

Deadwood (4/19/2011)

Using the gantry crane that I built to remove the engine, I removed the centerboard trunk to give me access to the top of the keel. This will allow me to remove/inspect the ballast keel bolts and ultimately replace the deadwood.



The centerboard trunk is now safely resting in the shop floor.



The pic below shows the top of the keel plank in the area of the centerboard well.

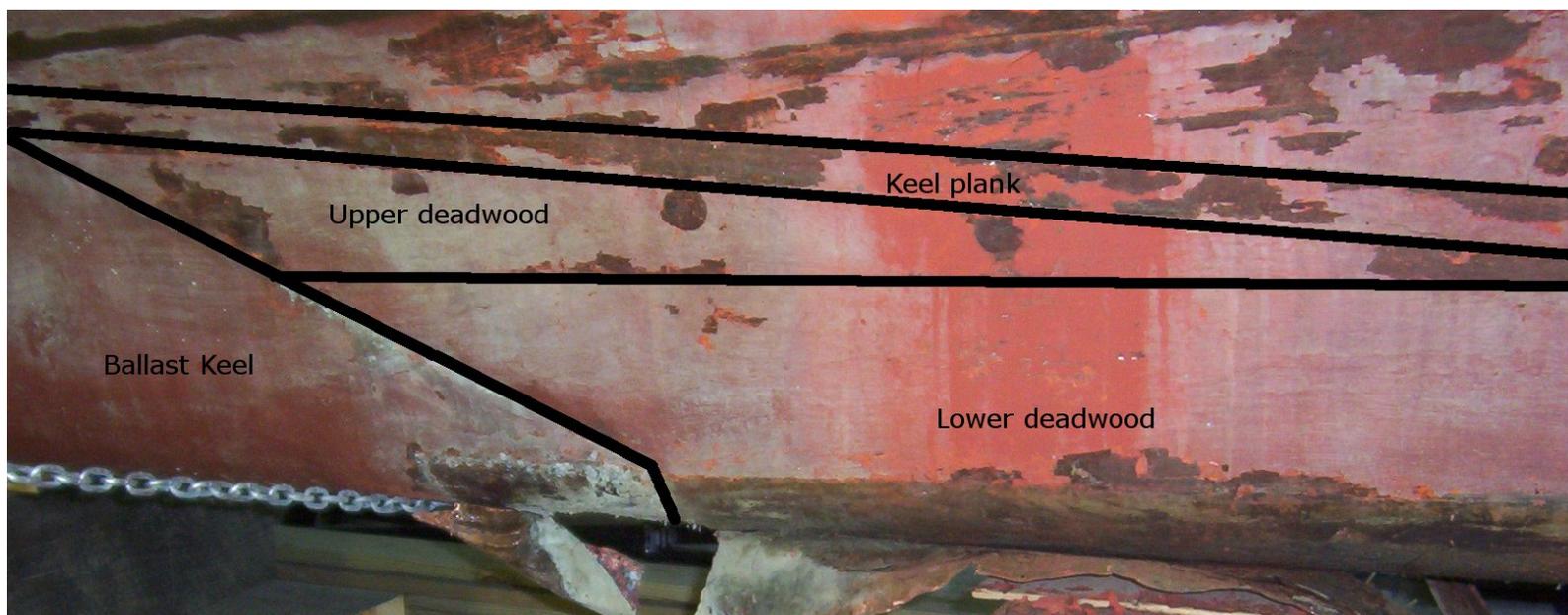


Recent postings on the WoodenBoat forum warned of the importance of inspecting ballast keel bolts on older boats. I'm sure these bolts have never been removed, and I sure wouldn't want the keel to fall off!

The bronze ballast-keel bolts come up through the Amendoim keel plank and are threaded on the top to take a nut and washer. The larger bolts are 1" diameter; the smaller ones are 7/8". In some cases the top nut and washer clamp to the centerboard trunk. I had to remove 4 of the larger top nuts to remove the centerboard trunk. After some 50 years in service, loosening the nuts required a 1.5" socket on a 3/4" drive breaker bar with a pipe extension.

4/14/2011

The goal is to remove the deadwood so that it can be repaired/replaced and to inspect the keel plank. The deadwood consists of 4 pieces of Amendoim - two on each side of the boat's centerline, with a longitudinal parting line, presumably to facilitate cutting the centerboard slot and limit the size of timbers. The two pieces on each side are symmetrical and consist of a large lower section and a smaller upper triangular piece (see the pic below).

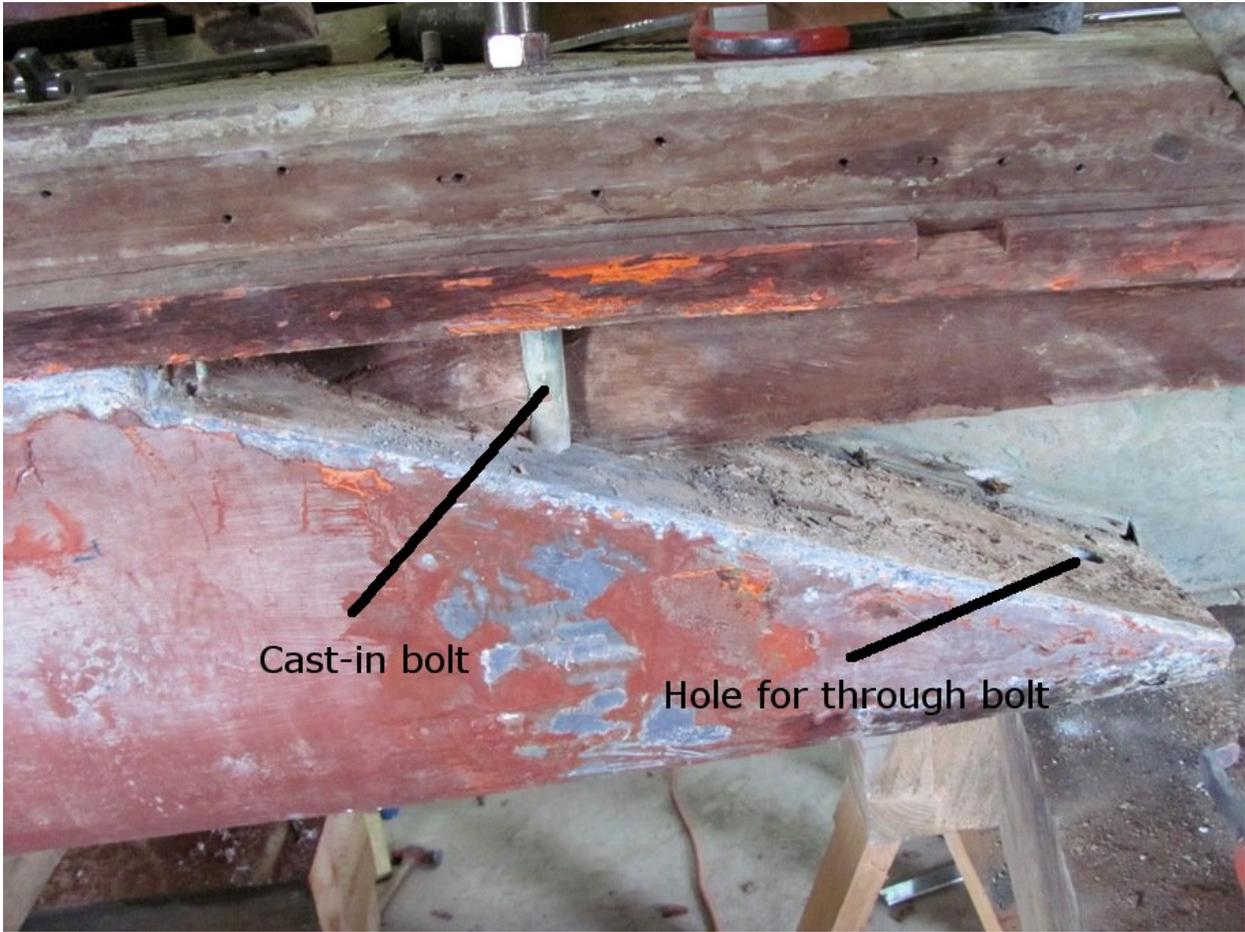


As you can see to the left in the picture, the two deadwood components are wedged between the ballast keel below and the keel plank above.

The deadwood is fastened vertically to the keel plank with long bolts at regular intervals (approx. 18"). The two lower sections are also bolted together laterally to hold the two deadwood halves together. Due to the presence of the centerboard, however, the number of lateral fasteners is limited and consists of three carriage bolts plus two wood screws at the very aft end of the lower section. The access holes for the three carriage bolts can be seen in the pic below (you are looking at the lower deadwood section, which has been removed from the starboard side).



In addition to these fasteners, the four aft-most ballast keel bolts penetrate the deadwood. Only the two aft-most keel bolts penetrate the lower section, but all four pass through the upper section. Refer to the pic below. This pic shows the port side with the lower deadwood section removed and the upper section split to reveal one of the keel bolts. The aft most keel bolt has been removed, but the hole in the ballast keel is visible. The missing bolt is shown below.



In theory, removing the deadwood should simply require removing all these bolts. Of course things are never as easy as they first seem - at least not for this project.

For instance, the lower nuts for the aft most two keel bolts are readily accessible via bronze cover plates on the bottom of the ballast. So you can remove both top and bottom nuts and then pull the bolt from the top of the keel plank. Not so for the other two bolts. The bottom nuts are not easily accessible.

At the time, I thought that these bolts were cast into the ballast; however, if that were true you couldn't replace the bolts! Instead the lower nuts are accessible through holes in the side of the ballast, called galleries. These holes are then plugged with lead after the nuts are installed.

This was not the only problem. Observe in the figure below that the centerboard trunk has a liner - a rectangular tube made of copper - to protect the centerboard well from marine borers. This liner is fastened to the deadwood via a flange at the top of the keel plank and another at the bottom of the deadwood. The liner and lower flange can be seen in the pics below.



Evidently, the upper flange was formed on the bench, the liner inserted into the keel/deadwood from above, and then the lower flange was formed in place. The result is that the deadwood cannot be removed as a unit without destroying the liners. So this means that I have to separate the port and starboard deadwood halves, removing them laterally. So I remove the three lateral carriage bolts (easily driven out with a drift), the two wood screws aft, and all the screws (that are visible) connecting the lower flange of the copper liner to the bottom of the deadwood. But there is yet another flange in the way of the ballast that isn't accessible or even visible with the deadwood present. So I can't remove these fasteners without removing the ballast. Of course I didn't know this at the time!

I also have another problem!

In addition to all the bolts fastening the deadwood to the keel plank (which I have yet to remove), the centerboard trunk is fastened to the keel plank with numerous fasteners. Many are lag screws but seven of these (on each side) are bronze studs that penetrate the deadwood. These studs are threaded on each end. The lower ends have nuts and washers that are accessible through large holes (galleries) in the deadwood (which are sealed with bungs). It would have been better to use carriage bolts, countersunk into the bottom of the keel plank, instead of studs. So maybe the studs were installed as an after thought - after the deadwood was fastened to the keel plank.

In any case, because I have to remove the deadwood halves laterally, these studs have to be removed.

First I chopped out the bungs with a small chisel to gain access to the nuts. The access holes are shown in the pics below. The three in the first pic are in the lower deadwood section and four in the second pic are in the upper section.





A 7/8" box wrench fits the nuts, but in many cases I don't have enough clearance to turn the nuts (clearance holes are big enough to hold the nuts while tightening from above but not enough to remove the nuts). So I use a drift and hammer to spin the nuts a little at a time. Fortunately, corrosion has not seized the nuts to the studs. After removing both upper and lower nuts, I used an improvised puller to extract the studs.



With the studs removed, I'm now faced with the problem of removing the fasteners that hold the deadwood to the keel plank. These are carriage bolts with heads recessed into the bottom of the deadwood. Unfortunately, they are so tight that no amount of hammering from above can drive them out - I don't even try, because even if I could, the flared head of the bolt (due to pounding) would enlarge the hole in the keel so that the new fasteners would probably leak! The only alternative is to wedge-open the seam between the deadwood and keel, enough to insert a saw blade, and cut the bolts.



After all this, the deadwood is almost free. I just have to remove the four ballast keel bolts mentioned earlier. The aft two are through bolted. Removing a bronze cover plate below



allows me to remove the nut.

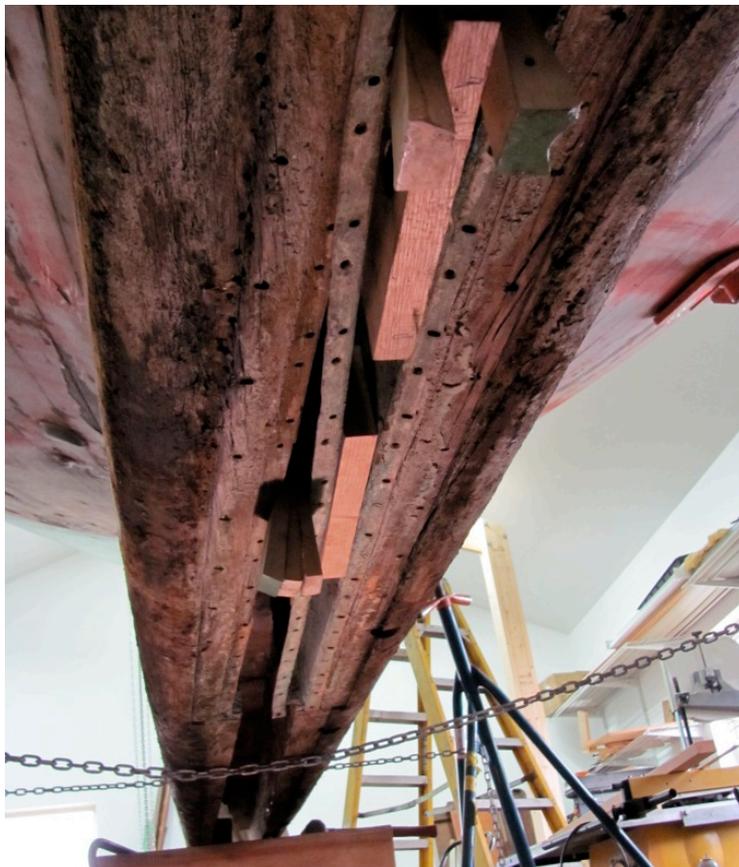


and another improvised puller (this one beefier, consisting of 6 ton and 20 ton jacks) is used to extract the bolt from above.



The first bolt came out without a whole lot of fuss, but the second one was very tight. I ended up bending the heavy angle shown in the pic above and had to use two heavy angles. I suspect that close to 10 tons was require to get it moving. In fact, I was so concerned about blowing the seals on the 6 ton jack, I replaced it with a solid 7/8" rod.

With the aft most ballast keel bolts removed, the lower deadwood should be free, but it doesn't seem to be! After much pulling and prying with wedges driven in from below



it finally comes free, and now I can see why it was so obstinate! The lower deadwood was in fact fastened to the upper deadwood with wood screws. Also the copper liner had a hidden flange (between the deadwood and ballast keel that is visible in the the pics above but not to me at the time) that was screwed to the lower (and upper) deadwood.



I now have the lower deadwood removed, but the problems are not over yet! To remove the upper deadwood requires that I remove two more ballast keel bolts. But these are not through bolted! They are either screwed into the ballast or were cast in place. If they are screwed into the ballast, I might be able to unscrew them using a double nut. This is no simple task. Simply tightening two nuts on the bolt doesn't provide enough resistance - my efforts just turn both nuts. So I need to Loctite the top nut in place. I'd also like to try an impact wrench but I can't fit a socket over two nuts - the flats don't line up. So I put the top nut in the lathe and remove the flats, Loctite the top nut in place and wait for the glue to set. The next day I have at it with an impact wrench - no luck. So I try a long pipe on a breaker bar - still no luck. I'm applying a considerable amount of torque here. I'm now wondering if this bolt is really treaded after all. If I get too aggressive, I might shear the bolt. Then where will I be? The only way I'm going to know for sure is to rip out the upper deadwood to inspect the bolt/lead interface. In some sense I'm lucky that the port upper deadwood is badly checked and will need to be replaced. The checks are so bad that a few well placed wedges are all that it takes to part the timber revealing the bolt - cast in place, darn!

Now what do I do? I've got to remove the ballast keel - my worst nightmare!

(Note that this troublesome keel bolt might look cast in place, but as we know now it's a stud with its bottom nut in a gallery cut into the side of the ballast. So it would have been possible to

remove this bolt. In any case, removing the ballast was the right choice for it facilitates fastening the liner to the deadwood.)

For what it's worth, I now have a fairly clear understanding of how this part of the boat should be constructed. Here are the steps, as I envision them:

- Cut centerboard slot in keel plank and recess top of keel to accept top flange of copper liner.
- Mark keel plank for fasteners that will attach centerboard trunk to keel plank. Most of these fasteners are lag screws but some are carriage bolts inserted from below. Drill holes for lag screws and carriage bolts.
- Fasten keel plank to the rest of the backbone structure (stem, stern post, rudder post, horn timber, etc.)
- Fabricate both port & starboard deadwood halves.
- Fastened port deadwood to starboard deadwood using three carriage bolts aft of the centerboard slot and two wood screw at very aft end of the deadwood
- Raise deadwood into position below keel plank. Drill top down for pairs of carriage bolts (port/starboard) at 18" intervals (approximately). First pair are angled into the stern post knee. Second and third pair through wood floors. Remaining pairs just through keel plank. Counterbore deadwood for all carriage bolt heads (heads and nuts for three lateral bolts). Fasten bolts and plug holes.
- Insert copper centerboard liner. Fasten to top of keel plank with small wood screws. Form lower flange over bottom of deadwood. Fasten with small wood screws. Fasten pair of bronze skid plates over lower flange (to protect flange from groundings) with wood screws.
- Construct a template that locates the position of the ballast keel bolts. Raise ballast keel into position below keel plank. Use template to drill the keel plank and ballast for these keel bolts.
- Insert bolts and lower nuts (in galleries).
- Bolt the keel in place, using only those nuts that do not attach to centerboard trunk or mast step. Drill for remaining four through keel bolts. Fastened bolts. Apply cover plates.
- Raise centerboard into position in trunk so that pivot hole in centerboard lines up with hole in ballast keel. Insert two bronze wear plates on either side of centerboard. Insert bronze pivot rod, bronze plug, and two bronze cover plates.
- Raise centerboard so that lift point is above keel plank. Attach lift tube to top of centerboard trunk (with rubber gasket).
- Lower trunk onto top of keel plank (with gasket material at interface; canvas was used originally). While lowering, insert centerboard lift pin (slip fit). Fasten trunk to keel plank including remaining ballast keel nuts & washers.

