

# KELSALL CATAMARANS LIMITED

## Questions and Answers on KSS and Kelsall Designs

Why KSS?	2
What is KSS	2
Why should I choose Kelsall?	2
How tried and tested is KSS?	2
How Many KSS designs have been built?	3
How does KSS produce round bilge from flat panels?	3
Is hard chine viable with KSS?	3
What skill level is needed?	3
What could go wrong in KSS build?	3
What risk is there with Resin Infusion?	3
What advantage is there to using CNC cut parts for boats?	4
What space and equipment do I need?	4
How does a designer develop a build method?	4
Why does a designer go on developing a build method?	4
Should I build a small cat first to get experience?	4
What is involved in working with foam?	4
Have there been KSS hull failures?	4
Is secondary bonding a problem?	5
How tough and durable is KSS build?	5
Is KSS tortured foam and fiberglass? Are stresses built in?	5
How fair and how accurate is the hull shape?	5
How do we handle large panels?	5
Does a KSS hull look like plywood?	6
How does a KSS Kit compare to a Duflex Kit from Australia?	6
What comes in a KSS Kit?	6
How practical is shipping Kits overseas?	6
What size is suitable/economic for Resin Infusion?	7
Is there an alternative to PVC foam?	7
Why not use ply bulkheads?	7
What is the best way to apply resin infusion to KSS panel making?	7
Why do you use polyester instead of epoxy?	7
How long does it take an owner to build a KSS cat?	8
How and what should I build in order to do so in shortest time?	8
How do I compare KSS with other methods that are claimed to be quick to build?	8
What does it cost to build a KSS Cat?	8
How is the table made?	9
What are the shape limitations with KSS?	9
What about Decks etc?	9
Does KSS restrict styling?	9
Some designs use steps in the bridge-decks. Why?	9
Does the step slam?	9
What bridge-deck clearance do you use?	9
Is a bevel panel or round between hull and bridge-deck important?	10
Can I add to the designed headroom?	10
Can I build and then move to the water in parts?	10
Can I build a design of another using KSS?	10
Each different method is claimed to be the lightest weight for the cat. How is low weight achieved economically?	10
What can we believe of the conflicting opinions and claims?	10
Can I build your design using ply or strip cedar?	10
What is the effect of extra weight?	11
How well do your boats sail?	11
How fast do your boats sail?	11
Does the standard rig need runners?	11
What do you think of Proas?	12
Should I fit low aspect ratio keels or dagger boards?	12
What do you see in your Freewing Twins rig?	12
What do you think of Airorig & Freewing Rigs?	12
Can builders make their own masts?	13
What about rotating wing masts on cruisers?	13
In Boom Reefing is popular, is it necessary?	13
Should Survival Compartment be fitted?	13
35 ft has accommodation I need, but I want 45 ft hull length for offshore. Which design should I choose?	13
Can I use KSS to build a trimaran?	13
Can I use KSS to build a monohull?	13
Where are you with X-Kat and Amkat trailer/sailors?	13
Amphibious cats?	14
Can KSS build be classified or pass survey for charter?	14
What do others say about KSS?	14
Can I reduce the overall beam to fit into our local marina berth?	14
I can buy plans for a lot less. Why should I pay more?	14

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## Questions and Answers on KSS and Kelsall Designs

**FAQ.** *The vast majority of the questions I answer are related to KSS build.*

### Why KSS?

There is one simple answer. Total efficiency, with no compromise. We are talking real benefits, which can be measured in months and even years on some projects. At the same time, we lose nothing in terms of quality, fairness, cost of materials, build time and weight savings. For user friendliness KSS gets top marks. KSS is simple and quickly learnt.

### WHAT IS KSS?

KSS stands for Kelsall Swiftbuild Sandwich. The term was coined by the first owner builder of a catamaran after we dispensed with the conventional setting up of frames and put some of the shape control into the panels themselves – 1991. Geoff, Helen and family went on to spend three years living their dream and sailing around the Atlantic. Their two young boys took to the water for the kind of experience and confidence building no schooling could provide.

KSS is our own, complete build technique. It is based on making all structural parts on a mold table. It is to put together a vast amount of experience of all aspects of boats, the knowledge of what works in the boat-shop, an intimate knowledge of the materials (we pioneered them) and an ongoing commitment to refinement. Literally hundreds of full size projects have made a contribution to where KSS is today.

Briefly, KSS is about designing for efficiency and doing each task how and when it is most conveniently and efficiently done. It is Kit based, with kits made by the boat builder or bought from specialist supplier. It is a simple, common sense approach, which makes it particularly applicable to the first time boat builder. For example, we have moved 95% of laminating onto the table. Roll out the glass, leave it there, lay down the foam and leave it there. Roll out the glass for second skin. Then infuse the whole part in one shot. It makes sense, especially when looking at the alternatives. Add lots of other jobs while still on the table and then add in the value of a finish, which has cost nothing. Finish alone can take as much time as we take to build the whole structure. Finishing is the most onerous task in boat building, as well as the one which benefits from the most skill. Hand laminating off the table is the second most onerous. Hence, KSS is a lot more than just saving time. In KSS, onerous becomes fun. The work on the table is where quality is much easier to achieve. We may not follow the fashions of the industry, but neither do we compromise. This is a win win situation for our clients.

To put what KSS achieves into context, a four day workshop, where instructing a group who have never done it before, is the prime objective, has produced a 15m hull and a deck ready to bond into place. Full topside gel coat, deck edge radius at sheer and around the deck for bonding. About 10% of glass to add and underwater finish to apply. Then there is the modular assembly designs option that add efficiency across the board.

We do not indulge in fanciful sales talk and make promises of building a 50 footer in 4-5000 hours, but we do promise that no-one could build either faster or better any other way. Our clients never fail to confirm this. When seeing KSS for themselves, no one has ever, unless with vested interest otherwise, suggested that there is a better way.

### Why should I choose Kelsall?

For unmatched all round experience, for unmatched know how, for style, for practical innovation and for the KSS build method. KSS is the only ever build technology to be the topic of long term R and D. It began in 1973, when the first full size table was made. Which makes most sense – laminating glass and liquid resin on a flat table or over and inside a hull shape. Obvious, but then throw in the finish from the table which costs nothing and which does, literally, take thousands of skilled hours to apply to the typical custom cat project. That is just the start. We keep refining.

We suggest that you look at THE one most important factor – how you will build it. It will determine a lot of things throughout the project. Which way, **in your view**, discounting all opinions, will get your job done most effectively and with least effort and time. This should be your choice.

### How tried and tested is KSS?

We have used the same materials since 1965. The Kelsall Kit panel methods have been in use since 1973. KSS began in 1992, which is when we first dispensed with the conventional framework and made hulls from one or two flat panels. RI for all KSS projects began in 2002. The idea that KSS is in some way taking a risk, is promoted by our competitors, but is entirely false. KSS is subject to an ongoing refinement process. However, we prove each stage and each step before it becomes a standard part of the KSS technology.

# KELSALL CATAMARANS LIMITED

## Questions and Answers on KSS and Kelsall Designs

### How Many KSS designs have been built?

The tally of different KSS hull designs (not the number of boats) that have been built, is as follows, arranged in length measured in feet, with the number of different designs at the same length in brackets; 8(4), 11, 13, 17,18 (2), 20, 21, 22, 23, 25, 26 (4), 28, 30 (2), 33(2), 36, 37, 38, 39, 40(3), 42, 45, 46 (3), 52, 54, 55, 60, 64, 70, 82 and 93. 43 different models, mono, cat and tri, of which the majority are cats. Of course, the more popular sizes have been built a number of times. I myself have been present at the initial stages for 90% of these.

### How does KSS produce round bilge from flat panels?

KSS is primarily a way of handling flat panels to produce the desired end result for all parts of the structure. For the hulls, the mechanics of how to achieve the hull shape is simple to understand and to undertake.

About 10% of the area of the typical KSS hull is round bilge, ie compound curvature. When starting from flat, compound curvature needs to either remove material or to stretch material. Most of our current projects use short dart cuts to remove material as well as some stretching of the core material only. After shaping, the glass skins are added to, to complete the scantlings. Obviously, the area where glass has been added, has to have a smooth finish applied in the usual way. It is all below water line and hence not critical to appearance.

### Is Hard Chine viable with KSS?

Yes. As examples:

The first all panel catamaran we built was at 39ft, in about 1974. The hull was of three panels, 'flower pot' style, with the bottom panel being of six inch thick foam, into which we shaped a reasonably generous radius chine. A recent hurricane in Florida caused irreparable damage.

A tender was built in 2007, using the deck edge radius join system to build a cat with same three panel hull style.

The simple 'flower pot' hull shape makes a valid cruiser. We are about to start such a project, converting a plywood design to KSS.

I found that producing the KSS round bilge hulls is quicker than the usual five panel hard chine hulls. With these developments together with what we are learning about bonded assembly however, we will test the interest by applying the hard chine to some of our designs, when supplied for owner build.

The main negative, for a cruiser, is that hard chine tends to make the design look dated compared to a nicely rounded transom!

### What skill level is needed?

An advantage of KSS is that it is not skill based. Quality and accuracy come from the technique. The practiced boat builder has some advantage, providing he or she can step away from their traditional training. Otherwise it is good old common sense and a practical bent, which achieves the best results. The main learning curve is in working with resins which is no different whatever the build method (unless metal).

### What could go wrong in KSS build?

The most likely time for anything to go wrong in building a KSS boat or any other is when first working with resins. We stress the need to practice on smaller panels. Usually it will be in getting the mix wrong for the conditions. The worst that could happen in the hull shaping is that the builder would need to go back a few steps and start the shaping again. In 20 years of making panels professionally, we never lost a panel. A very small number of KSS panels made by owner/builders have not been acceptable. These have been put to another use, so not entirely lost. One of the advantages of foam sandwich is that repairs can almost always be undertaken and are no great setback.

### What risk is there in resin infusion?

This question is prompted by the early experience of a few series producers when working with Resin Infusion. From molds, the objective is to pull out a perfect part every time. When relying on gel coat finish, there is little room for error or repairs. RI on the table is much simpler. You can see it happening. Get the resin into the voids and the job is done. We took the RI idea aboard, saw it as the perfect partner to KSS on the table, refined the set up to suit, and never looked back. "I now make panels for fun", to quote one of our first clients. 7 years on, I still call it the 'magic' in removing so much of the handling of the sticky stuff. Resin infusion is the latest technology to sweep the world of composite boat building. It is the first real alternative to bucket and roller. That is no reason for the first time builder to miss out on this real benefit. Make a test panel, which we do on glass to be able to monitor what is happening underneath, and 2 or 3 small panels and you will not look back.

# KELSALL CATAMARANS LIMITED

## Questions and Answers on KSS and Kelsall Designs

### **What advantage is there to using CNC cut parts for boats.**

There are lots of uses for CNC parts and where we have used them they have been nice to have. However, we do not see CNC machines as playing any critical role in KSS. We draw each part in such a way that it is easily transferred to the table on which it will be made or to the CNC machine. We use few complex curves which would have greater benefit from CNC.

CNC cut foam would provide the pattern for each part. It would give neat bevels already cut and could be set up for neat bonding of foam sheets into the sizes needed. Clients with access to CNC are encouraged to do so. We have made no attempt to compare time saved v. cost.

Foam shapes for rudders or dagger boards could certainly use CNC effectively.

### **What space and equipment do I need?**

Resins do not mix with moisture, cold or direct sunlight. Temporary cover is often used for assembly, but not recommended for panel making. The space, the size of the boat, plus 5 feet all round and 10 feet one side for the table, is a guide. The size of the table if making own kit, should be the length of the boat and 2 –2.5m in width, again depending on the model. The normal tools that would be found in any DIY workshop and the few special tools for laminating and working with fiberglass. The table and the vacuum set up.

### **How does a designer develop a build method?**

There is only one way to develop a method and that is on full size, real projects. It has to be an innovative designer working with the boat builder. It just happened that I was both for 20 + years. As the custom boat builder, I had an enormous incentive to find more efficient ways. The wages paid out weekly, to pay a bunch of men to do nothing but the onerous job of long-boarding concentrates the mind. No, I have never had the funds to build experimental, throw away hulls, but I have been lucky. When KSS began, to take us right away from the traditional approach to building, I had a number of own projects on which I could experiment without having to answer to an owner. We were also lucky to have owners willing to work with us. Jeff and Helen Hall were the first to take on their own KSS project. Jeff suggested the KSS name. They built their cat, *Island Dancer* and spent their dream 3 years with young family between Europe, W. Indies, US, Bahamas etc.

A while later, we came to 'one step hull shaping', which has also gone through a number of refinements. Again, I was lucky to have the KSS workshop hull projects and co-operative owners.

### **Why does a designer go on developing a build method?**

Part of the answer is that we just got into the habit of seeking a better way. It is also something of a roundabout which is difficult to get off, because the opportunities keep presenting themselves. The end result is the foam, that we started, has found universal acceptance, but we still stay ahead. No other method has had this continuity of refinement. I see no end to the ideas we would like to trial. That does not mean for one moment, that we are selling something which is untried.

### **Should I build a small cat first to get experience?**

Experience and confidence in the materials and the method are important. Of course this is where the KSS workshops come in if convenient to you, but certainly not essential. To undertake even the smallest full boat project however, involves a lot more than handling the materials and method, which is the experience being sought, unless that boat is the simplest form of outboard or rowing boat. With this in mind we do have a couple of outline designs that would suit, with the intention that this becomes the tender to the big boat. Another suggestion is to invest a little money in a sheet of foam and some glass and resin and experiment with it. I started by buying PVC foam and making a few panels. I put them together as a 7 ft. hard chine dinghy. I could lift it with one finger. It was our tender in the Round Britain race.

### **What is involved in working with foam?**

PVC Foam is the ultimate user-friendly material. Lightweight to move around. Warm to the touch, just try sitting on a sheet on a cold day. It cuts, sands, bends and can be fixed easily. It can be bonded. It will take screws. Rounded edges take just a few strokes with a sanding block. It is tough enough to be used to make complex shapes and be self-supporting. Transom steps or helm consoles, for instance, can be put together in foam, with nicely rounded edges and then have glass added to give it strength.

### **Have there been KSS hull failures?**

Yes, but only on own project during a workshop. This was when making the last major change in the KSS shaping process. Failure here meant that we made the hull panels as usual, but when we set them up the untried shaping method, which I had gone over in my head many times, proved to be a miserable failure. For some time, I wondered if I had made a big mistake in moving away from what we knew worked and was working well. I have forgotten the number of times those same two panels were bent and went back to flat, before a working system emerged, to make it all worthwhile. That hull was not lost. It is in build as an X-

## Questions and Answers on KSS and Kelsall Designs

Kat trailer sailor. There have been a few projects that did not achieve all the KSS advantages, due to decisions made contrary to our instructions/recommendations.

### Is secondary bonding a problem?

Secondary bonding is where fresh laminating is done over cured laminate. Abrade thoroughly, remove the dust and laminate over. All ours and every other boat ever built have done the same since fiberglass was invented. The main point to remember is that although the bond is slightly weaker (15%), area for area, the join can be designed for whatever strength is needed.

### How tough and durable is KSS build?

The basic materials that are used are virtually unchanged since we pioneered foam sandwich – PVC foam and unidirectional E-glass. The way in which KSS handles those materials, which has changed dramatically, enhances the already exceptional proven quality, for even better strength and durability. This makes KSS and Kelsall foam sandwich the most proven for durability and toughness. Decades on the water, including the ultimate round the World racing, seven times racing round in the case of GB 11 + lots more and still going strong 35 years. 40 year old Kelsall foam sandwich boats are still passing survey. Foam exposed to the weather since 1969 as a spacer on a concrete slipway can be seen today, still standing proud of the concrete. Unlike some other foams, PVC foam cannot become waterlogged. If there is water in the structure, there is some other reason or the wrong foam has been used. All the early Kelsall boats are polyester. A few of the later ones are vinylester. A handful of race boats are epoxy.

### Is KSS tortured foam and fiberglass? Are stresses built in?

Other than the fact of starting with two flat panels and pulling the shape, KSS has no similarity to tortured plywood. The ply is forced and stretched. The foam and glass are not. The secret to the KSS shaping process is to avoid forcing the shape. Allow the shape to happen slowly and steadily.

KSS shaping involves bending the topside area, at full scantlings, to the gentle curve in plan view. This has been done on every one of my designs since 1973, and includes monos with much greater bend. The transverse bend below the water line takes place in the foam with one partial skin of fiberglass. Foam is a material which does not retain stresses. Bend and hold for a few days and it stays bent. The thin single glass skin is not subject to any stress while bending. The main structural strength of the shaped area is in the extra layers that are added after shaping. The bending of foam core and one skin and then adding the second skin, has been part of our catamaran building since 1965. This is a favorite with the KSS critics. Ask what they do about the high pre-tensioning of shrouds, which is involved in the typical 3 stay cat rig. These are high stresses, which are left on through the working life of the boat.

### How fair and how accurate is the hull shape?

We use a simple frame system to produce the hull shape. We have introduced other controls for a few of the large hulls, but found they were not required. There are lots of other things we could do if there were any shortcomings on this count. Nothing more is needed.

The explanation is as follows – (I have left this as written for the one-step shaping process. We vary in some detail from this but the general illustration applies.)

The shaping involves spreading two identical panels, which automatically bend evenly. The deck width and the depth in the hull from sheer to keel are controlled by the frames. Fair topsides are guaranteed, as is a fair sheer line. In the one-step shaping, the stiff steel “T”, of two RHS steel sections, keeps the center line straight in plan view and it’s slightly lesser stiffness in side view ensure a perfect curve for the keel line. This only leaves the bend portion between the topsides and the keel line which could be uneven. We ensure that the bend takes place where we want it to, by using grooves on the inside of the foam. The depth of the grooves varies across the bend. The room for variation from the drawn shape is strictly limited. Make a test strip of the typical hull section, with grooves etc, and it bends the same way every time.

### How do we handle large panels or parts?

We tend to take pictures at workshops with lots of people around and lots of hands available, which may give a false impression. With resin infusion, with no hand laminating, size does not affect the process. Moving large panels around has never presented any particular problem. 15m x 7.5m is the largest I have been in charge of. A block in the rafters to a vehicle at the entrance to the building was the lifting mechanism. Two people handling 50 foot KSS panels is not unusual. When it comes to turning hulls over, I see some elaborate systems devised. Nothing elaborate is needed. A couple of braces across at the deck level and an old mattress, is often all that is needed to allow it be rolled over. Most builders have no difficulty in getting a few friends to come along to offer a helping hand at these interesting stages.

# KELSALL CATAMARANS LIMITED

## Questions and Answers on KSS and Kelsall Designs

### **Does a KSS hull look like plywood?**

Most of the topside area is developed surface as it would be if made of plywood. However, there is a tendency for the radius chine to migrate, very slightly, into the topside area. We encourage this by keeping the inside skin of the topside narrower than the full topside width and by the way we make the dart cuts. Examine some of the pictures on the web-site. The rounding is noticeable and when combined with a generous deck edge radius, the appearance of flat panels is lost.

### **How does a KSS Kit compare to a Duflex Kit from Australia?**

There are some nice catamarans built using Duflex. It is heavily promoted by a number of designers. It comes as 8x4 pre-made sandwich panels, which can be CNC cut into a kit of parts, which are easily transported. The full size panels for the structure are joined on a table and have epoxy/glass laminate added to each skin and a finish applied in the usual way.

Claims are made for the product. The claims can be justified in comparison with traditional custom boat building methods. Any comparison with KSS falls a long way short.

KSS uses PVC Foam (never balsa), mostly unidirectional glass and recommends either polyester or vinylester resin. All these products have been proven, beyond question, as having all the properties needed for lightweight strength and stiffness and exceptionally durable boats of all kinds. The resins recommended are less toxic than epoxy, less cost, easy to use and lacking nothing in use.

KSS uses a full size mold table, for full length, complete parts and a smooth finish. No transport is involved when making own KSS kit. Edge treatment for joining, edge radius, solid pads, provision for bonded assembly are applied at the same time. Full size ensures fair lines.

KSS laminating is 90% resin infusion for best quality, least time and a clean workshop.

CNC of foam sheets, while not essential to KSS, will provide the pattern for the parts, plus bevels, cutouts, rebates and more.

KSS produces round bilge hulls from two hull panels. Bending single skin and foam core then setting by adding the second skin is a great asset in a number of areas on a cat.

KSS does not compromise performance or function.

KSS uses basic materials, so no added costs.

KSS allows full freedom to position the fibers and vary the number of layers to suit the structure of each panel.

Wastage is very little with KSS. Ancillary materials are less.

A nicely finished, full fit out, 52 footer of Duflex in NZ took the experienced crew 4000 hours on finishing only, of a total of 16,000 hours.

ATL is the company who produce the Duflex panels. I can recommend the company for the supply of Airex foam, fiberglass and for resin infusion materials.

### **What comes in a KSS Kit and what value to the builder?**

Most builders choose to make their own kit. When buying the kit, it can be for every structural part or it can be the large panels only. Most builders will make some parts themselves and have a small table in use anyway. Shaped hulls have also been included in some kits. Larger panels from which nested small parts can be cut are being drawn to assist.

For the builder, starting with a Kit is a huge boost to progress. Within days, boat shapes will be achieved. The cost will, at least, double the cost of the basic materials.

### **How practical is shipping Kits overseas?**

The cost of shipping in container is surprisingly low. US \$6,000 will get a 40 ft. container to most parts of the World. Any size can be arranged to have all the parts fit into container and joined later.

## Questions and Answers on KSS and Kelsall Designs

### **What size is suitable/economic for Resin Infusion?**

When we first looked at resin infusion, we anticipated that there would be a lower limit on the size for which it would be practical for the home builder. We have revised that view. RI has become simpler, with less throw away materials and we put no lower limit on size. It just changes the whole build process making it much more enjoyable and therefore applicable at every size. If RI did no more than just remove the styrene from the workshop and the resin drips from the floor, I would count it worthwhile. We are hard at work on the designs with the objective of making ever more use of the table, with less laminating on the boat. There is a set up time, so unless they can be nested, small panels are quicker by hand.

### **Is there an alternative to PVC foam?**

There are good reasons why PVC foam, which was the province of Kelsall boats alone in the beginning, is now in all quality composite boats.

I have been responding to this question since 1965. We look at all potential alternatives, but so far, my answer has always been the same. A cheap core to do the same job would be great. PVC foam has been proven to be the perfect core in the sandwich over 4 decades. In the materials list, the foam is the major cost item. When making the cost comparison however strip costs more, good plywood costs just as much and can cost more when considering the wastage percentages. Foam wastage for KSS is usually less than 15%. Plywood can be 40%. Where additional insulation is needed, essential for comfort, the extra cost will always out-weigh any potential savings against the PVC foam.

A few builders have used same density polyurethane foam in parts that are not subject to impact and these have been satisfactory. Balsa is promoted as an alternative, but would go against a rule I made for myself 40 years ago. Nothing should go into the structure that can take up water or rot. Given time, water will get to some part of a balsa core whatever the protection. Nida-core is a possible for bulkheads and some other structures but not for resin infusion and not for exterior surfaces. Aircell makes claims for superiority, but only compares at higher density than the PVC (?) and then it costs more.

We have had such exceptional results over such a long period of time, it would take something special to convince me to change in order to save a few dollars. The potential saving in the total bill is minor. The value of the boat would definitely be compromised.

### **Why not use ply bulkheads?**

I have seen cats with foam sandwich hulls, plywood bulkheads, strip cedar saloon and ply/foam/ply bridge deck. Why? My advice is never, never mix materials in one structure of this nature, without good reason. Different materials have different properties and if overstressed, do not work together. This is why it has been known for ply bulkheads to pop out. I am occasionally asked if we need to put in plywood or steel to strengthen the glass for chain-plates or other attachments, as though glass is inferior. The same applies. One of the beauties of composites is that it is simple to add more layers of fiber where needed in stress areas. To add another material should not be done without careful calculations. For example, adding a little carbon, but not enough to take the full load, can weaken a stressed area.

### **What is the best way to apply resin infusion to KSS panel making?**

My first experiences with RI were in three different locations; NZ, Texas and W. Australia. The difference between the initial vacuum set-ups was remarkable considering that each had the same objective.

The set up has been refined over a number of projects. Today, we use a resin flow media over the top of the panel, perforations in the foam to get the resin to the glass below the foam and usually we will arrange for the resin to flow from one side to the other side of the panel. The resin flow media will be either grooves in the top of the foam, with the perforations lined up with the grooves or we use shade cloth or one of the special cloths for the job. This needs nylon peel ply below the shade cloth to enable release.

### **Why do you use polyester instead of epoxy?**

KSS is not dependent on resin choice. We recommend polyester or vinylester resin. Both work well and similarly with resin infusion. These materials have stood the test of time. In some instances in race craft, with carbon and extremely light scantlings we have used epoxy. However, let me quote from several articles on epoxy which express similar experiences. "Work with epoxy resin for long enough and everyone becomes sensitive to it". This is scary stuff. Hands so affected that they can no longer form a fist. Most custom designs recommend Epoxy. The usual claim is that it is 'stronger', which is actually misleading. I am grateful to have been working with polyester almost exclusively for all these years, with no incident of health problem from hundreds of clients and hundreds of employees.

# KELSALL CATAMARANS LIMITED

## Questions and Answers on KSS and Kelsall Designs

That Epoxy, properly cured, is a better resin is true but only slightly better than vinyl ester. On a boat hull or in most applications the only difference would be in the event of impact. No resin will eliminate impact damage. The question is, to what extent is impact damage a common problem. In my experience, it is rare. I am happy to live with the excellent impact of the foam sandwich. There are some good, lightweight, poly boats we built in the sixties which are still sailing. Would any one have been one jot better had we used epoxy instead of poly? They will go on sailing for a long time yet. The correct underwater treatment after build eliminates the osmosis problem, which is often used as another justification for epoxy. The positive side to this is if epoxy was used for KSS, infusing would keep it away from the skin, but would take longer.

### **How long does it take an owner to build a KSS cat?**

There is only one answer to this question - it depends who is building. We do not indulge in the fantasy numbers of sales talk. To give a list of hours against each design, without qualification has to be misleading. We have seen some quite remarkable results from some of our clients. 40 footers in less than 2000 hours and one 55 footer in 6,400 hours. We do quote these figures and I know them to be reliable, but it would be totally misleading to suggest that this is in anyway a guide to the typical. Some home builders move slowly whatever the method. We do give guide figures. We base these on what we would expect a well motivated and enthusiastic builder to achieve, but always with the reservation regarding the wide range we see. My figures on this basis, for KSS build to good standard and extent of fit out, is more like 4,000 hours for the 40 and 10,000 for the 55. When you read of non efficient methods and plans with figures like 4-5000 hours for 52ft, treat with the proverbial dose.

Another major variable is the amount and the standard of finish, particularly inside. Whether fitting fixed keels or dagger boards and lifting rudders can make 500+ hours difference. The keen to sail owner may well use minimum fit out and leave some parts with no fit out. Another may wish to display his woodworking skills and spend 2000 hours in fitting out the typical 35 footer.

### **How and what should I build in order to do so in shortest time?**

So far we have talked about the structure and how we have developed the most efficient custom build system to produce it. After the structure comes the fit out, which is usually another time consuming part of the job. A few years back, this was underlined for me by the time taken on a big cat after the structure was complete. All estimates went out the window. The outcome, aimed directly at this situation is our modular designs. These are catamarans which are designed in such a way that three modules can be built and fitted out, while the boat builder can walk right up to them and the final assembly is shortly before launch. The reasoning is simple. Take the job off the floor and you can at least double the time, every time. Most of the furniture can now go into rectangular spaces. Alternatively, use light weight domestic furniture. Cane seating for instance. Eliminating made-to-fit furniture can save a thousand hours on most projects.

Look for the new Kittiwake designs which are entirely practical cruising catamarans, which will get you to the water soonest. We already have a range of modular power cats from 6-14m and commercial designs in negotiation up to 100ft +.

### **How do I compare KSS with other methods that are claimed to be quick to build?**

Compare task by task and decide which makes most sense to you. A reliable figure was given to me recently. Two 33 foot slim strip hulls, by experienced boat builders, took 800 hours. Some form of strip is the method most often referred to and often claimed as quickest for the job. We give results of a four day workshop. I do invite comparison and suggest comparing, task by task. The unmistakable truth is that any time the finish has to be applied onto bare fiberglass, KSS is immediately hundreds of hours ahead. Anytime laminating has to be done over the boat surface, KSS is ahead. Anytime a full shape timber frame is needed, KSS is ahead. Placing full size sheets onto a table and rolling out full width glass is what we do. We are still adding such items as bonded assembly in place of laminating on board. Makes sense!

### **What does it cost to build a KSS catamaran?**

The basic materials cost per sq.m. or per kg. of foam, glass and resin are not different for KSS. To buy shaped cedar or foam for strip is more expensive. There is also however less wastage and there is less requirement for ancillary materials, such as timber for framing and finish materials. If making own KSS kit there is the table and the vacuum system to add. However, the table, which would pay for itself if only used to pick up one smooth surface, gets used long after the kit of panels is made. The vacuum system can be quite inexpensive. We are working on the reduction of those throw away materials for RI and this is not a major in the total cost and partly offset by the less resin, acetone, brushes and rollers used. The basic material cost difference is never enough to make it the basis of the choice either way. We could make a case for KSS on cost alone. Any bought kit will at least double the cost of the basic materials.

# KELSALL CATAMARANS LIMITED

## Questions and Answers on KSS and Kelsall Designs

### How is the table made?

The table requirements for RI are that the surface must not leak under full vacuum. Joins between sheets making up the table top must be done well. Butt straps and plenty of white wood glue do the job. For one off projects, melamine covered chipboard or MDF do the job economically. Trestles or steel framing support the table top at about 2 ft. level.

A series of trestles, with full length, joined, longitudinal timbers and the butt joined chipboard sheets resting on top, (with no through fastenings) has proved to be up to the job for my 32 foot, near ten year old table.

### What are the shape limitations of KSS?

**Hulls** – KSS is dependent on much of the topside area of the hulls being of developed panel. It starts flat. If you consider the fully curved topsides, as seen on many strip built designs today, of great importance to the way your cat will look and worth spending an extra few hundred or thousand hours on, then KSS is not for you. If you are tempted to believe that miles of strip will compete on time to build, as promised by some, I do suggest that you compare a few tasks, imagine what each one takes and then make up your own mind.

Below the water line, there is relatively little that we could not achieve in terms of hull shape. There is nothing in the standard KSS hull shape that I would wish to change. My career started based on race designs. Given the job of designing the best financed race boat ever, on which my reputation was carried, I would use KSS. Put it another way, THE RACE (Around the World) winner "Club Med" hulls could (and I would say, should) have been built using KSS.

### What about Decks etc?

The typical deck or saloon top could not be easier. A few cuts are the most we ever do to add more shape but there is no limitation in this respect unless again, you want the top of your boat to look like it started life as an egg. For myself, I want to be able to walk on all top surfaces and do so comfortably. Many of our latest designs have flat decks, so full sandwich as it comes off the table. Decks with a radius edge to match the hull deck edge radius are simply bonded together. Tube in deck edge for wiring and ducting.

### Does KSS restrict styling?

How a boat looks is almost as important as any other aspect of a yacht. I learnt a new but apt term recently. 'RAF' standing for 'row away factor'. Today tenders tend to be outboard powered but for anyone who has rowed away from their own anchored boat will know exactly why I find this term apt. Cats are not immune from the ugly duckling syndrome. There are some real shockers. Style is individual to some extent, it is difficult to define and I guess that most of us know it when we see it. Styling is not about lots of curved shapes. It does have a lot to do with proportions and symmetry. For 99% of cat design projects, style which follows function must be the only sensible style. The pictures speak for themselves.

### Some designs use steps in the bridge-deck. Why?

We have used both steps in the bridge-deck and flaired hulls on cats since first cat design in 1966. Both add some work to the build process. Both are done mainly for accommodation purposes. The knuckle is regularly used to provide berth width within the hulls. In custom build it means building the knuckle full length on both sides of each hull. We find the step easy to build and just as effective in most situations. There has been not one occasion where we have found the step or the knuckle to be in anyway a disadvantage in the performance of the boat. A step will often provide the same convenience, a lower coach-roof, hence less structure and less windage and a sleeker profile. I find some of the high bridge-deck cats to look overblown and they are in fact big boats in terms of area to build for their length.

### Does the step slam?

Not noticeably. All cats slam at some time. The most regular slam is on the center line with bow waves meeting, under the mast and again under the cockpit. The full impact is greatest when the water hits a large flat area. In some conditions breaking up the bridge-deck level is an asset in this way. I have no hesitation in including a modest step and it sure adds to the interior convenience (step down into hulls in particular), allows a sleeker profile as well as adding bridge-deck stiffness.

### What bridge-deck clearance do you use?

I am of the opinion that some designs have swung too far in this respect. There is no universal formula and no way to eliminate slamming entirely. I have found it better to keep the bridge-deck length short than to have a longer higher bridge-deck and better to lower just the part that is needed for headroom than to raise the whole. Most of my designs are in the 75 to 85 cm clearance for 40 ft. to 50 ft.

# KELSALL CATAMARANS LIMITED

## Questions and Answers on KSS and Kelsall Designs

### **Is a bevel panel or round between hull and bridge-deck important?**

The ideal structural shape would include a softer line between the bridge-deck and the hull. As an angled connection this proved to be a problem on a few early ply and metal catamarans. Our 1969, 50ft, *Triana* was done with a generous round, to Lloyds classification. It added a lot to the build time. We still had to build out floors and steps inside, effectively doubling structure. Our more build time efficient methods have proven to be entirely satisfactory, both before and since, which includes satisfying surveyors.

### **Can I add to the designed headroom?**

Usually the answer is yes, but do ask the designer. A couple of inches in the middle on something 20 foot wide is barely noticeable and is not a windage issue.

### **Can I build and then move to the water in parts?**

This has been done many times and in different ways, depending on the problem. My suggestion is do as much as possible close to home. Pre-planned longitudinal cut in full bridge-deck is our preferred. Designs for Modular assembly is another way, which we are offering.

### **Can I build a design of another using KSS?**

We can produce a KSS hull design and all parts, which will be the equivalent in almost every way to any other hull design, with the only restriction that much of the topside area will be developed panel. To do the job properly, nearly all new drawings are needed. I believe that KSS is worthy of wider use than being applied only to our designs. In principle I have no objection to working with other designers (with a couple of exceptions). A handful have already made some move towards a co-operation to use KSS.

### **Each different method is claimed to be the lightest weight for the cat. How is low weight achieved economically?**

The least weight structure would be of honey combs core with carbon epoxy skins. Sandwich is the starting point. There is no more efficient way of achieving stiffness, which is the critical factor in cat structures. We use foam but not honeycomb for the core. The weight difference is minor. Glass is our skin material of choice for its combination of economy and suitability for the purpose. Insulation is essential to comfort.

On method, the vacuum pressure of RI produces the best possible composite with no excess resin. The way parts are laid out allows for accuracy and putting the strength exactly where we want it to be, with fiber direction exactly as we want it to be. When each part is produced, post curing is normal procedure for the kit producers because it is simple to apply. This is quality that comes from the technique rather than from practiced skills. KSS saves on filler material. It may be a little resin with a lot of micro balloons but many cats have as much filler on the outside as glass skin. Everything is in place for least weight with KSS, in the basic structure.

There is one other effective means of reducing weight – which also reduces time and cost. KISS. Keep it simple. If we can reduce the number of panels or parts from which the boat is made, the weight saving in less joining and less finishing material is substantial. This goes back to the design and something we always try to keep in mind. Do not use two panels where one will do the job. One approach to consider, why spend days and perhaps weeks hanging doors and making drawers etc. Curtains, zips, open shelves, hanging canvas containers are all practical on board.

### **What can we believe of the conflicting opinions and claims?**

Clearly, the conflicting opinions cannot all be true. Everyone is biased towards their own product and there is no 'consumer guide'. Those who give an opinion are rarely, if ever, without some motive. My advice is to first ask; what does this man have to sell? Claims are everywhere and easy to make. We are the world cat experts. The best designs in the world. The best engineered in the world. A new generation of performance. We do not expect our competitors to endorse KSS, though there are now an increasing number of designers who have seen KSS and have an interest in using KSS for some projects. Our claim that *KSS is the Best custom build method* is made knowing our background, track record, and the results are indisputable. Ask if it makes sense to you?

### **Can I build your design using ply or strip cedar?**

There is nothing in the design shape or elsewhere that dictates that ply combined with strip could not be used to build any of our designs. The materials would do the job. However, if you have read through the rest of our literature, you will have read our advantage in foam and glass. If you do not appreciate the importance of those factors at this stage, I will guarantee that you will as any build project progresses. Usually, we choose to turn away clients rather than put them to the extra work of other build methods/materials. This is not to say that all our builders are done in months but at least I know that we have done all we can to make their job quicker, easier and better.

# KELSALL CATAMARANS LIMITED

## Questions and Answers on KSS and Kelsall Designs

Having said that, Robert Ayliffe who promoted our ply designs (ex. <duckflatwoodenboats.com>) who built or whose clients built a range of Kelsall cats in the past, believes the designs are worth promoting again, for the dedicated timber people. As a master of timber, there is no one better. We will be working with Robert. We do apply some KSS to plywood!

### **What is the effect of extra weight?**

Weight is the enemy of performance. Add an extra kg that is not needed and there is a penalty to be paid for the rest of the life of the boat. Performance however, is of different importance to different owners. My advice as in all things is to be aware and to take reasonable precautions to ensure that too much extra is not added.

I came to multihulls by racing them. At that time I saw the fast cruiser/racer as the slot that the multihull should fit into best of all. For me, the poor performance of some of the cruising cats is a disappointment. The problem is always weight. I am surprised the number of production cat builders who concentrate on charter style cats where performance is not a priority.

The problem is also that too much is put into the boat for its length. Some owners choose to custom build for the simple reason that there are no performance production catamarans available. To me the whole character of the cat is more to do with its weight to length ratio than any other factor.

In my own experience where, whenever performance is mentioned to a potential client, it is always somewhere in the top two or three priorities on the list. My hope for catamarans is that we will see more of the fast cruisers/racers on the water in the future. They will come from keeping the boats simple and lightweight and there is no better way to cruise.

Obviously, the start is to get the build right. KSS, KSS kits and resin infusion are the ideal starting point to produce a lightweight structure.

### **How well do your boats sail?**

A sail boat that does not sail well in terms of handling, responding to the helm and providing the helmsman with the feeling of being in control is not a sail boat worthy of the name. It does not have to be high performance but must be capable of all normal maneuvers under sail. We put the factors which determine the handling performance, high on our priority list. Having spent 18 years between racing and designing and building mostly race boats, we never lose track of performance.

### **How fast do your boats sail?**

Sailing performance is primarily dependent on the power from the sails v. the weight. Our models vary across the board. How far will she sail in a typical hour or a day is the only real interest. Cruising cats do not get launched and sail at 20+ kts. The occasions when I have sailed at 20+ have been memorable. On every occasion, it was on a boat designed for performance and on over 50 ft., (unless on foils) and it does include recent experience – *X-Factor* and *Room with a View*. I do not count surfing down a wave, or wave assisted burst as a sailing speed. A ten kt. average is rare for most cruising boats, mine included. 8 kts. needs good conditions. 6-7 is more usual. 5 kts. is common indeed, particularly for the heavier models. Bursts of 12-14 are not unusual but maintaining is another matter entirely. If you want a 20 kt sail boat, we know a designer who can draw it up for you! Looking for that bit of extra speed, let's talk. We have been pleasantly surprised at the reports we have received recently from the strictly cruising, 70 ft. *My Way*. 14-16 kts., on one passage with the occasional burst up to 23.5 kts. riding waves between San Francisco and Los Angeles. The KSS 55ft. Brigand won the ARC a couple of years back. ARC – Atlantic Race for Cruisers.

### **Does the standard cat rig need runners?**

Most cats are designed without out runners. We design all our cats with runners. I believe this to be an important issue. The popular three stay rig is dependent on high pre-tension in the shrouds. Higher loads on the stays, on the mast and on the boat are inevitable. Anyone who has been involved with cats for any length of time will have noticed how much heavier rigging and spars are than they used to be. This is the main reason. The runner angle more than doubles the support angle for the forestay, halving the loads and no need for pretension.

We started using the fully battened main, small jib combination for our multihull rigs in 1966. The first on race tri Trifle started with the plan to use the multipart main sheet to provide the forestay tension. It was a good arrangement for most of the time, but we then argued that we would often be sailing on headsail only and runners would be the best way. The runners allow us to move the main shrouds further forward to get max boom angle and to have relatively slack rigging. The slack rigging allows rotating of the mast, as well as providing the means of adjusting the forestay tension. Unlike on monos, where runners have a certain reputation, the runners are arranged so that they can remain tight when short tacking and unless in strong winds, the rig is secure should both be let go. Runners are another control and most clients do ask if we

# KELSALL CATAMARANS LIMITED

## Questions and Answers on KSS and Kelsall Designs

need them. I find the restricted boom angle to be unacceptable in the way I want to be able to sail. On a week's recent sailing, we could never let the boom out beyond the end of the track (40 degrees) without the battens going hard against the shrouds. The runners really come into their own when running fast down wind, the steering begins to get difficult and a reef is called for, but the last thing you want to do is to round up with the main sheet cleated. Having sailed with freestanding masts, with no fixed stay restrictions, eliminating runners to me is a step backwards. Planning trade wind sailing, use runners. Like to reduce mast section and pay less, use runners. Avoid the high built in stresses of pre-tensioned shrouds on boat and rig, use runners. Two controls, which can always be adjusted at leisure, are a small price to pay. Not all Kelsall clients take my advice.

### **What do you think of Proas?**

I still see proas as having the potential to be the lightest weight craft, for length, ever, which should also mean the cheapest, with particularly pure sailing speed possibilities, although it is about 25 years since I sailed one. We had a lot of fun with proas. It was a setback to the movement when the Atlantic Race organizers decided that the capsize record for proas was so bad that they would no longer allow entry. The main problem at the time was in the rigs though a number of viable systems were being proposed. There are some interesting options but guess that I have enough other things to keep me fully occupied to wish to get involved again – other than the Rob Denny co-operation where his designs are KSS built.

### **Should I fit low aspect ratio keels or dagger boards?**

The fixed low aspect ratio keel on each hull gives plenty of lateral resistance for windward cruising performance and positive tacking, excellent directional stability, good protection for props and rudders and takes the ground or slip when beaching. Another advantage is that they are easy to make and trouble free. They add fixed draft; typically 30 –50 cm. They add wetted surface drag, which will slightly slow sailing performance, particularly down wind. The boards are slightly better up wind, can be lifted for off wind and for shallow water. They will take ten times as long to make and fit and will take space from the hulls. Something also has to be done with the rudders to retain shallow draft. This is the typical compromise. I love shallow draft and good performance, but in order to get afloat soonest would probably choose fixed. We offer the option with most plans.

Fixed keels are not the safety hazard that should be applied to them if the popular theory of the cat sliding sideways in front of a breaking wave were true.

### **What do you see in your Freewing Twins rig?**

Light weight mast sections.

Lightweight rigging.

Relatively slack rigging and no need for ss wire or bottlescrews.

No restrictions of boom movement or sail handling from stays.

Makes full use of the cats overall beam.

Low loading on the structure.

Low center of effort.

Headsail and down wind options.

Simple rotating mast systems.

Freewing Twins was first tested on 24 foot cat in California. Report was positive.

A 60 ft project is in design stage at this time.

The objective is to achieve the near equivalent of Cool Change, at less weight and cost.

### **What do you think of Airorig and Freewing rigs?**

The unstayed twin wing rig on Cool Change is outstanding for windward performance.

I have designed, built, sailed a number of monos and cats with unstayed masts. Airorigs, Freewing rigs as well as several Junk rigs. The first realization is the restrictions imposed by the fixed stays of the standard rig. Reefing down wind, spilling wind or weather-cocking on any tack are enormous benefits as well as safety issues.

The fitting of unstayed masts is not difficult with deck saloon. The loads are not perhaps as high as one might expect. The balanced rig, the low sheet load and the wing shape of Freewing is the attraction. There is extra material and extra weight needed to provide the strength for unstayed rigs.

I do have this one reservation for cats. Cats have this wonderfully wide staying base. It seems a pity not to use this asset. Hence my interest in the Freewing Twins, which halves the mast weight.

# KELSALL CATAMARANS LIMITED

## Questions and Answers on KSS and Kelsall Designs

### **Can builders make their own masts?**

With the advent of RI we have devised a way to produce masts which does not require an expensive set up to achieve the shape. Early days, but I believe this will enable some owner builders to tackle their own masts. As we all know, carbon is the most efficient way to achieve the stiffness needed for any mast. Carbon can be used with RI as with any other fiber. We are combining carbon and glass for cost saving. The shape most easily produced is a wing section. Coming soon we hope.

### **What about rotating wing masts on cruisers?**

The first rotating mast we did went on to race Trifle (1966). The section was aluminium but a good rotating section. The rotating system used was no more elaborate than used on the Hobie day cats and this has proved to be good for lots of similar since. We soon learnt that sailing without rotating the mast correctly was like sailing with a brake on. I would choose rotating every time for myself. One of the reasons that rotating has not become popular is that most spar makers choose to design over elaborate systems. There is also the factor of section shapes. Few standard sections are particularly good rotating sections. Trifle is still sailing and I believe with original rig. When rotated the section is the most efficient for stiffness and, with runners, the fixed rigging does not need to be tight.

### **In Boom Reefing is popular. Is it necessary?**

The boom, for in boom mainsail is not an efficient structure. A long slot in a spar requires additional stiffening. Several strong attachment points are needed and the mandril inside needs good support at each end. This, for catamarans, I see as an example of boating following fashion. When I started sailing, rolling the boom, with boom end sheeting, was common place. The roller systems could not have been simpler, with the topping lift to set the angle of the boom. Sail problems have been solved. We should be able to go back to just rolling the boom. I will mention - some Farrier tris do. The neatly stowed main is easy to cover. I have asked a few spar makers but got no real answer. It would be neater than slab reefing - but slab is still pretty effective.

### **Should Survival Compartment be fitted?**

We fitted survival compartments into a few trimarans. We have talked and sketched a number of arrangements for cats, but none fitted. For serious offshore sailing, I am in favor of taking that little extra trouble to add what is needed to make a viable survival compartment. It is not that difficult and would make the difference between being on an uncomfortable raft and a sustainable situation.

### **A 35 ft would have all the accommodation I need, but I want 45 ft hull length for offshore. Which design should I choose?**

I get this question regularly. Not everyone needs four or more fully fitted cabins. This approach makes for the ideal offshore cruising catamaran, provided the designer and builder stay with the concept and do not get tempted to make use of the potential extra space. Design the accommodation, draw the hulls needed and then stretch the hulls - is how I love to design and sail. Come and talk about it.

### **Can I use KSS to build a trimaran?**

We could design trimarans to use KSS and there would not be a better way to build three hulls. It is 25 years since I designed the last tri. Why? The cat, for serious offshore has proven to be the most seaworthy, the best performer when designed for performance and you get more boat for your money or for your build time. However, there is a market and we have not ruled out tris forever. This is where co-operation with another tri designer could be of interest to the owner builders.

### **Can I use KSS to build a monohull?**

A little prior to KSS, but using KSS shapes, we designed and built a 38 foot ULDB mono called Brainwave. It is a fine sailboat, was easy to build and present owner in Cornwall is delighted with the performance in all the local races. When we have time, we plan to take the idea further. Much of our recent work on cat hulls, applies to monos. Past Kelsall mono hull designs range from 26ft to 76ft.

### **Where are you with KissKat and trailer/sailors?**

Our trailer sailer cats have been the subject of a whole series of 'stop go' situations over a number of years. We built a couple of Amkats in UK. What better than to be able to fold your wide cat to trailer width and push it up onto hard sand or slipway and never have to put your trailer into the water. It works great. We built the first X-Kat on telescopic beam. Has been refitted in Belgium. I moved to NZ and got involved with KSS refinement and resin infusion etc. etc. The innovator has a problem. Just when you think that you have done all that you can with a new idea, another one pops up to take you down a whole new avenue of options - there are not enough hours in the day.

# KELSALL CATAMARANS LIMITED

## Questions and Answers on KSS and Kelsall Designs

KissKat is about to receive some promotion. A trial beam set is in our workshop about to be tested. It is now quite practical to build ones own beams. There are no complex or precisely engineered parts to the system. From all the sailing of open deck cats I have done over the years, where no one wants to go below, that central accommodation arrangement seems to make the most sense and even more so when it is itself part of the beam system.

### **Amphibious cats?**

I love the idea and the two we built (1991) proved the concept. Own wheels opens up so many options. Every boat has to make the transition from time to time and many do at every use. The cat offers the perfect platform to do so. Either for towing or own powered wheels are within the capacity of the cat systems we have worked with. We hope to do more. Are you looking for something a bit different? The folding hulls and central accommodation is ideal for family trailer sailer.

### **Can KSS build be classified or pass survey for charter?**

The classification societies and surveyors have no problem with KSS. US coast guard will approve KSS. This, I will mention, does include foam core below the waterline. Core of any material, below the waterline is condemned by some surveyors in the US. To include PVC core in this condemnation, is to defy the facts.

### **What do others say about KSS?**

I have a wonderful fund of quotes. Everything from "cutting around with a chain saw" to "the only advance in boat building methods in last 100 years". I like "elegant but so logical, logical but so simple". There are two distinct sides from two distinct sources. My competitors and from a surprising number of others within the industry on one side and those from people who have seen KSS, or just reasoned it through and understood and have formed their own opinion.

### **Can I reduce the overall beam to fit into our local marina berth?**

Generally I regard any major reduction of the overall beam of a catamaran as a major compromise. If it was one foot less, then OK. If it was 3 feet or less, I would strongly advise against unless there was a long term plan to only use the boat in sheltered waters etc. We might also suggest reducing the rig.

The same question is asked with regard to the power cats. The answer is the same. I believe the power cat needs plenty of beam and not that much less than a sailing cat. I have no desire to see 50 foot, serious offshore cats carrying my name, squeezing into 16 ft. wide berths.

### **I can buy plans for a lot less. Why should I pay more?**

The importance of the plans cannot be underestimated and price should never be an important factor in this, so important, decision. The plans and the designers name goes with the boat for the life of the boat. To illustrate, we have just quoted a client for our 70ft. design. He came back to tell me that he could get standard 70 ft. plans for 8.5K or 15K in the US. I do not know who the designers are but you can guarantee that they are only costing the plan reproduction and a profit. We spent a lot more than 1500 hours on our 70 design. There is a huge amount of information in great detail, of every aspect of building.

We have invested heavily in our own KSS foam build method, very effectively, to the advantage of all our clients. Other designers have followed the typical industry standard methods, which owe nothing to efficiency. At the same time, they have made the switch from foam critics to foam users and some have become foam 'experts' overnight.

Even so, the difference in plan prices may be difficult to understand by a first time builder. In another industry, a standard design fee might be equivalent to a commission based on value. By the most conservative estimate, a 70 footer is a \$2,000,000 project. If this was a commission on selling, look at the %. Selling cheap may suit a no longer active designer, supplying minimal information, but could not work for an active design team, investing in new technology. The chances of the outcome being satisfactory are not high.