

KELSALL CATAMARANS

KSS The Leading Edge of Custom Boat Building

What is KSS

KSS is a complete boat building system, applied primarily to Kelsall Catamarans' designs.

KSS gets you to launch day sooner, in style, with best quality results.

KSS gives the builder a clean and satisfying process with time savings and using less of the sticky stuff.

KSS stands for Kelsall Swiftsure Sandwich.

This booklet explains KSS for boat builders. It includes:

- The Materials – PVC Foam, polyester or vinylester E-glass skins for the whole structure.
- The basis – starting by making flat panels on a full size, simple, flat table.
- Laminating – all panels (for complete structure) are made using resin infusion, for best quality and least time.
- Shaping hulls – a simple framework, ratchet straps and some battens produce the round hull shape from the flat panel starting point. A single skin on the core and dart cuts in the shaped area allow the compound curvature to be achieved with little effort.
- Completing hulls – topside areas are smooth from the table. Glass and finish is added below the topside area.
- Assembly – most joins are preplanned for bonding or laminated joins. Final assembly depends on design.
- Hard chine hull options are available.
- New modular design models save substantial build time. This approach applies to all sizes. Large, multilevel designs gain an enormous benefit from this approach.

The major time savings come from:

- Working on a table, with a relatively small portion of the work done on the boat.
- Picking up the finish from the table, for one side of all parts, plus edge treatment at the same time.
- Resin infusion which produces the full panel in one shot.
- Designing to make best use of KSS.

The KSS structure being light weight and durable is THE ideal for catamarans of all sizes and types.

KSS efficiency, compared to the usual alternative, cuts the build time by at least half.



KSS 54 Coolchange

KSS in More Detail

KSS (Kelsall Swiftbuild Sandwich) was suggested by the first KSS owner/ builder who was the first to use the full structure from flat panels 18 years ago. He and his young family spent 3 years cruising on both sides of the Atlantic on board their 36 foot KSS sailing catamaran, Island Dancer. The KSS process has been subject to regular refinement ever since. A new and more appropriate interpretation of KSS - Kelsall Swiftsure Sandwich System was suggested by Michael Waters. The similarity to KISS is entirely appropriate.

KSS produces round bilge hulls, using a technique which we have devised and refined over a number of years. Making hulls is seen as the novel part. See below for more details. However, KSS addresses every part of the catamaran structure for best build time efficiency and best quality, as well as the option of hard chine hulls for some models.

KSS has primarily been developed and refined for building Kelsall designed catamarans of PVC foam and fiberglass. We acknowledge the contributions of a number of clients, though most of it is all our own work. In recent years, particularly since resin infusion became standard for KSS, we have been the most productive in time saving innovations. Resin infusion is neat, clean, and reliable and has itself been subject to a number of refinement processes to suit our KSS mould table. We continue the effort with KSS Modular Designs for more build time saving.

KSS is to forget all we know about traditional boat building. This is the hard part. The blinkers of what we know are very powerful. KSS takes the requirements of the final craft, the properties of the materials involved, the structure and what is efficient in the boat shop, and combines them into a common sense handling process.

The beginnings were in 1965, pioneering the use of foam. No other build system has received similar ongoing refinement of any kind. It is also true to say that no other system has that potential. We have no competitors in this field.

A full size, flat mould table, usually of melamine covered chipboard, is the basis of the technique. Butt strap joins underneath, join the table surface sheets and trestles to support the table top. The first table was made in 1973. All structural parts start on the table, which allows ease of laminating and provides a smooth finish for one side. Vacuum Resin infusion has been adopted and refined to suit the table, as the standard laminating technique.

The materials are composite skins (glass and polyester or vinylester resin) on PVC foam core. Epoxy can be substituted but adds cost and toxicity. No other core material has the ideal properties, the durability and the tremendous versatility of PVC Foam. PVC foam is described as the 'Gold Standard' on the second hand market. The common core alternatives being endorsed by a surprising number of designers do not match foam on any count, particularly on durability or versatility.



Legs of Mann IV

All Kelsall designs have been drawn with KSS in mind. Every part of the structure is drawn so that a kit of parts can be made by the boat builder or bought from kit suppliers. Special techniques have been devised to produce compound curved shapes, such as the round bilge portion of a hull, while starting from flat. A 40 ft. hull can be completed by a small team, in one week. KSS dispenses with the traditional, full temporary mould shape for hulls. The shape is partly controlled by the shape and the make up of the hull panels.

KSS does not require full size templates. A recent innovation is a setting-out frame which is used on the table, to which full size printed strips (supplied with the drawings) are applied with the dimensions marked ready to transfer to the table. It reduces the time spent using a tape measure and reduces the chance of errors in measurement. It accurately sets right angles.

KSS foam kits, CNC cut, are a neat and attractive way to work, but do not offer huge time savings. KSS can be combined with other custom methods if some complex parts are essential. There are no strict limitations or boundaries to KSS. Every build project can benefit in some way from KSS know-how.

KSS does not immediately lend itself to the designs of another. We do work with other designers to a limited extent. The situation is that we can always produce the equivalent design, to make best use of KSS, but all new drawings are required.

KSS tackles every part of the boat building process and is the most efficient way to build a catamaran. Devising suitable methods to produce monos is underway. The current popular strip method, for example, came along about ten years after our first foam sandwich craft were on the water and winning races. We were never tempted. We were achieving all the shapes we ever needed. Strip never looked like saving any time or improving quality and it did not address the big one of achieving a smooth external surface. This is not a few % saving. Compare tasks at any stage and the simplest analysis will confirm our claims for, at least, cutting build time in half.

KSS can be combined with part moulds for the more complex or time consuming parts. This approach is particularly appropriate for producing a number of the same design. Hull 'shoe moulds' have been combined with panels from the table since the seventies. Transom steps are another item which benefits from this approach. 'Splash moulds' can also be used. For example, shape the stem of the first hull, cover it with parcel tape and take a pattern which is used for the second hull.

KSS designs are influenced by our belief that style must follow function. Style is all important to us and we work hard to find the style to suit. KSS avoids the less practical, all rounded look, which is common on other designs.

The KSS panels for hull topsides or saloon sides, have built in stiffness which ensures the kind of fair lines which take immense time and skill by the traditional methods.

When making KSS panels, a number of other jobs can be done at the same time. Capping openings, recesses and edge treatment are examples. They are much quicker done on the table than later on the boat. Weight and materials are also saved.

The KSS panels make a kit, which can be pre-made in a smaller space, with environment control (or bought) before any assembly needs to begin.

For further time savings, assembling the kit is increasingly being done by using bonding techniques, rather than the traditional laminating techniques. The laminating on the boat is reduced to a minor amount. The finishing can be reduced to the join areas only for much of the structure.

KSS has been applied to every size from 8ft to 100ft. The limit is unknown but double that at least.

Modular Assembly

A number of new designs are available for Modular Assembly, both power and sail and more being added. Ships, houses and other items benefit from the approach. Catamarans lend themselves to modular assembly, with further major build time savings at every stage. Large, multilevel catamarans can slash build time this way.



KSS 42 Kittiwake

Detail of KSS, Round Bilge, Hull Production

The hulls are no compromise shapes, whether for high performance sailing, strictly cruising or power. Without compromise, KSS achieves all the catamaran shapes we could ever need as designers.



Table and Resin Infusion



Two panels



Final Hull

To produce a compound shape from flat requires either the removal of some material or the stretching or compressing of the material. KSS hull shaping involves both to some extent. The dart cuts are the means of removing material and pressure stretches or compresses the foam. The secret is in the make up of the panels and the set up to control the shaping process.



Setting out on the table

The KSS hull kit starts with two panels. One panel for each side of the hull. The whole of the topside area is smooth gel coat from the table with full scantlings. The area of the panel below the topsides, which becomes the round bilge, has no inside skin. The KSS shaping process of dart cuts, pulling to shape etc., produces the round bilge. This area, mostly below water line, has more glass and finish applied after shaping.

Today, we have two approaches to hull shaping. One-step and half hull shaping. Either can apply for most designs, depending on circumstances. The one step process, which came first, uses the same panels but with a set of frames to control the deck width and the keel depth, with the center plane of the hull vertical.



Frames for half hull shaping

The two side panels are tied together after the dart cuts have been made. The ties are electrical ties, which also tie in a longitudinal "T" usually of steel. The T allows the keel line to be pulled down, using ratchet straps which are attached to the leg of the T between the two panels. When the keel line is brought down to meet the frame on the center line inside the hull, the shape is as required.

Half hull shaping, with the half hull at 90 degrees and central plane horizontal, allows for easy access to all parts of the hulls during shaping and while fixing that shape. Even the largest hulls are complete without having to move off the shop floor.

The portion of the hull which is round bilge, with rocker is compound curvature. In section, the panel is curved in this area by omitting the inside skin. The foam core easily compresses sufficiently to achieve this bend. The compound curve is achieved by using relatively widely spaced, but short dart cuts from the keel line, across the area to be bent. This removes some material. The dart cut is a tapered shape starting around 3, 4 or 5mm at the keel line and spaced at about 350cm along the length. One edge of the area to be shaped is next to the topsides and is guaranteed fair and it is all there in the one panel. A few short cuts do what it takes miles of strip to do – and no strength fibers are cut.

The shaped area is a relatively small proportion of the typical hull. The topside panel acts like the designers spline. It naturally takes a totally fair line and it controls one side of the shaped area. At the other side of the shaped area there is a stiff steel "T" section, which again, would need forcing to go far out of line. With just a small area between these ideal control features, the KSS hulls are, barring errors, exceptionally fair. KSS has a tendency, which we encourage, to lose the flat panel look of plywood or metal.

We are experimenting with the extent to which we can use what we call pressure shaping. This requires a slightly different approach. The dart cuts are shorter with the attraction that there is no line up of adjacent fingers (the parts between the dart cuts). This is not yet for all designs. It is not in itself a huge time saving difference, but it is a logical and elegant next step. Pressure shaping is a topic in itself, with some very interesting options - watch this space.

Half Hull Shaping

A set of frames are used to assist in controlling the final shape of the half hull. Typically there are between 8 and 11 frames, all made of straight timbers, to same outside dimensions. An angled timber sets the width and the topside panel angle. A relatively small ply pattern for the chine area, is added to each top timber, which is hinged at one end – to allow the panel to be set in place. The pattern is the same for all stations except stations 0 and 1.



Frames

The dart cuts are made in the panel, taking the position and length from the drawing. On a flat floor, the frames are moved to the positions, marked on the panel for each station. A full length batten of “L” section is run along the keel line, capping the edge. The panel is laid into the frames, on the angled timber. A ratchet strap, around the “L”, at each frame is used to pull the keel line up to the center line, bending to the section shape. Pulling on the batten allows the fingers to move relative to each other. The whole process from flat to final shape rarely takes an hour. KSS makes the frames, sets them up and pulls the shape in a lot less time than it takes to set up the frames for a typical alternative. Completing the inside skin, by hand, fixes the shape. Final laminate and finishing is done after assembly into a hull. The frames are reversed for the second half of the hull.



Transom

One Step Shaping

One step shaping preceded half hull shaping and is still applicable for many designs. The two panels for the hull are joined along the keel line, with a “T” batten also in the tie, after cutting the dart cuts. They are set over a set of very simple frames. The frames set the deck width and the depth from sheer to keel. The keel line is pulled down till the keel line is correct, at which point the hull is very fair. One edge of the bent area is the stiff topsides. The other side of the bent area is the stiff keel batten. Not much room for the shape to go awry. The fingers are lined up, using a timber batten on the outside, half way across the dart cuts if needed. In some cases, this whole setup can be rotated 90 degrees one way to do half the laminating and then 90 degrees the other way etc.

Overhead laminating, sufficient to hold the shape, is another way. This is not as difficult as it may sound. One layer of light weight csm does the fixing and is the easiest to apply. Wet the foam with resin. Wet out a strip of csm say 300 mm wide and length to go from inside skin to keel. Lay over a T holder and a resin roller. Position and roll out. It stays in place and can be done with very few resin drips. Size and space determine which is the most appropriate method of fixing. After fixing the hulls can be rolled back and forth very easily.

Our Build Instructions cover each step in more detail.

From the pictures you may notice that the hull shape is not totally flat sided and that the gel coat in some cases extends beyond the flat topside area. These are the finer points of KSS which are covered in the Build Instructions and the drawings.

Resin Infusion

Resin infusion became a KSS standard 8 years ago. It is the “magic” which changes the nature of the whole process of boat building. The boat shop can be clean and smell free for most of the time. No more “you are not coming into this house in those smelly clothes etc”. Your partner is more likely to come along and help.



Resin Infusion on table of 70 ft panel

This is open technology, which we have perfected for our use on the KSS table. It is simple to understand and set out, and is entirely reliable. Making a few test parts provides the confidence to produce the largest panels. Do not be persuaded by the warnings of the ‘experts’. By all means read what others say, but always remember that what is needed in a mould, is where most will have got experience. What is needed on the flat KSS table is very, very different. We do not lose panels.

For more than twenty years, we used vacuum bagging techniques, to make foam sandwich panels on the KSS table. The only incentive to change was the improvements resin infusion offered. A high quality panel in the least time, made neatly and cleanly, and with reliability. A panel, of any size, can be made by one person. This is not sales talk. We do it at every workshop. The last workshop group made three 32ft. panels, in four days of hands on instruction to people who had not done it before, with the first day spent in other preparation work.

What Others Say

One of the common criticisms we hear is that KSS does not produce a hull with fair lines. The source is almost certainly a competitor. This guy is still publishing a report he wrote more than 15 years ago. That report was an exercise in how to omit half the facts in order to give his desired effect to his readers. Those who know the full story are positively impressed. There are hundreds of pictures of KSS projects which tell the truth and that go with the common sense argument of just how fair KSS is, in the shaping controls description above. KSS produces fair lines from the technology rather than from practiced skills.

I could write many pages on this topic. Suffice, I suggest, to consider the adage – the innovator is never acknowledged by those who do not stand to gain directly. A few designers have seen and acknowledged KSS as having no equal. Others will ‘find’ some means to try to discredit KSS. Of course, build time and environmental issues, which is what KSS is all about, are such all important issues that for the industry to endorse KSS would be to send all custom boat builders to us. I am, however, amazed at some of the amazing reasons that have been given to our clients in the attempts to divert attention away from KSS.

A Simple Choice

While working with liquid resins, does it make more sense to work on boat shapes or to do 95% of the work on a flat table, from which a smooth finish to one side is free, letting vacuum pressure do the hard work, to achieve the best standards? Everything in KSS follows from there.



KSS P33 KaivitiKat

The Pros and Cons

A new friend, not previously closely acquainted with KSS, writing about build alternatives set out to give the pros and cons of each system, expecting to find lots of cons for KSS, particular from what he had heard from others. Many items on the down side for KSS were raised and crossed off the list. Our background, our achievements over so many decades and the ongoing nature of the KSS development, show KSS as a versatile, no limitations process. The KSS development has been a step by step process. Each time we see an opportunity we try it. Each time we see a chance to improve a step in the process, we find the best way. We know better than anyone in the business what the ultimate objective is for the boat builder and the boat owner. We have never accepted compromise of shape, quality, or utility.

The following is a genuine list of cons that do apply to KSS

- A full size table is needed.
- A vacuum set up and some know how is needed.
- There are throw away materials along the way.
- There are few fancy styling curved shapes on our KSS designs.
- We do not use wood anywhere in the structure, which some owner builders still like to work with.
- KSS does not look like the romantic, conventional picture of boat building.
- Your partner might want to come along and get involved – which might not suit some.
- Some of your boating buddies are almost certain to tell you how big a mistake you are making.
- Some ‘experts’ will tell you that resin infusion is only for the experts. You will have to prove them wrong.
- KSS is all PVC foam sandwich. Bolting requires the foam to be replaced locally with a denser material.
- KSS only applies to Kelsall designs.
- You may be tempted to borrow a hair dryer, hair grips, clothes pegs and even old blankets from the household.



KSS P46ma



KSS P36ma Outboard Powered

The Next Addition to KSS

Our deck edge radius set up, where decks are bonded to hulls etc., offers the opportunity to simplify a number of deck items. We are designing chain plates, lifting attachment points, cleats and tramp attachment points into the DER. They are simple to do and really neat. The lifting cleats we have used previously have proven their value but these are simpler. These all fit nicely with our stanchion mounting system and preference for eliminating through bolts where ever we can.

Bonded assembly is proving to be reliable for much of the assembly of the kit of parts, removing even more laminating and finishing from on the boat.

The Value of the KSS Table

The Smooth Finish

From recent figures for applying the smooth painted finishing to the typical custom build project, approx. ten hours per sq.m. is given as the time to apply the fairing compound, longboard etc., and to paint. Add a litre of fairing compound plus four paint coats, for each sq.m. and you have an idea of the time and cost of the finish when using conventional methods. While employing finishers for my custom boat building company, a long time ago, I allowed close to two hours per sq.ft. The above, I believe, is by a skilled and well motivated owner builder. Reduce the motivation and double the time would not be unusual. That means, if your 40ft. cat has 200 sq.m. of exterior surface, it will take a year full time to apply the finish alone. This is in line with figures I have from an experienced team finishing a strip planked 52 footer, which took 4000 hours. KSS does not eliminate finishing but does give a huge head start, with 95% of the area smooth from the table. These figures put the conventional finish roughly on a par with the time to produce the shell structure.

Toxicity of Epoxy

Most conventional finishing is done using epoxy. We have always used polyester or vinylester based fairing material. In terms of health hazard, we understand that working in the dust of epoxy is next to getting it onto skin. Resin infusion and KSS means a lot less contact with these, not nice, materials. Our recommendation is to use the less toxic ones.

Laminating

Liquid resin and a flat table on which to do 95% of the laminating has to be efficient and a lot better quality, however the laminating is done. Applying the resin and the glass cloth to a boat shape is messy, very difficult to be accurate and will quadruple the laminating time taken. By using resin infusion on the table, KSS substantially improves on hand laminating.

Full Size Panels

Working on the table, we use the basic materials at the least cost. Working with full size panels, with inbuilt stiffness ensures that each part automatically takes a fair line. A lot less skill and control is needed to achieve the best results.

Other Tasks while panels are made

A deck edge radius batten is standard on all our hull and deck panels, to create the sheer line and the join. Recesses are made in the panel as it is infused, in order to make subsequent joins within the recess area. Capping of openings can also be done, as well as other items such as solid pads or extra layers where needed. Each one takes a lot less time on the table than it would take in doing it later on the boat.



Bonefish a KSS 82



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