

## Catamaran Seaworthiness and Safety

By Derek Kelsall

A few points for the cat owner to ponder



*A stability test*

The picture was taken 30 years ago. It is on a lake in Kent, England. The 36 foot catamaran is one Kelsall Catamarans' built which incorporated a clever self righting system devised by the owner. We pulled it over a couple of times, learning lots in the process and watched as she automatically came back to within about 30 degrees of upright, at which point the bows were pumped out. At the top of the mast is an inner tube, used to float the mast till towed into deep water and nothing to do with the righting system. Firstly, this demonstrates the concern for cat capsizes at the time, but it is also worth noting that in the situation shown, 90 degrees rotation, she is still trying to come back upright. The righting system, though clever, was too much of a compromise of the accommodation to be widely used and attracted no further interest.

Any discussion on this subject should be prefaced with the fact that there are all kinds and all styles of cat that are out there sailing year in year out, which may not conform to the ideal but never meet with any danger. Many yachts and sailors sail for a lifetime without ever weathering a storm.

Many who have been involved with multihulls for a long time have been surprised at how seaworthy cats have proven themselves to be. That is not to say that the capsize situation should be ignored but we are a long way from the beliefs of 30 or 40 years ago.

One of the lessons we have learnt is that the cat can give tremendous confidence in its ability and crew over-confidence is perhaps the most likely cause of the rare but typical cat capsize today. Two theories are that:

Two theories that are put forward for catamarans on a regular basis, I believe, warrant further discussion and understanding. The first is that the capsized cat makes a good raft. A raft yes, one that (usually) will never sink, but as a comfortable place to spend time, definitely not, unless some other provision has been made. I will come back to this.

The second theory is more widely publicized. It is where the cat lying a-hull to the large breaking wave will move sideways down the face of the wave. Most will have seen the illustration. I have yet to see the picture drawn when the wave impacts or as the wave passes. The theory is put forward to support the use of dagger boards that can be lifted to more easily allow the cat to slide sideways. Further analysis of the situation, I believe, reveals a rather different situation. The face of the wave is actually moving toward the breaking wave. The speed of the wave itself will be perhaps 20 kts.

The reality is that if the wave is going to carry the cat with it, the 5 or 10 tonnes of boat will need to accelerate from 0 to 20 kts in less than the half second it takes for the wave to travel the width of the boat. This I find unlikely. The explanation I believe is, that the initial wave impact throws the windward hull upwards. Before a high angle of heel is reached, the wave has passed under to act on the lee hull throwing the boat back onto an even keel. Both tank tests and owner accounts seem to confirm this. One client described the falling back after the wave passed as the most frightening.

I do not believe that we are jeopardizing seaworthiness by promoting fixed keels. The theory fits at any angle in relation to the wave. We are primarily concerned with cats here, but the *cat v tri* situation does illustrate the situation well. I liken sailing in rough conditions to driving over rough terrain. Stability depends on support from as far away from the center of gravity as possible. That is why we have cars with a wheel at each corner. On the water, it is reserve buoyancy which provides the support. The tri is the equivalent of having a third larger wheel in the middle of each axle.

The question is whether in severe conditions, the extra width of the tri counters this obvious shortcoming? I think not. The short coming is further added to by the very low buoyancy in the outrigger ends. The evidence from capsize incidents seems to indicate that the cat is usually sailed over, but the tri has gone over in situations where the crew were unable to take avoiding action.

For serious offshore, there are a number of safety topics that every new owner should consider.

### **What can be done at design stage, stability and hull shape**

Let's go back to the picture. Most cats will capsize if heeled to about 70 degrees. The difference on this design is that the side of the hull is angled outward at 15 degrees. As the cat rotates, the center of buoyancy moves towards the sheer line, retaining positive righting moment to a higher angle of heel.

The designer has a choice. For the same overall beam, he can provide maximum initial stability with vertical hull sides or even inwardly canted hulls or he can have maximum ultimate stability by using a side angle or a knuckle. I believe the later is preferable for ultimate seaworthiness.

There is another safety issue which comes in at hull design stage. The plumb stemmed bow is a common feature. On the race cats it provides maximum waterline length for that little extra performance. I like the style of the bow overhang and can quote one instance where the 40 ft cat ran up onto an obstruction, with barely a scratch, where a plumb stem would have been disastrous.

### **Overall stability**

Obviously, the height and weight of the rig and the height of the structure all come into the stability equation. Design is all about finding the right compromise to suit the particular craft, the owner and the use to which the boat will be put. For the cruiser, I find the best motto is to stay away from the extremes unless for a particular owner. One example of this is the high bridge-deck clearance on some cats. Slamming is something that can never be avoided entirely. Most of the time, the noise and the impact are the only issue. Cats started with too little clearance.

The pendulum has swung too far in some instances. The cats started with short rigs. Again, I find that some of the current designs carry very powerful sail plans and again for the average owner, could be the pendulum swing is too far.

The rig and style of rig is clearly very important in difficult conditions. This again is where I diverge from the typical cat of today. The fully battened main, small headsail is supported by just the three stays. In order to maintain some fore-stay tension, the shrouds are set well back, restricting the boom angle. When sailing down wind this can cause problems. I prefer the ability to let the boom out a lot further, which we achieve by using runners. These are there to tighten the fore-stay with the main shrouds further forward. Runners are not the concern that we associate with runners on the narrow mono base. I see the runner as being just as applicable on the cruiser as on the racer and I do see it as a safety issue.

A situation often found in trade wind sailing is a series of squalls passing through at intervals. The typical cat rig cannot be reefed on a run and needs to round up to do so. This is not what you want to do at the time - and those well aft shrouds make the manoeuvre more hazardous. A number of owners of the three stay arrangement have described how they have hung onto full sail in conditions when they would have been happier reefed but they were not happy to attempt to round up either.

This is where any of the un-stayed or the Freewing Twins rigs come into their own. Firstly, letting the main out beyond 90 degrees takes much of the pressure off the steering, allows feathering of the sail till the squall has passed or reefing if necessary without change of course. It removes the danger of the unintentional gybe.

### **Could the cat sink**

This would seem to be a simple one. However, I know of two situations which became very serious, one boat was lost in one incident and several crew members only just survived in another, simply because no one knew for sure whether she could sink or not. Most foam or timber cats cannot sink. There are still a few solid glass cats around that can.

### **Survival compartment**

A waterlogged boat either way up has very little stability. The typical upturned cat will float with the underside of the bridge-deck above the water but it will almost certainly be washed by waves. That situation changes dramatically if a small amount of buoyancy can be added at one end, to lift that end.

This is where that survival compartment could work very well. True, this is something that I have been saying for a very long time but has never been done on any of my cats. It was on a couple of my tris, years ago. The typical cat aft cabins could easily become survival compartments by providing a reasonably watertight door, or preferably double stable door type, to be able to close off but still access over. Pumping out one end behind the door will lift that end so that there will be relatively little water

against the door. Immediately, stability is added and the motion will be reduced. This gives sufficient of the picture to suggest what is needed - which is not very much in the total boat build project.

## **Escape hatches**

Some regulations make such hatches compulsory. Most cats can have the hatches built into some part of the inboard side of the hull. In the above survival compartment itself is the ideal. Can also be used for ventilation at anchor. I have not known of any that are fitted with standard good quality deck hatches ever give a problem if properly installed.

## **What about supplies aboard**

The lesson I learnt was that the wave action inside a hull operates like a pump through any opening, sucking everything that is free inside out through the opening. Tie things down. Fasten the stove and the gas bottle firmly. Anything that can break or release toxic gases likewise. Put a non return valve on the water tank breather and use good locks on the cabinets with the essential stores. The possibility of the air inside a capsized cat being contaminated is a real one and should be considered before diving down and into the boat.

## **Avoidance action in heavy weather**

I have been lucky in having been in the position to run with the weather in the few storms that I have encountered in crossing oceans. Turning down wind immediately changes the situation - from crashing into waves to running with them. Looking back as the breaking wave approaches is sobering but my experience was that each time it looked like this one would fall on top of us, we would surf away, the wave would dissipate behind us and only spray would fall on deck. The surfing away can cause other problems. The first is to keep the boat on track and avoid the broach, which can put a lot of pressure on the steering.

The most important factor in this is the rig. The typical modern rig does not come out too well in this condition. The big main on one side is trying to push the boat into a broach, but it also needs careful attention to avoid over-steering and causing a gybe. The ideal is a rig where the boom is not restricted by stays, which can be used as an anti broach device. Hence my interest in unstayed rigs, the Freewing rig and the Freewing Twins rig. The second problem is the speed and the wave shape. Short and sharp waves can cause the boat to run into the back of the wave ahead - which feels something like running into a brick wall. Drogues should be available to slow the boat in these conditions.

I would always carry a sea anchor. I can claim no experience, but I do have the accounts of a few clients who swear by them. Typically, once deployed the situation changes from a crash bang and rapid motion one, to relative calm. The diameter of the sea anchor needs to be close to the beam of the cat. A small drogue does not work off the bow and can cause more problems than it solves.

## **Tender/life raft**

The boat itself cannot sink. The life raft is all too often taken to mean just that. Get aboard and it will save your life. Not necessarily so. Stay with the ship if at all possible, should be the rule. The case for some means of leaving the ship, as I see, will only apply in the case of fire or when the boat is drifting out of control into dangerous waters. In the second situation, the life raft is not likely to be of too much use. Can the tender fill the requirements of both situations. I do not believe it is too difficult to provide a suitable design to fulfil this purpose. Only needs someone to put the mind to it - starting with a cat tender. Some races and some situations do require life rafts on board.

## **The Tender**

More people lose their lives from the yachts tender than from on board the yacht. A recent few days sailing we did from yachts at anchor were a very good demonstration of this. The typical tender was a small rib. With four aboard, I was very thankful that we were in sheltered water. Even so, dead slow was the only speed to avoid swamping. A cat tender would have been so much better. It does not take too much imagination to see that a cat tender would be more efficient in every roll and could be equipped as a life raft.

## **A final thought**

There are lots of sailors with lots more offshore experience than I have and do read their stories. Hopefully this will prompt some of the actions and preparations that hopefully will never be needed.