable theoretical characteristic data relating to wing sections of this type, from which we would be able to establish if there were any better type sections to use, and in particular which would enable us to eliminate the high