POWER CATAMARANS:

By Malcolm Tennant

Power catamarans are becoming an increasingly prominent part of the boating scene. Despite this increasing familiarity there is still a perception among boaters that all catamarans are the same. This is obviously not true for monohulls so why should it be true for catamarans? Just like there are many sorts of monohulled vessels there are also numerous sorts of power catamaran. Which one is used depends on the purpose for which it was designed. And, just like monohulls, you need to have the right boat for the job. However, unlike the monohulled vessel there is a much greater overlap in performance and behaviour between the two basic types of catamaran; the planning craft and the displacement vessel. This is largely because a displacement catamaran can, unlike its monohulled cousin, often go just as fast as a planning one, and in some conditions faster. However it is not quite that simple, there are many more variables than just the hull form. So let's look at some of the parameters that differentiate the different types of catamaran and see if we can determine how they may affect your choice.

Although the hull form is not the only variable, to most people it is certainly one of the most obvious. If we ignore the more exotic examples of the breed, such as the SES [surface effect ships/side wall hovercraft] craft and the SWATH [small water plane area-twin hull], which is really a very extreme displacement vessel. Then, just like monohulled vessels, there are two basic types; the planing hull and the displacement hull. The hull of a planing catamaran is usually similar in shape to that of a planing monohull. It is generally a relatively low dead rise hard chine hull with no rocker. Just like a monohull it may have planing strakes, and the currently very fashionable steps. There are planing catamaran hulls in which the deadrise angle is constant for at least the last half of the hull [a monohedron hull] and others where it will vary along the length [a warped bottom hull]. Others may be similar in section to the deep vee monohull. There are also a number of variations on the single chine/multiple chine/longitudinal and transverse steps theme. However there is one planning catamaran hull form that you will be very unlikely to see on a monohull. This is the asymmetrical planning hull as epitomized by the larger Prout power cats, and the offshore racing tunnel hulls. This can probably be characterized by likening it to a monohulled vessel cut in half down the centerline, spread apart and with the gap then spanned by a wingdeck. This means that the inside of the hulls is flat with all the shape on the outboard side. This configuration is considered to have superior performance to the symmetrically shaped planning hull in some conditions. It can also be designed to lean into a turn just like a monohull whereas the symmetrical hulled planing cat will tend to lean outward in a turn. Displacement cats also lean outward in a turn but because the angle of heel in their case is around half a degree it is usually not even noticed. Most designers of planning power cats use symmetrical hulls like the original Australian design, the Bruce Harris "Shark Cat". These are essentially two narrow planing monohulls placed side by side with a spanning bridgedeck in between. Others use planing hulls that are symmetrical forward but asymmetrical down aft. Then an extra wrinkle can be thrown into the mix by fitting foils to boats that are intended to exceed 28 knots. Foils allow the boats to plane sooner and also carry heavier loads when on the plane. The retrofitting of foils is sometimes used to enable an overweight planing cat, which is showing a disinclination to plane, to do so.

Foils were fitted to the initially rather sluggish Prout "Panther" with an immediate improvement in her performance. And in a similar way the French designed "King Cat" benefited from the fitting of foils. The fitting of foils is an approach that is difficult to use on a monohull but the catamaran configuration is perfectly suited to them as the main load carrying foil is generally fitted between the hulls. Foils, particularly the active systems, are also sometimes fitted to the larger displacement hull forms, such as those found on high speed ferries, to improve the ride quality.

Generally, the planing cat is designed for relatively flat water, but it will still handle rougher conditions better than a monohull provided there is sufficient wing deck clearance. It is also usually a relatively short-range vessel and is also relatively small. Just like a monohulled power boat it becomes increasingly difficult to make the catamaran plane as it gets larger. This is largely because while the planning area is increasing by the square, the displacement is increasing by the cube. The bottom loading gets too high and it just requires more and more horsepower/speed to plane. At somewhere around 18 to 20 metres it makes much more economical sense to go to a displacement hull form which at this particular size will go just as fast, if not faster, with considerably less horsepower than the planning vessel. Going fast in a displacement vessel is something that you just cannot do with a small monohull. The displacement monohull, excluding warships and the rather extremely powered "Eco/Katana", is a relatively slow vessel whereas the displacement catamaran can go just as fast as the planing boat. And, just as it is with monohulls, unless you are the King of Spain, it is prohibitively expensive to run a large, fast, planing vessel. However the converse, size wise, is also true for catamarans. It becomes increasingly difficult to justify the use of the displacement hull forms below about 10 metres in length unless you are willing to go quite slow or have a very light vessel whose hulls can only be used for stowage. Essentially, if you want to go fast in a "short" catamaran you use a planning hull form.

So what characterizes the displacement hull form? Like monohulls it is usually a round bilge form of minimum wetted surface that depends on its length to achieve its speed. Unlike the monohulled displacement craft, the hull speed of the displacement catamaran is not restricted by Froudes Law. This is that "the hull speed is equal to 1.34 times the square root of the waterline length" formula that is so familiar to the sailor. I have displacement catamaran designs capable of more than 30 knots with quite minimal horsepower and the more extreme high speed catamaran ferries are achieving 60 knots from very long thin displacement hulls. Like the planning hull cats there are a number of different design approaches to the shape of displacement hulls. When many of the French production catamaran companies decided to get into power cats they just fitted larger engines into their sailing hulls, probably because being production boats they had the moulds handy. This is fine as long as you are not going to exceed around 15 knots. Beyond this speed the hulls start squatting and assuming a bow out attitude. The sailing boat hull form is not really suitable for a displacement power cat with any performance, or long range, aspirations. They are essentially trying to go up hill and require increasingly large amounts of horsepower to move. A number of designers, took a somewhat different approach. They took the traditional trawler displacement hull with its buttock lines sweeping up to a flat surface at the stern, made it much narrower so it had a higher hull speed and then joined two of them together. When in 1979 our design office started looking at power catamaran design we to started with the sailing cat hull shape because we knew how fast we could make them go from some twenty years experience of designing sailing catamarans. However to prevent the squatting normally associated with this hull form under power [*] we increased the buoyancy down aft by fitting a bustle with a vertical trailing edge. This worked well but when the first of this type was built in 1983 it proved to be a difficult hull shape to construct as a one off and so the buttock lines were straightened in profile. Instead of kicking the hull lines up toward the surface down aft, as with the traditional displacement hull shape, we drew them in to a canoe stern [CS] beneath the water surface. We then placed a large amount of buoyancy above this in the form of a flat section to prevent squatting. Since then this form has been refined by the addition of a concave surface above the propeller complete with some kick down toward the aft end. The distribution of the buoyancy has changed slightly, and the entry has been fined up even further and very early on a "knuckle" was added and has since undergone a number of refinements. Now that this CS hull form that we developed in 1983 has proven to be so successful it has become the preferred shape for an increasing number of the worlds displacement catamaran designers. Schionning, Brady, Lidgard & Grainger in Australia employ this hull form as does Kelsall in New Zealand. In the USA some of Morelli & Melvin designs employ this shape as does Cortland Steck in his recent designs. The "wave piercing" designs of Craig Loomes and Roger Hatfield of Gold Coast Yachts are also basically of the same configuration. [See Figure 1.] Most of this hull's demonstrated low resistance may be attributable to the basic shape. But we have also considerably reduced appendage drag. There is no exposed propeller shaft, nor any supporting strut. We have also maximised propeller efficiency by having a horizontal tail shaft. The propeller is at right angles to the water flow but still protected from damage. Another attribute of this hull form is its ability to take the bottom and being a catamaran it remains level. This "CS"hull form, and its many variations, have proven to have one of the lowest resistance's of any hull so far developed. This has been demonstrated many times in the test tank and full size in the ocean. Slip factors of from 12 to 15% are commonplace.

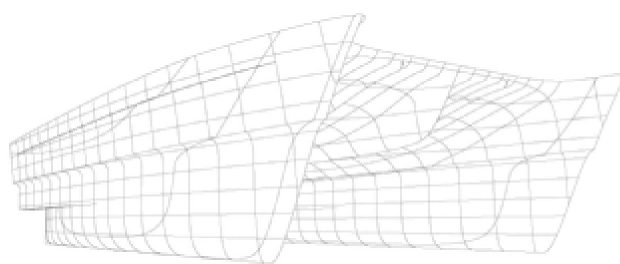

Figure 1. Hull lines Drawing

It is not unusual to see a displacement hull with a bulb bow and there are several reasons why a designer might employ such a device. One of the parameters that determines the resistance of a displacement hull is the hulls half entry angle. The finer the entry the less the resistance. By its very nature any catamaran hull is finer in the forward sections than an equivalent monohull and this tendency is even more exaggerated in the low resistance displacement hull. As a consequence of this the centre of buoyancy of such a hull tends to be located well aft. If the superstructure of such a vessel is then located well forward it will tend to move the LCG forward also with a resulting bow down trim. In this case it may be necessary to fit a bulb to move the LCB forward to where the LCG is located if a bow down trim is to be avoided. This characteristic is clearly illustrated by the fine entry and bulbs that are typical of a

Craig Loomes wave piercing displacement catamaran, or some of the high speed displacement ferries from the Crowther Office and others. A bulb may also be fitted after launching to correct a bow down trim problem. If possible I prefer to gain forward buoyancy by lengthening the hull forward as this will also lead to an increase in hull speed and is generally easier to build. However this is not always possible and I have had to have recourse to a bulb to move the centre of buoyancy forward on some designs. Careful tank testing will often show a decrease in hull resistance at a particular speed if bulbs are fitted and this can be another reason for their use, as it is with freighters which travel at a constant speed.

With our particular displacement hull form, provided it is allowed for at the design stage, a bit extra weight usually makes very little difference to its performance. This is because most of the major parameters determining the hulls resistance:- the half entry angle, the length to beam ratio and the prismatic coefficient[**] vary very little with increased immersion. True the wetted surface [viscous drag] will increase but this is only important at relatively low speeds. At speeds above approximately six knots to the 25 to 30 knot range where we are often operating the major component of resistance is wave making drag, rather than viscous drag, and that is largely determined by the before mentioned parameters which do not change. In practice this means that the displacement hull form is particularly suited for long range, and particularly long range at speeds that monohulls can only dream of. However as the hulls are made finer and longer in the search for higher hull speeds viscous drag will ultimately become the major component of the drag equation. It should also be kept in mind that the add on weight of fuel, water and food necessitated by ranges of 2,000 to 4,000 nautical miles will result in high displacement/length ratios which will adversely effect performance unless they are allowed for in the design. One of our ocean going designs, the “Wildwind IV” has a cruising range of 2,500 nautical miles at 9 knots [with a 10% reserve]. And this from an 18m displacement boat with a top speed of 23 knots. [See Figure 2.] But of course ultimately you cannot get around the fact that a heavier vessel will require more power to move it than a lighter one.

Figure 2. Wild Wind IV under power

However this weight issue does raise another point of differentiation between the planning and displacement cat. The height, shape and span: both transverse and longitudinal, of the wing deck, will vary from design to design, and from designer to designer. When looking at the wingdeck structures of power catamarans it is necessary to recognize that they may be operating in conditions that will never affect a sailing catamaran. Most sailing catamarans will never be going any closer to the wind and waves, under sail, than 45 degrees. This to some extent reduces the slamming effect of the waves. The power cat on the other hand may very well be

Figure 3. Clearwater Spirit on Lake Tarawera

"punching" straight into a seaway and this should therefore be kept in mind. Although some extra weight does not have much effect on the performance of the displacement hull form, except at the extremes of the displacement/length ratio, and as long as it is designed for. It will however make the "knuckle" on our designs closer to the water. And even more importantly, it will lower the height of the wing deck off the water. If this lowering is extreme then it will impact quite literally on the vessel's rough water performance. Consequently if the vessel is to operate in rough water conditions we design the wingdeck, and the various structures associated with it, to suit those conditions. Firstly we try to keep the wingdeck as high off the water and as far back from the bow as is feasible. However the clients striving for a stylishly low profile often forces the wing closer to the water than is desirable from a rough water performance point of view. We faced this dilemma with the "Tarawera" design "Clearwater Spirit". It had an elegantly low profile, which forced us to use a wing deck clearance of only some 700mm [27"], which was 200mm lower than the 900mm [36"] I consider the minimum required. This was fine for most of the time on Lake Tarawera but the boat was also in operation in the rougher water of the Hauraki Gulf during the America's Cup races. The solution we arrived at was to raise the forward 50% of the wing up to 900mm and then step it down to the 700mm down aft. This meant that there was only sitting headroom up front in the saloon but in practice the compromise worked. [See Figure 3]. The boat was reported by one charter skipper as being the best rough water catamaran he had ever skippered in his long and varied career. It is obviously very necessary to ensure that the vessel has sufficient displacement to carry its intended load if wingdeck height problems are to be avoided.

If we are designing for offshore, or even extended coastal travel, then we also use a number of other design features to maximise the vessels rough water capability. I have seen it said that the fine bows and deep forefoot that are typical of the displacement hull form, and that allow it to slice so smoothly through the seas, can lead to wing deck slamming and also bow steering, or even broaching, in large following seas. There is some truth to this assertion if unheeded, but of course the designers of this type of vessel are well aware of these potential problems and take the appropriate design action. For instance we provide reserve buoyancy in the bows in a number of ways. We have a "knuckle" that is located some 600 to 700mm above the waterline. This is curved in section so that the

increase in buoyancy is not so fast that slamming of the knuckle itself occurs but it ultimately provides a massive increase in buoyancy. From this knuckle, on the inboard side, we have a further increase in buoyancy in the form of a panel at 45 degrees. This we term the under wing “girder”. On the sheltered water boats this is a flat panel in the interests of cost and simplicity. But on the ocean going craft, or boats that are intended to function is rougher conditions, this curves up transversely and then down in the centre in two arches reminiscent of the “McDonalds” symbol. This provides a further gradual increase in buoyancy, as does the “nacelle” itself. These structures have the added appeal of presenting no flat surfaces to any potential wave impact. The centre of this double arch wing deck carries right to the bow forming an “anti slam nacelle”. The nacelle also performs structural and access functions. It provides internal tranverse and longitudinal stiffening structures and allows piping etc to pass from one side of the vessel to the other unhindered. The bows are also very high and with some flare to provide even more reserve buoyancy. This even further limits the possibility of wing deck slamming. And of course the wingdeck is kept high and short [see Figure 4.] So in fact the perceived problem is just that. It is only someone’s perception, and in reality does not exist in boats where the appropriate design action has been taken. In a similar way the “wave piercing” displacement cat designs of Craig Loomes use the larger central “hull” to prevent burying the low freeboard hulls and minimise slamming of the wing deck. Roger Hatfields “wave piercers” employ very long forward overhangs and a very short and high wing deck structure to minimise impact and ensure that the hulls “surface”. All displacement hull power catamarans are in reality “wave piercers”. They all slice through the waves. Where the differences occur from designer to designer is in the way that particular designer employs reserve buoyancy to ensure that once the hull has “pierced” the wave it surfaces on the other side. Our use of knuckles, high bows, the curved wing deck and nacelle are just one designers answer to the question of how to distribute reserve buoyancy to achieve maximum efficiency and minimum vertical motion. Each approach will have its advantages and disadvantages.

The Gold Coast yachts approach results in very long hulls for the size of the vessel and this is always something worth having on a displacement catamaran. However care has to be taken in the design of the structure of these relatively unsupported long bow overhangs because of the very high cantilever loads. While these long bows are not a problem on a commercial vessel they could to lead to some serious difficulties with anchoring on a similarly proportioned pleasure boat. The “perceived” size of the vessel would put off some pleasure boaters who have a tendency to want to use all of the available space, including the space between the bows.

Craig Loomes approach minimises the visual impact of the two catamaran hulls. The boats look very much like monohulled vessels with relatively insignificant side hulls. Given that this was a primary design requirement it is a very successful approach. On the other hand, the designs from the Malcolm Tennant office, and many others such as Crowther, are very definitely catamarans with two prominent bows. However both of these offices have on occasion used a variation of the “wave piercer” called a “Z” bow. [image of white sands]

All the above features also militate against bow steering, “wave stuffing” and broaching. But, because when you are in middle of a very wide ocean there can be no room for error, we also fit larger than the usual sized rudders to our ocean going designs. This ensures that regardless of the severity of the conditions, and the size of the waves, the vessel goes exactly where you want. The end result is a vessel that literally "runs on rails" down wind with no tendency to broach and with no need for any stability devices such as active fins or paravanes to counteract the rolling. They are very docile vessels in following seas.

The transverse span of the wingdeck is a direct reflection of the hull spacing. On a planing cat the hull spacing appears to have little effect on the performance other than its contribution to compressing the air and water in the tunnel. Conversely the spacing can have quite significant effects on the performance of a displacement power cat. If the space between the hulls is too small then there will be wave train interaction and an increase in resistance [up to 50% increase in residual resistance has been reported from tank testing]. So how close is too close? It depends on the length to beam ratio of the hulls and how fast the boat is going. We designed two boats with identical hulls, displacement, and installed power. One had an overall beam of 7m the other 5m. The boat with the 5m beam was 2 knots slower. To further complicate the issue of hull spacing it has been shown that at some particular spacing the interaction of the wave train with the opposing hull can sometimes lower the resistance at a particular speed.

The planing cat will typically have a wing deck clearance that is less than that of the displacement cat. The major reason for this is that they are generally utilizing the ram effect of the water and air compressing in the tunnel to both provide some lift and to cushion the impact when leaping clear of waves. This works well, particularly on the smaller vessels, and the tunnel hull race boats, until such time as the boat has to slow down because of the conditions. The ram effect does not contribute anything at lower speeds and the craft is now susceptible to slamming from the low tunnel. At some length the vessel also becomes too big/heavy for the air/water cushion effect to work. What happens when you have to slow down in adverse conditions is a major parameter in the design of any power catamaran that is going to operate in other than sheltered water. Owners of small planing craft will be well aware that in some particular wave conditions it is often better to speed up rather than slow down. A similar effect occurs with our larger displacement boats. In some adverse sea states driving the boat at 18+ knots results in a very much smoother ride. The cats slice through the water in what an American owner of one of these boats calls "hydroglide".

It should be obvious from the foregoing that there is a much larger size/speed overlap between the planing and displacement hull form catamarans than occurs in the equivalent monohulled vessels. With monohulls the displacement boat is on the low end of the performance scale and the planing boat on the high end and "never the twain shall meet". Admittedly there is an amorphous hybrid called a semi displacement craft, which attempts to bridge the gap. But generally speaking the planing and displacement vessels are quite distinct in their performance, purpose and area of operation. It is not possible to separate the planing and displacement catamarans on a straight performance basis in the same way as is possible with monohulls. It is often just not possible to say which type is superior for a particular purpose, or in a particular set of conditions, unless you define your requirements very carefully.

It is generally considered that a catamaran will always have more accommodation than a monohulled vessel but this is not necessarily so. If the beam of the catamaran is restricted to the same as that of a similar monohull, then the monohull may in fact have more interior space. Hard to believe? Then consider that essentially what has been done with the catamaran is cut a piece out of the centre line of the monohull. If the catamaran then has the same beam and length of the monohull then it does in fact now have less interior volume because we have cut that piece out and not replaced it by making the vessel wider. So restricting the overall beam of the catamaran to that of a monohull can impact quite severely on the accommodation. The varying types of accommodation found in catamarans is largely distinct from the type of hull used but again some types of vessel do tend to have particular accommodation layouts. The two extremes in the case of accommodation are the vessel where all the cabins are in the hulls and the vessel where they are all located in the wing and the hulls serve engine, stowage, and utilities purposes only. The hulls of the displacement vessel tend to be narrower and, until the vessel gets larger, often serve only as corridors with the berths cantilevered inboard or entirely located in the wing. Conversely some planing

cats with generally wider hulls have all their berths located there. But of course there are any number of variations, and combinations, of these arrangements. One of the things that people tend to like about power catamarans is that it is possible to have most of the accommodation on one level, up on the wingdeck. This can be considerably cheaper than hull accommodation and has access benefits. However if the client then wants a fully enclosed wheelhouse up on top of the accommodation structure the result can resemble a wedding cake. This is because if your wingdeck is 900mm to 1m, or more, off the waterline and then the primary accommodation is another 2m and the wheelhouse another 2m on top of that you end up with a considerable height. This is not a problem stability wise but on a shorter vessel can certainly look a bit top heavy. Of course this is nowhere near the same problem on a longer boat because the people don’t get any taller and so most of the structure stays exactly the same height. The overall profile can, of course be lowered by lowering the height of the wing off the water. But, as discussed earlier, this brings a whole new set of problems. One solution that we in our design office have borrowed from the monohulls is to use the raised pilot house concept that is so common on the passagemaking trawler style vessels. We have applied this layout to some of our long-range cruisers and even our “super yachts”.

The raised pilot house is seen by many clients as an “appropriate” styling for passage making type of vessel but it also works well on a practical level because it reduces the overall height of the craft despite the very high wing deck clearances, and bow heights, associated with the serious ocean going boats. The down side, accommodation wise, and with boats there is always a down side, is that the accommodation is no longer all on the one level. It is now necessary to go up and down stairs in a similar fashion to that found on the monohulled trawler yacht. [See Figure 6.]

Figure 6. New Yorker Interior Rendering

Figure 7. Pacific Harmony at 25kts under power

Styling wise you can essentially have any type of styling that you want. As pointed out earlier there will be some constraints imposed by such things as the wing deck height but aside from that anything goes. You can have everything from the ultra conservative trawler styling through to the very latest in sleek "Euro-high tech".[See Figure 7.] These days the designer can give you any shape you want. As a designer I used to say to clients "we can draw you any shape you want but, [1] can it be built and [2] even if it can be built can you afford to build it". In these days of surface modelling programmes and five axis milling machines [1] is now of much lesser importance. However [2] is still with us. The more curved shapes, if built as one offs, do tend to be more expensive as they may require quite complex moulds.

But again the computer does come to the rescue somewhat in allowing these moulds to be much more easily constructed than in the past. There may often seem be little linking the styling of the craft to the hull form. Though it would probably be seen as inappropriate to put aerodynamic styling on a vessel with a top speed of 8 to 10 knots. We have designs at the extremes of the size, styling and performance continua but the basic in the water shape, the structure and the naval architecture of our displacement hulls remains essentially the same although the basic parameters will vary.

To some extent the choice of drive system also separates out along similar lines. The extreme long range displacement boat would probably use a relatively large CP [controllable pitch] propeller, a fixed propeller or perhaps even a carbon fibre prop. The smaller high speed planing craft, if it were small enough, would use outboard propulsion. The large high speed displacement ferry boats tend to use water jet units, often coupled to gas turbines. A lot of the medium sized planing craft use surface drives. But again in the overlapping centre part of the type, performance and size continuum all of these drive systems would appear to have a place depending on exactly what you are trying to achieve with your vessel and the level of importance you ascribe to particular features.

It would appear from the foregoing that. While it is obvious that at the extremes of performance and size one type or another has a fairly clear-cut advantage. eg: To go fast in a short power cat you have to plane. To get long range at reasonable speed and comfort the high speed displacement cat is the obvious choice. However there is a place in the middle where often either type may do the job.

So is it possible to generalise in any way concerning which type of vessel should be your choice? It is very difficult to do this because often the choice of boat is influenced by emotional factors as much as rational ones. It probably depends mostly on where your priorities lie. If the styling is the dominant factor, and if you are looking for a vessel that has a profile of no greater height than a monohulled craft of the same size, then you are probably going to have to go with a planing cat with a very low tunnel height. You will have to accept that the wing will hit sooner in rough water and you will generally require much more horsepower to drive it. Conversely, if you want a high tunnel height and good rough water capability combined with economy and extended range, then you are going to have to live with the higher profile that accompanies these characteristics. If you are looking for lots of accommodation in a short boat then you will need a boat whose beam is going to make the use of a marina berth problematical. Conversely if you wish to restrict the beam to that of a monohulled vessel then you will have to accept the loss of internal volume, and if it is a displacement boat, possibly performance also. If easy engine access of the stroll around type is your major requirement then perhaps you should be looking at monohulled craft because no smaller catamaran has the wide open engine rooms that can be found on some monohulled vessels. However the planing vessel will generally have wider hulls and will often have the engines located further aft than in a displacement boat, particularly if surface drives are being used, but of course the engines will also be larger.

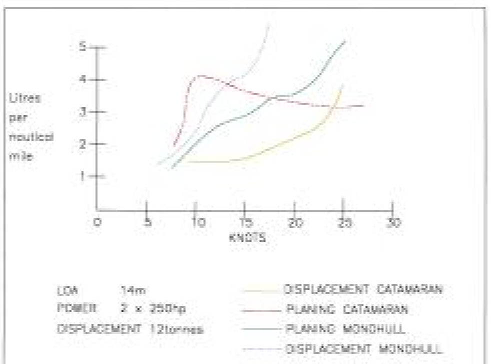

Figure 8. Fuel Economy Graph

If fuel economy is the number one priority then our high-speed displacement boats can give this to you very easily [See Figure 8]. Ally this to the longer range and good sea keeping and the displacement boat again stands out. But the displacement cat will usually have less accommodation space in the hulls than the planing craft until the boat gets to the size where the planning craft is no longer an option. However the greater volume of these wider planning hulls will usually be offset by the fact that displacement cats tend to have greater overall beam, with the attendant increased wing deck cabin space, than do planing ones.

If you want to carry big, heavy loads then a barge should probably be your vessel of choice, not a catamaran. Although catamarans may potentially have lots of interior volume this does not necessarily translate into load carrying. The planning cat has wider hulls and will not sink as far into the water under excess loading. But it will take longer to get onto the plane, and may even be actually prevented from planing under load. It then becomes a rather inefficient displacement craft. The displacement cat may sink further under the load but generally the performance will not be affected until the wing deck height is compromised. A very good reason to keep wing deck clearances as high as possible consistent with the clients' requirements.

This is a very brief summary of what is a very complex topic. The possible permutations and combinations of the hull type, style, performance, drive system and accommodations of a power catamaran are considerable. Much greater than for monohulled vessels. But hopefully I have shown that there are some generalizations that can be made about the large number of different types and styles of catamaran each of which will have a particular advantage, or disadvantage, depending on its intended purpose. Ultimately it always comes down to horses for courses and, of course, your personal preference. Along with this must go the recognition that all boats are compromises and that you just cannot have a boat that will do everything.

[*] This squatting that occurs under power does not happen when the vessel is under sail. This is because the squatting tendency caused by the water flow around the hull with longitudinal rocker is counterbalanced by the diagonal/forward drive of the rig. So the force of the rig pushing the bow down is counteracted by the water flow sucking the stern down. If there is "excessive" rocker in the stern the boat may actually sail stern down, which is not necessarily a bad thing. However this can lead to a sudden overcoming of the suction at the stern by the thrust from the rig which can then culminate in a rather catastrophic lee bowing incident.

[**] This is a way of expressing how full or fine the ends of a hull are. Is it more or less a constant shape or does it pinch in at the ends? It is the ratio between the actual volume of the immersed hull and that of a solid having a constant section the same as the mid section multiplied by the waterline length. On a vessel with a prismatic coefficient of 0.65 the immersed volume of the hull is 0.65 [65%] of the volume of the solid formed by multiplying the area of the widest section by the waterline length.