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May/June 2016

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Sea Trials

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The first HH66, *R-Six,* is finally complete and makes its way to Xiamen's Shang Shan Marina for sea trials. Read article on page 26.

DEPARTMENTS *continued*

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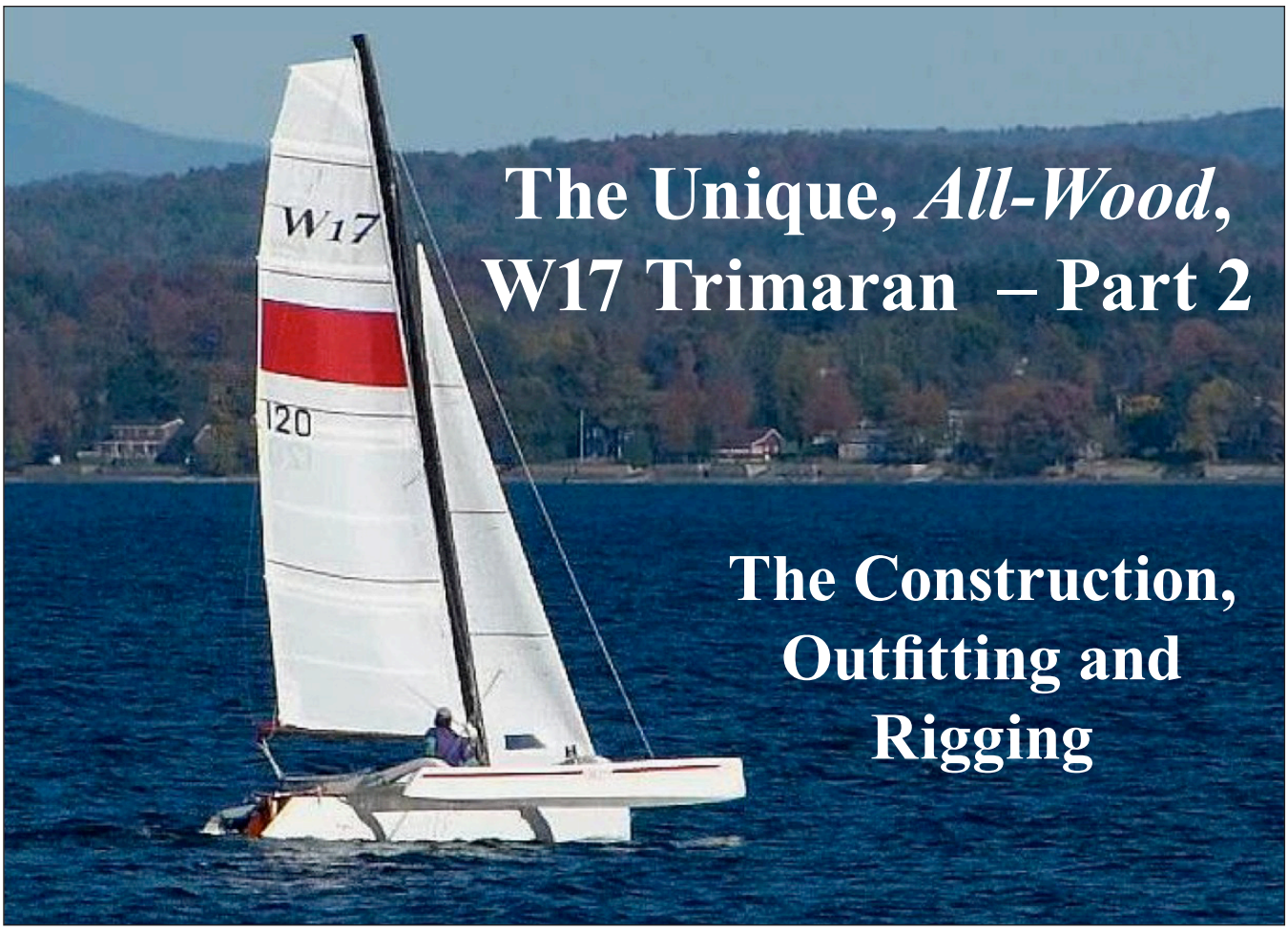


The Unique, *All-Wood*, W17 Trimaran – Part 2

The Construction, Outfitting and Rigging

This is a continuation of Part 1, published in the March/April 2016 edition of MULTIHULLS Magazine, an article presented as 'a design exercise' to show how a more satisfying product can be created with an orderly approach that starts with clearly defined design criteria. In this example, naval architect Mike Waters takes us through his process of satisfying all the pre-set criteria for his new, all-wood 17ft trimaran, and explained the unique solutions chosen to achieve those goals. Part 2 gives an overview of the construction, outfitting and rig, which also includes a home-buildable rotating wing mast.

The Construction

The W17 hulls are built in a fairly traditional way, upside down on a simple table. Here is a brief run-through of the main steps:

The center girder is first pre-assembled with the daggerboard case built-in and then attached to the cockpit end bulkheads.

The hull plywood is scarfed-to-length and then pre-sheathed internally before fitting. I strongly believe this is the best approach when skinning with plywood, as not only is the glass on the tension side in the event of external impact, but the surface is fully sealed *before* being laid over any longitudinal


Setting up main hull framing


Mike hot gluing the plywood edge

stiffeners, which survive better when left unsheathed. This is because fiberglass cloth does NOT like going around corners and by pre-sheathing the plywood first, you can avoid poorly covered joints that hold water and then rot.

For the W17, the sides are added first, followed by the bottom. In contrast to most plywood boats that are assembled using copper wire stitches, the W17 uses a system that saves all those little holes and the time taken to remove the wires. For all three hulls, the sides are first laid around the bulkheads. This leaves an unsupported upper edge that is rather wavy, so before adding the bottom panel, a batten is clamped to the plywood edge about 30 mm down and attached with hot glue, so that the clamps can be removed. The bottom is then laid over the now fair edge, with just a small bead of thickened epoxy over the plywood edge and the panel held down with strips of duct tape until cured. The corner is then lightly rounded, a 50 mm tape added, before the boat bottom is sheathed externally, at least to 50 mm above the waterline. The full strength of the chine corner will only by


Cockpit


Interior

obtained after the hull is turned over and the inside corner filleted with another tape added over. The hot glue is easy to remove and there are no holes to fill or wires to pull.

While the plans include guidance sheets on where to cut each part from the various sheets of plywood, pre-cut kits of the W17 are also now available from the world's largest wood kit supplier CLC Boats, with the W17 being the first trimaran kit they've offered. Kits are available in other countries too, all based on the same cutting data with Witt Design being the Australian supplier.

After the small aerofoil slot is cut in the bottom for the board and the main hull is sealed and painted, the hull is then turned over and all interior seams bonded with filled epoxy. The self-draining cockpit floor lays over the only stringer, after some short beams are fitted. Once the deck structure is added to receive the main beams, the fore and aft decks are fitted and the central part of the main beams (akas) are laid over the deck and through-bolted to the main hull structure.

The cockpit seats are then attached to the hull gunwales, which are mounted *externally* to the plywood to keep the cockpit nice and clean. With the main

beams in place, the longitudinal cockpit boxes are built between the beams. Considerable effort is made on all my multihull designs to provide ample horizontal surfaces for safe mobility, as the high stability permits one to walk around far more than on a monohull. This is another great advantage of the trimaran, as it provides an "area of mobility" about double that of a monohull of the same length, so it's physically easier to sail for longer periods, as there's no excuse to get stiff on board.

Building the Amas

The amas are built in a similar manner…starting with a few simple bulkheads upside down and applying the pre-sheathed sides first. Two sturdy areas are built into the deck, where the curved crossbeams will later be permanently attached. To satisfy the design criteria of comfort, dryness and performance, a unique bottom shape was developed that, for want of a better name, I call "Tri-Form."

Tri-Form refers to the three distinct angles that the ama bottom occupies, starting nearly vertical at the bow and twisting about 45 degrees to amidships and then becoming horizontal at the stern. The bow angle gives a fine, clean entry, while the amidships angle is 'idealized' for impacting with waves, often unavoidable to windward (see sketch with Part 1). The slightly tucked-up flat surface aft helps the stern of the ama slide slightly to assist in turning, and also helps the water flow off cleanly.

All internal areas for all amas should always be well sealed with an extra two coats of epoxy over any place where water may lay for any period of time. Even then, one should always sponge this out on a daily basis. Marine plywood will last 50 plus years if it's kept dry, protected and ventilated – but less than 10 if it's neglected and allowed to stay wet, so the rewards for the effort are huge.

I've already mentioned the need for flat surfaces to move about. This needs to apply to coaming tops as well as seats, decks and even cabin tops for larger designs. Sloping coamings and rounded deck edges are fine if the boat is large enough to *still* offer enough flat surface to safely move around, but on smaller boats (say under 40 feet), I'm definitely a fan of flat, horizontal surfaces for safe mobility and comfort. This is particularly true for the over 50 crowd. It's safer, way less tiring and encourages the crew to move around and keep mobile.

This photo shows the unique Tri-Form bottom – achieved with the outboard chine kept perfectly straight for reasons explained in Part 1.

Once the curved end beams are made, the forward fairings are added by sliding them down inside a temporary barricade of wood battens, controlling the bonding in place before glassing over. By forming a triangle with the main beam, the fairing becomes


Ama twist


Adding outer beam fairing

remarkably stiff and strong, despite being of light (internally pre-sheathed) 3 mm ply.

On my boat, most deck areas were initially left bright to show this is indeed an *all-wood boat*, but plywood exteriors look and wear better with paint, so another experiment that worked quite well, was to lay on the chosen one-part white polyurethane paint with the normal brush but then finish off with a flexible squeegee or blade. Practice was needed and the timing has to be right, but this can totally remove brush marks, creating a finish closer to a sprayed one than most other hand brush options.

Outfitting

A major part of outfitting a trimaran involves creating and attaching the trampolines. Tramp attachments are the nemesis of many builders as they often underestimate the extremely high loads that can be inflicted on local attachments. Previous experience with this led to the solutions now proven effective for the W17. The secret is to distribute the local loads, and for the W17 that meant attaching the full length of the tramps inboard to the cockpit sides, and then making use of strong fiberglass tubes inside a wide pocket for the outboard edge. They are then strapped back to sturdy D-ring attachments and bonded into a central stringer under the ama deck. This places the load on these outboard attachments in shear and that can effectively be handled with epoxy inserts poured-in-place, with a large annular ring at the deck surface. The use of black poly-mesh is also recommended as you can seal the edges with a hot knife and the material will last 'forever' in the sun. Using black thread helps too.

While on the subject of trampolines, they are set up to play a special role on the W17. They are pulled up tight behind the forward beam so that water passes easily under them, but at the rear end, they are pulled

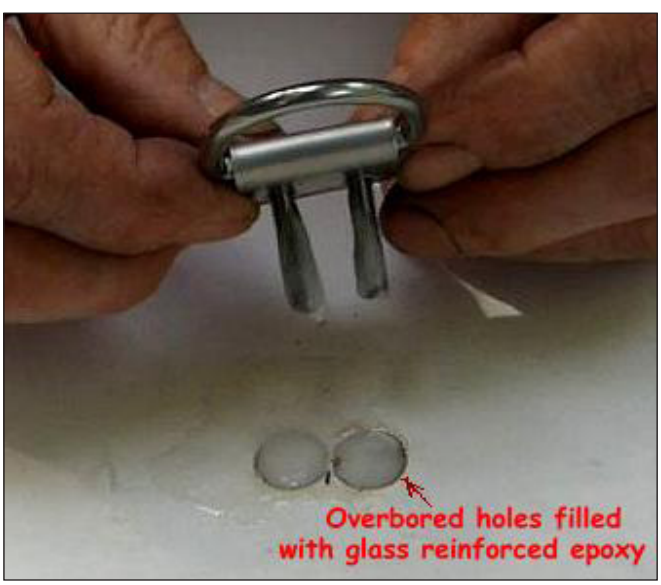

Tramp outboard attachment

down, so that water cannot easily hit the aft beam, which then requires no fairing.

Rig

As it made no sense to have a very ordinary rig on this uniquely efficient hull, the boat was given a full-battened mainsail, with the racing rig having a square top. As I also wanted the option of sailing with mainsail alone, I combined that with a relatively small blade jib set back from the stem. What was particularly different to other small boats is that the mainsail is set behind a rotating wingmast *and* additionally, designed to be optionally rolled around the boom for storage. This latter arrangement does wonders for the life of the sail and in seconds, all the sailcloth that would otherwise fill the cockpit, is quickly tamed and neatly rolled up (see photo Part 1). With the jib tack located aft of the stem, a Code-0, genoa or spinnaker can be set on the short removable bowsprit and each maintain a good slot with the jib.

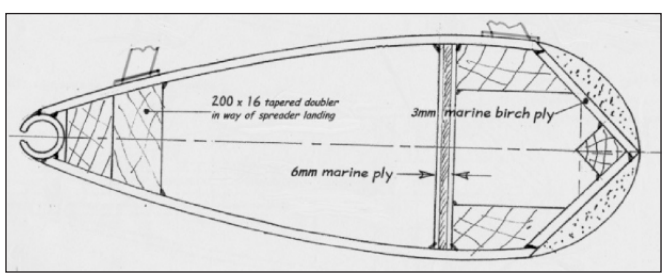
At the aft end, the mainsheet is rigged to a broad, radiused track that extends right out to the hinge points, enabling the powerful mainsail to be sheeted down hard when needed, and also removing the need for a kicking strap when off wind.



A Wing Mast

One of the final steps is to obtain a suitable mast, and as already mentioned, nothing quite matches the efficiency of this little boat than a rotating wing-mast. This enables the sailor to effectively trim the leading edge of the sail to most efficiently suit the conditions and apparent wind direction…But where to find one of these? Typically, alloy masts are not wing-masts at all, even though they may be rotating. I would not consider anything under a chord/width ratio of 2 as a 'wing-mast' and a ratio of 2.5 to 2.8 is recommended for the W17. So I ended up designing and building something more suitable and now offer plans for others to do the same, even if it's not for a W17. There are two wing mast designs available. One is of wood for the cruising rig, plus an original build-it-yourself carbon fiber design for the W17 racing rig – both duly tested and proven.

Both masts benefit from something that is very difficult to achieve with an alloy extrusion, and that's an internal transverse web. This not only considerably reduces the risk of collapse from buckling, but also divides the internal space into two – one watertight for buoyancy and another for the internal halyards. Shown here is a general section of the wood mast,



and one of the bonuses of building a W17 is that you can qualify for FREE plans for this design, just by sending in photos to prove you *really did build* a W17! More details of the carbon fiber mast are on my website, but with material cost barely over 10% of what PRO mast suppliers are asking for an equivalent wing-mast, it's really something worth looking at, and certainly the best solution if the racing rig is your choice.

Wrap Up

Of course, there are many details I am passing over in this brief description of building the W17, but all are covered in detail in the extensive build manual that accompanies the dimensioned plans. For full disclosure, I will freely admit that despite its popularity, this is not the simplest or quickest wood trimaran to build. After all, this is a relatively sophisticated design and each part has a reason to be as it is. But while there's nothing difficult about the building, things will take a little longer than for a simpler, more basic design. The end result is such an exciting and great looking boat that builders are proud to own it and are certainly getting in hours of fun sailing.

Drawings

Aside from a detailed manual, the W17 comes with 16 sheets of drawings to cover all the details. But while on the subject of drawings, I'd like to answer a question that is often raised to me.

Why do you still draft in 2D and not use the computer with 3D imagery?

I believe that the clearest way to dimension parts and their location, is *still* with drawings that are 2D. Let me try to explain why. Suppose you are laying a railway line and it needs to curve around a few obstacles. If this were in 3D, you could certainly get a fine image but perspective would automatically be part of it and your railway line would appear to get narrower and narrower the farther away it got. So where do you put the track width dimension? And then, how do you define the radii of the track to the left and to the right as you wind around obstacles? It's like trying to precisely locate where a spider is, that's hanging from the ceiling in a room drawn in 3D! Put this down in PLAN view and ELEVATION and you can clearly dimension exactly the position, as well as you could for the radii of the railway tracks and their width.

With detailed drawings, this situation repeats itself over and over. While there are some solutions, ultimately the 2D presentation wins out for production… even if you may still prefer a 3D image for sales and visualization. So be warned, both buyers and designers, it's a LONG way from *Conceptual Design* now made so easy with 3D software, to working out and drafting construction details, where strength requirements are assessed and structural connections clearly defined.

So despite the wonderful 'views' of boats and hulls using 3D imagery software, many builders will tell you those 'pretty images' are NOT the easiest way to find out the *real* dimensions you need on the shop floor, to actually build what the imagery shows. Often you'll find a builder scratching his/her head over an impressive looking 3D image, just trying to find out something as simple as, the station spacing! So 3D images for shop drawings are not all they are tooted to be and most professional builders are happier with traditional 2D views that give immediate access to measurements they need. In summary, as impressive as they might appear, we can all manage without 3D renditions, but at least for now, we *cannot* manage without 2D drawings, for accurate and easy-to-read dimensioning.

Finally, here is how the complete boat looks – shown here with the cruising rig mounted on the wood wing mast of the design noted above. For comparison, a couple of photos in Part 1 show the square-head racing rig mounted on the 8-meter wing-mast of carbon fiber – that was still black at that time.

So if boat design is your dream, start with a list of the features you want, together with the operating goals you want to achieve…and then work out the best ways to meet them. The more successful you are, the more satisfaction you will get from owning the final boat. Good luck to all!

Folding the Boat for Travel


Mast crutch

After hauling the boat out, the sail (already rolled around the boom) is generally moved to the vehicle or can be slipped down into the cockpit.

The following is the procedure for lowering the mast. I will give some average times as we proceed.

• A gin pole end fitting is slipped into the mast tube and the pole supported by a fixed-length topping lift clipped to the mast.

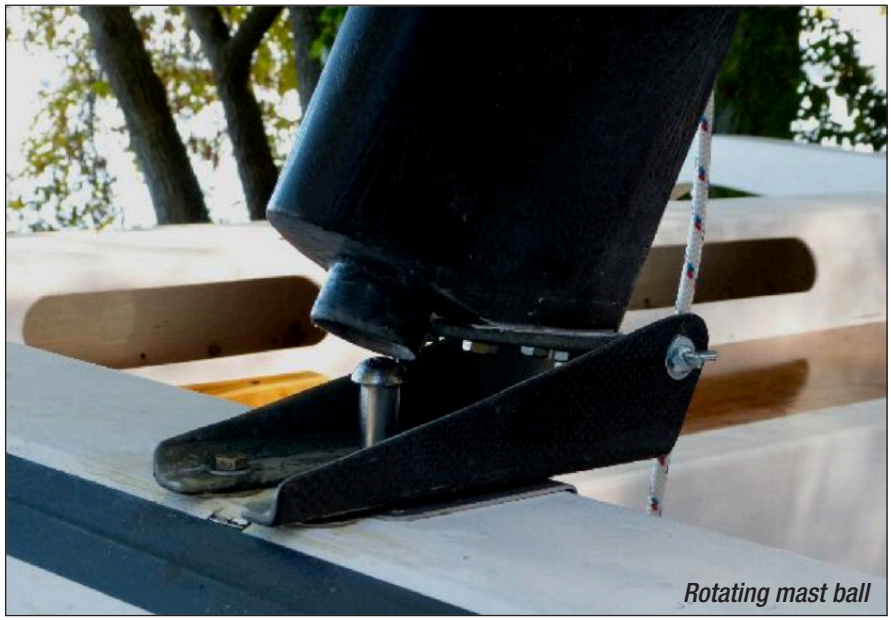
• Two side guys clip to brackets mounted aft of the front beam.

• A U-shaped 'shoe' is slipped under the mast base and bolted to the beam and a pivot bolt slipped through the bracket and the mast. This prevents the mast from rotating and holds the mast heel as it is lowered. This takes about 10 minutes to set up.

• After the main halyard is attached to the aft traveler and tensioned, the shrouds are moved to the same P&S (port and starboard) brackets so that all is in line with the mast pivot.

• The spinnaker halyard is then snapped to a 4:1 tackle, clipped to the bowsprit and the jib-forestay detached. These last two procedures add another 10 minutes.

• A wood crutch (complete with a roller) is then placed in the aft well of the boat and supported with lines P&S around the aft beam, and the mast then lowered into it. Once down, the pivot bolt is pulled out and the mast rolled forward a few feet…and moved slightly to port. So, about 25 minutes in all so far.



Rotating mast ball

• Plywood stools are now centrally placed over each beam, and where attached to the amas and beams, both trampolines are slackened about 6 inches.

• A notched post is now placed under the port ama to stabilize the boat during the folding.


Amas folded

• The two lower latch pins are then pulled out, and with the tallest person at the bow, the starboard ama is lifted up and over – to land on the wood support.

• Once folded, a small wood frame is placed over the bow of the starboard ama and the mast lifted up to the outer ledge of this bracket. (This moves the mast sufficiently clear of the centerline, so that the ama does not contact the spreaders while being folded).

• The port latch bolts are now pulled out and the last ama is folded 'up & over' to also sit on the wood stools. Not to worry, these are not heavy.

• Once both amas are folded, the mast is repositioned to the centerline and a mast retaining line (plus two straps) are added over the boat decks fore and aft. With a support under the rudderstock and a rear light-bar added, the rig is ready to trail. Say another 20 minutes.

Although the 'pack away' takes about 45 minutes in total, it will likely take 10-15 minutes longer to do things in reverse, as setting up the boat for sailing always requires a few more checks and adjustments. Either way, it's all part of 'playing around with small boats' and therefore something to be cherished rather than bemoaned.

About the Designer

As mentioned in Part 1, Mike Waters was first introduced to sailing after helping his uncle rivet up a lap-strake 15-footer at the age of 10. After a notable career designing ships in Canada, and many years of designing, building and sailing small boats, Mike turned to multihulls some 35 years ago and now owns his fourth trimaran.

Upon retiring from shipbuilding, Mike decided to apply his acquired expertise in both theory and practice, and created a website dedicated to 'Small Trimaran Design' that is today recognized internationally as offering free, but sound, advice to those equally enthusiastic about these fun boats and what makes them work. He is passionate about keeping the hard-to-find technical info available for free, as his hope is to see builders from all countries enjoy the deep pleasure of building their own boat without designs being out-of-date. For more information, visit: www.smalltridesign.com

Keep in mind that there's a question form on the website where you're welcome to ask any question associated with small multihull construction and design – and it's not limited to a specific design. Sharing is what life is about. MM