Forward Bulkhead replacement
Wavelength 24

Project description: Replace forward bulkhead in Wavelength 24. The old bulkhead was tabbed around the entire perimeter, even the bottom. With no limber hole or opening, any water forward of the bulkhead could not drain. The bulkhead did not appear to be protected or encapsulated in any way. Over time, the bottom several inches of the bulkhead had deteriorated due to water intrusion.

The bulkhead was tabbed to the hull around its perimeter and fastened to the V-berth flat with screws. The bulkhead was tabbed to shelves on either side above the V-berth. These shelves were also deteriorated and required replacement.

Planning: One critical decision was the order of fabrication and installation of the new pieces. One option was to fabricate and install the bulkhead then make the pattern for the shelves. The other option was to install the shelves and then install the bulkhead. After some thought, the second option seemed unworkable for two reasons. First, the shelves would interfere with the placement of the bulkhead. Second, the bulkhead, once placed, may not be located exactly where the old bulkhead was and thus the shelves might be wrongly sized.

Personal protective equipment: Since grinding of gel coat and fiberglass was involved. A respirator for toxic dust was required.

Figure 1 Dust mask protected in bag when not in use

Project demolition and preparation: First, removal of the old bulkhead was required. In order to save the original pattern for the anchor locker access, the center of the bulkhead was cut out with a jigsaw. The deteriorated bottom portion fell apart during removal but enough pieces were salvaged to reconstruct the pattern.

Figure 2 Center of old bulkhead cut out for pattern for anchor locker access

Next, the remnants of the old bulkhead were removed. A Dremel with a cutting wheel was used for most of the cutting. A chisel would have also worked.

Figure 3 Side grinder with 60 grit for removal of old tabbing

Next, the residual tabbing was ground out to provide a smooth area for the new tabbing. If adequately bonded to the hull, the periphery of the tabbing may be left and the new tabbing bonded to it. While grinding, the peripheral tabbing was carefully inspected for "unhealthy" bonding. Weak bonding can be recognized by opaque areas in the glass. Any unhealthy spots were ground to the hull to expose healthy glass to which the new tabbing will bond.

Figure 4 All tabbing removed and surface smoothed

In Figure 4, note the whitish opaque spot at right center where the cloth weave can be clearly seen. This glass was not properly laid in and is not adequately bonded to the understructure. This area was just under the V-berth shelf. Note the translucent yellow/orange area at the top of the picture. This is healthy glass to which new fiberglass can be adequately bonded.

Figure 5 Tabbing ground out and area smoothed

The bottom of the hull's V was ground out to allow free drainage from forward. Note that the old bulkhead and tabbing completely blocked any drainage.

Figure 6 Tabbing on shelf left intact but cut back from bulkhead

The old V-berth shelves were tabbed from the top. Their deteriorated condition allowed the wood to simply be peeled from the bottom of the tabbing. The plan is to place the new shelves on top of the old tabbing and tab from the top.

Bulkhead fabrication: A cardboard pattern was made of the bulkhead location. During the pattern making process it was determined that the V-berth shelving would interfere with installation of the new bulkhead. The forward edge of the shelves had to be additionally cut back to facilitate tilting the new bulkhead in.

Figure 7 Old bulkhead used as pattern for anchor locker access

The center of the access in the old bulkhead was determined and marked. A centerline was marked on the new bulkhead and the pattern aligned and marked.

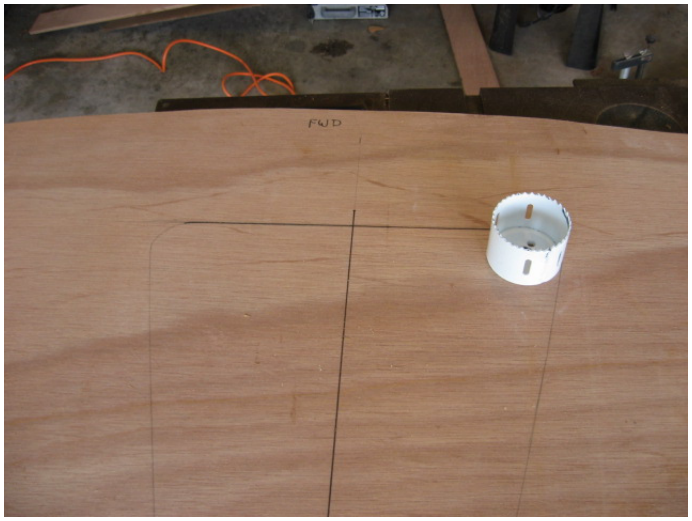

Figure 8 Hole saw placed to mark center for cut

The corners are made with a hole saw. The proper size hole saw was aligned upside down and the centering hole traced.

Figure 9 New bulkhead marked for drilling and cutting

Using the centering holes, the hole saw was started on one side. After partially drilling the holes, the bulkhead was flipped over and the holes were drilled completely from the other side. This process results in a clean hole. If the hole is drilled from one side only, splintering is likely when the hole saw exits the back side.

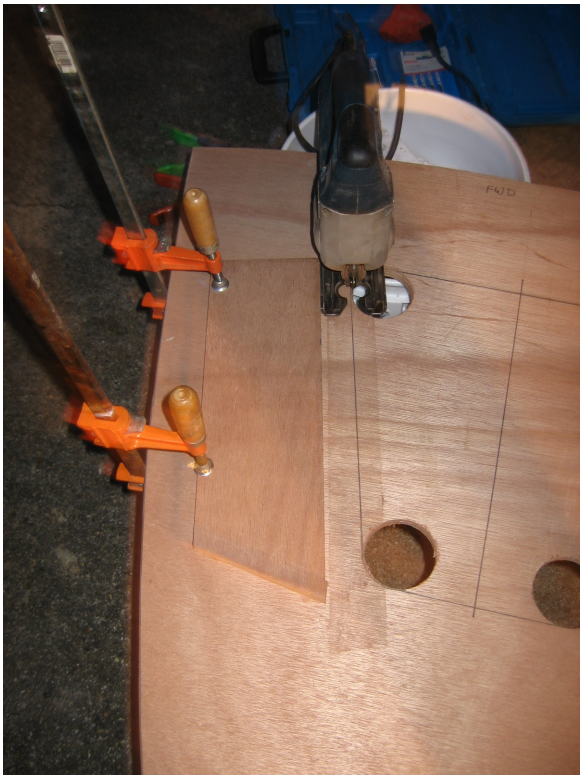

Figure 10 Connecting corner holes. Note tape on crosscut

The corner holes were connected by cutting with a jigsaw. The teeth of a jigsaw wood blade face upward and cut on the upstroke. Tape was placed on the upside to reduce splintering. A guide was clamped to the bulkhead to ensure a straight cut. Note the guide is on the outside to prevent cutting into "good" wood.

Figure 11 Router used for rounding access

The access was routed with a 1/8 inch round router bit. The edges were also beveled to conform better to the bow angle of the hull.

Figure 12 Bulkhead dry fitted

Bulkhead installation: The new bulkhead was dry fitted. Some additional shaping was required to make it fit closely. The final shaping was done with a side grinder with a 60 grit sanding disc.

Figure 13 Materials needed for filleting

In order to eliminate a stress line on the hull, a fillet should be created at the bulkhead/hull joint. Pictured above are materials with which a fillet can be made. The epoxy resin and hardener are first thoroughly then West System 406 colloidal silica is added until the desired consistency is reached. The epoxy should be a bit stiffer than mayonnaise.

Figure 14 Thickened epoxy being applied for fillet

The thickened epoxy is applied with a syringe. Most of the tip of the syringe was cut off to extrude the thickened epoxy.

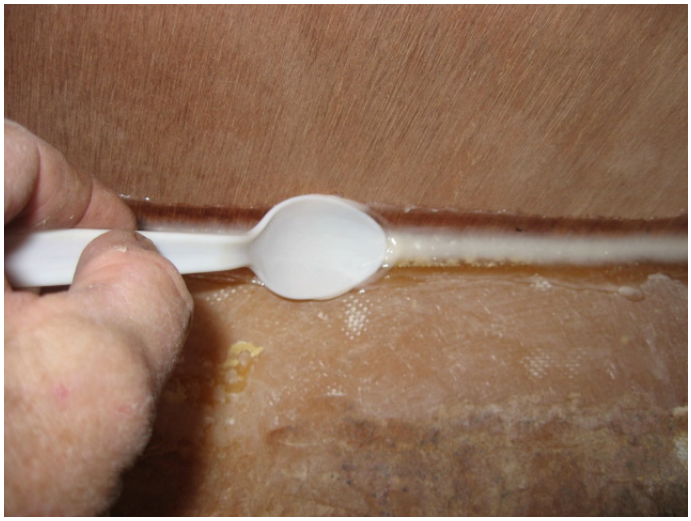

Figure 15 Spoon used to create fillet

Next, a nice round fillet is created using the back of a spoon. Excess material outside the fillet was wiped off. After curing, the fringes were sanded smooth.

Figure 16 Fillet finished. Ready to apply tabbing

Figure 17 Tabbing tape marked for cutting

West System 727 4 inch biaxial tape was marked and cut to fit.

Figure 18 Tabbing tape pre-creased for corner

The biaxial tape is fairly stiff so it was pre-creased to facilitate conforming to the filleted corner. The tape was then laid on a piece of waxed paper with the bulkhead/hull side up. The tape was saturated with epoxy. The tape and waxed paper were applied to the joint and the paper carefully peeled off.

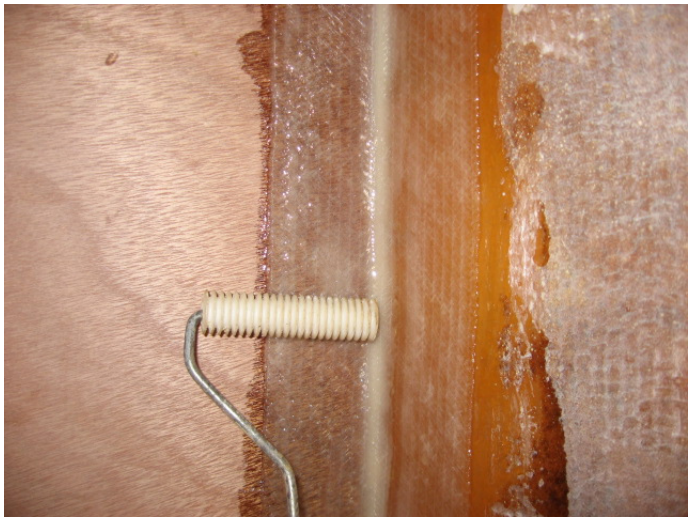

Figure 19 Laminating roller used to remove air bubbles

After the tape was positioned, more epoxy was applied with a brush. A laminating roller was used to remove any air bubbles in the lay up.

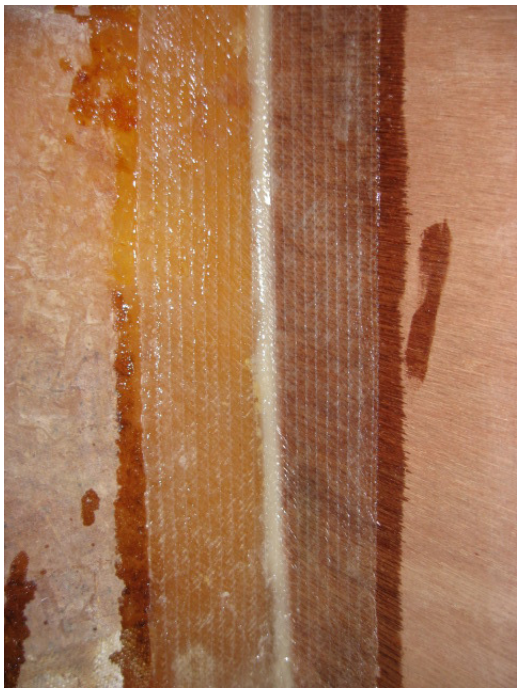

Figure 20 Close up of finished filleted tabbing

Close up of the finished tabbing. The one whitish spot at the bottom left is actually a ball of loose glass, not air bubbles.

Figure 21 Bulkhead installed and tabbed

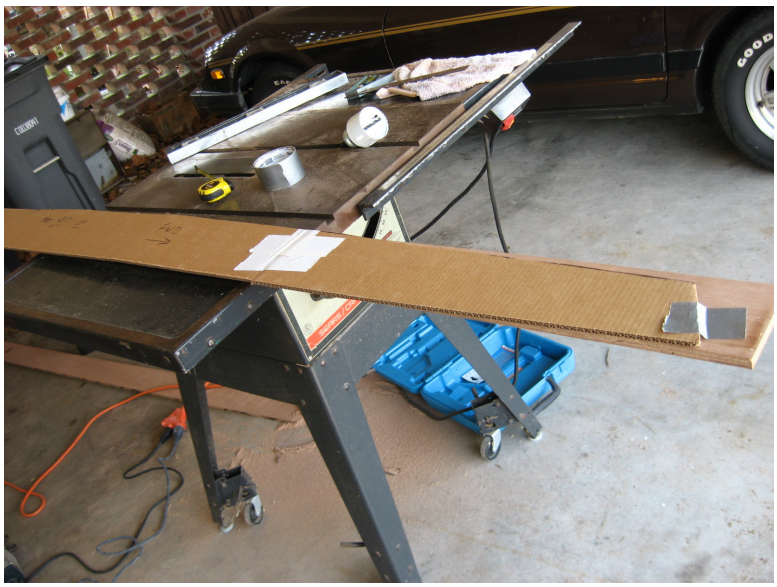

Figure 22 Cardboard pattern laid on shelf

Shelf fabrication: A cardboard pattern was made for the shelves. A strip of plywood was cut wide enough and the pattern taped to it. A jigsaw was used to make the curved cut. To make the straight end cuts, a guide was clamped to the shelves.

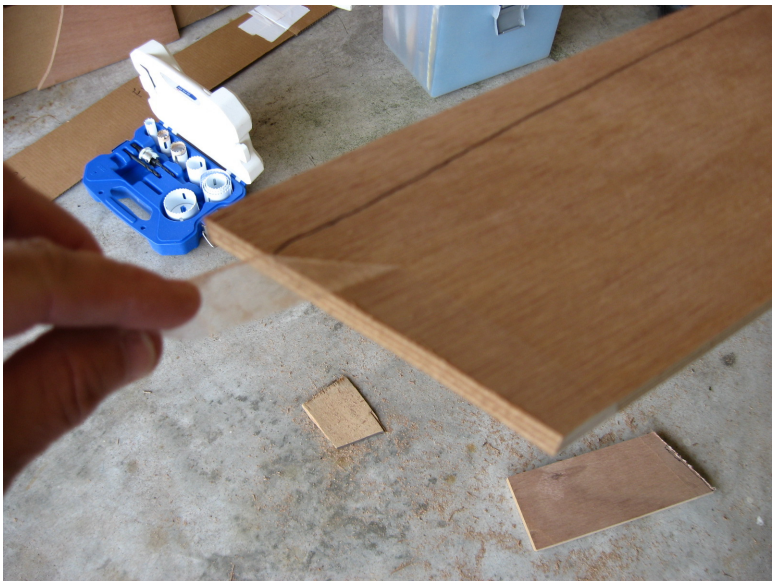

Figure 23 Removal of tape

As with the bulkhead, any crosscutting was taped prior to cutting to reduce the potential for splintering. The tape should be removed by pulling at angle towards the cut edge.

Figure 24 One shelf used as pattern for second shelf

The shelves were virtually identical, just mirror image so the first shelf was used as the pattern for the second.

Figure 25 Table saw sanding disc set to make angle for hull abutment

To more closely conform to the inward sloping angle of the hull, the outside of each shelf was beveled.

Figure 26 New shelf clamped onto old tabbing

Shelf installation: The new shelves were glued on top of the old tabbing with 3M Fast Cure 5200.

Here's a very technical issue. The shelves weren't deemed as structural as the bulkhead so less preparation was required. Above the shelves was a short strip of the old tabbing with the roving of inside of the hull above. Roving is fairly rough. If the shelves were structural and a robust bond required, the roving should be smoothed. Grinding the roving would remove strength from the hull. A smoothing coat such as thickened epoxy could be applied with a smooth edge spreader prior to tabbing.

Figure 27 Shelf tabbing complete

Here the biaxial tape worked OK but had a few air bubbles due to the rougher contour of the roving on the inside of the hull. Cloth tape would have worked better than the stiffer biaxial cloth. The softer cloth would have conformed to the contouring of the roving better.

Figure 28 Installed shelf (minus cleats)

Figure 29 Shelf cleats and end tabbing

Finally, the shelf needs to be tabbed to the bulkheads. I added cleats for additional support from below. The cleats were glued in with West System G-Flex thickened epoxy. This will allow for a minor amount of flex, but it was handy and easy. The thickened epoxy will adhere nicely to the rough tabbing. Small design mistake. Should have cut the blocks at a 45 degree angle for aesthetics.