Ballast Keel Removal
(5/2/2011)

While attempting to remove the deadwood, it became clear that it was necessary to remove the ballast keel. The ballast is fastened to the keel plank with 16 rather large bronze bolts. The plan is to drop the ballast without having to remove all of the keel bolts. For this to work, all of the bolts that remain in the ballast must be perpendicular to top surface of the ballast, otherwise the bolts would bind in the holes in the keel plank when the ballast was lowered.

As shown in the pic below, ten of the keel bolts are organized in pairs (port/starboard) and emerge from (and are perpendicular to) the top surface of the ballast where the ballast contacts

the keel plank. An additional two pairs of bolts emerge from the sloped section of the ballast where the ballast contacts the deadwood. The aft most pair were removed when the deadwood was removed. The other two bolts are perpendicular to the top surface of the ballast and therefore need not be removed.

The last two keel bolts (not visible in the pic above) are located at the forward end of the ballast and lie on the centerline. These bolts are not perpendicular to the top surface and therefore must be removed. Unlike most of the other keel bolts, which seem to be embedded in the ballast, these bolts are through bolted. Removing a pair of bronze cover plates on the bottom of the ballast provides access to the bottom nuts. The top nuts were a bit more difficult. As you can see from the pic below, one of the nuts is straddled by bronze webbing that is part of the mast step. As it turned out, a 1-5/16" box wrench just fit the nut and I was able to break it loose without much difficulty. I then rigged a puller to extract the bolt from below. This was my first attempt.

Unfortunately, this bolt was particularly stubborn. I ended up stripping the treads on this puller. I didn't realize until afterwards that the bolt was probably binding in its hole because I started to lower the ballast before removing these two bolts. Of course hindsight is 20/20. So I switched to a beefier puller, which did the trick.

Even with the forward bolts removed, the ballast seemed to be somehow still attached at the forward end. Careful inspection revealed that the forward tip of the ballast was covered with - as best that I can describe as - a bronze stem guard. It covers the the tip of the ballast where it meets the keel plank/stem.

The guard was fastened with many small wood screws. I should have thought to support the ballast before removing the screws, but I didn't. This resulted in some very tight screws that I had to drill out - the last couple poping as the guard came free and the front of the keel dropped about 1/4". No harm done.

The ballast is now free. Now to separate the ballast from the keel plank ...! Frankly, I thought the chance of success was slim at best. Removing just one of the aft-most keel bolts required considerable force (maybe 10 tons!), so the chance of separating the ballast from the keel with the remaining 12 bolts in place seemed unlikely.

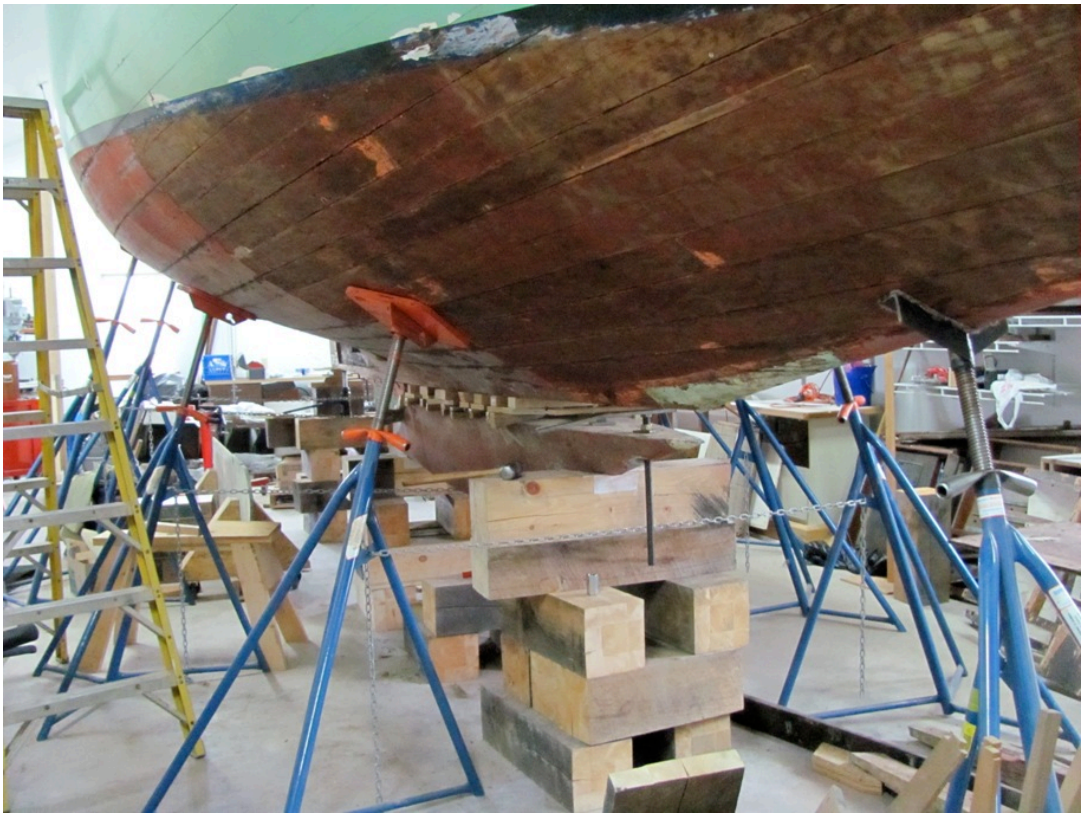
I began to drive hardwood wedges between the ballast and the keel plank, and much to my surprise it worked! After about 2 hrs, I was able to produce an 1/8" gap between the ballast and the keel plank. It's amazing how much force wedges can generate - 70 in all.

5/23/2011

Having made some progress with separating the ballast keel from the keel plank using wedges, I needed to find some way of supporting the ballast once it is no longer attached to the boat. The goal is to support the weight of the ballast (almost 6000 lbs.) while being able to move it without it tipping over. After considering several options, I decided ultimately on simplicity - see the pics below. The first pic shows the support aft, while the second shows the support forward. The supports are 8"x8" pine beams 32" long, which have been sculpted to fit the shape of the bottom of the ballast. The supports are bolted to the ballast with 7/8" all-thread through the existing holes in the ballast (two bolts for the aft support and one for the forward support). Note that the forward support consists of a pair of beams, with the total height adjusted so that when the ballast is resting on the floor, the top of the ballast will be level. Keeping the ballast level is important when removing or (later) installing the ballast. In this way the keel bolts will be vertically aligned.

The following pic shows the blocking arrangement prior to shifting the load from the original centrally located blocking to the new ballast supports.

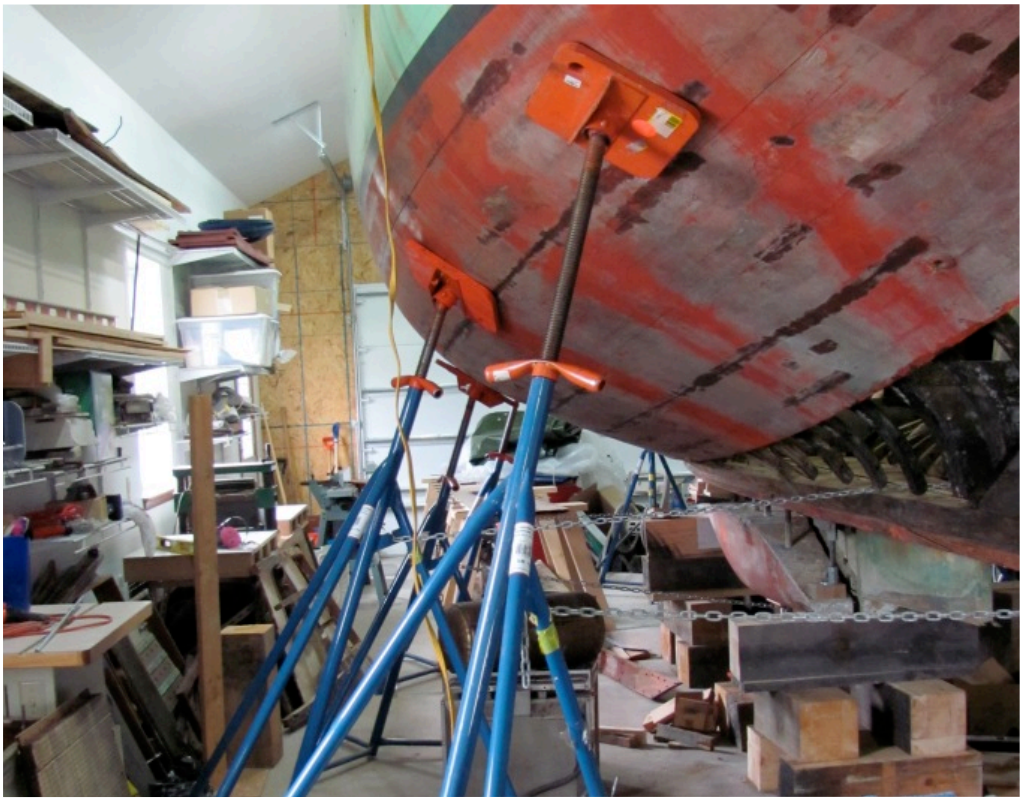
Note that at this point the boat is blocked so that the waterline is level. In this configuration, the keel slopes considerably aft. Before proceeding with the ballast removal, it is best to make the keel level so that the keel bolts are aligned vertically.

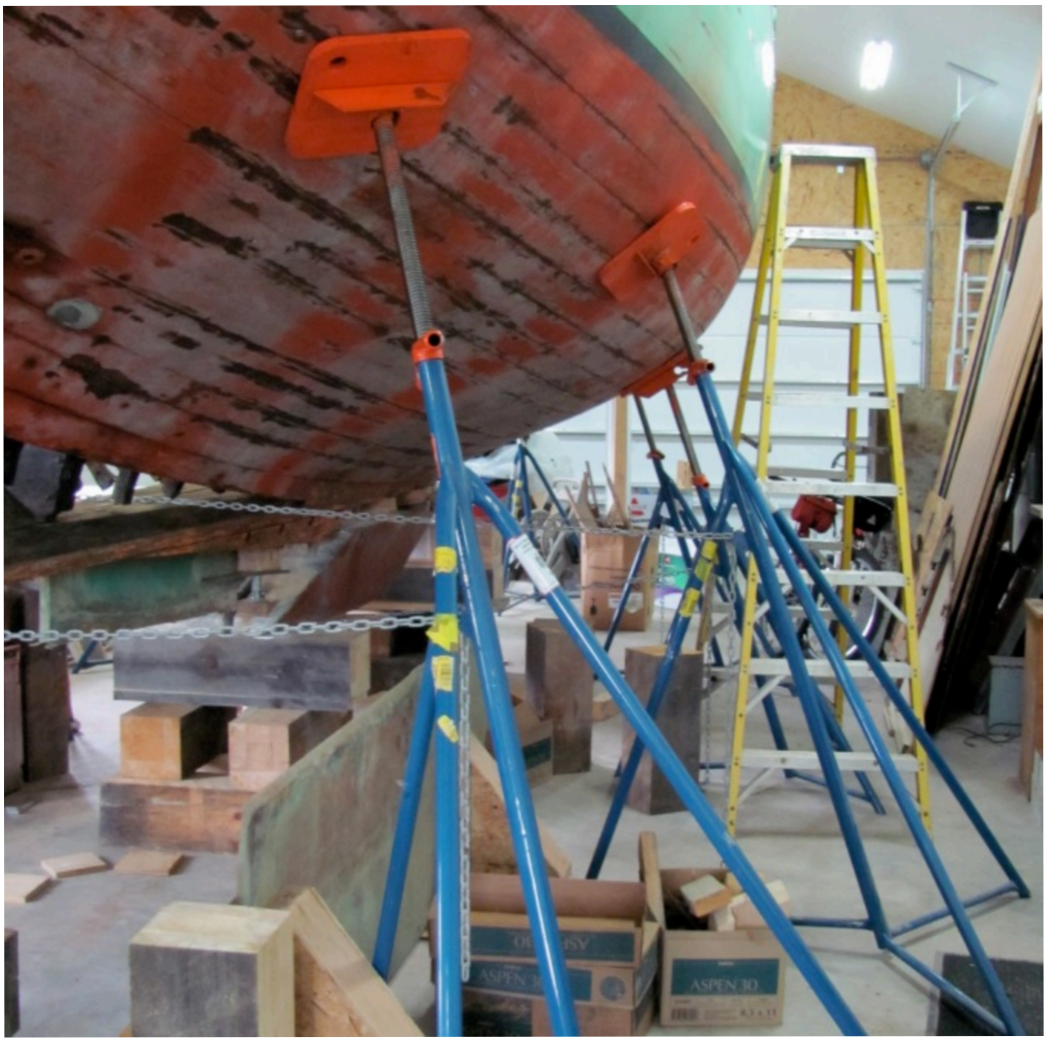


Here we see the boat with a level keel.

In this position, the boat is very high off the ground. This makes me nervous. The boat had to be high to remove the centerboard, but now it's a liability. The problem is that the poppets don't have enough adjustment to properly support the boat in this high position - they are too close to the centerline of the boat. I think I'm ok while the ballast is still attached to the boat, where the CG is very low. But when the ballast is detached, the CG of the boat will be much higher, and I worry about stability. So I'll lower the boat before proceeding.

Here you can see the boat after it's been lowered 8". Note how the poppets are much further outboard.




ASPEN 30

With a level keel, I use more and more wedges to increase the gap between keel and ballast.

The process is slow but progress is steady. Using a 5# hammer, I drive each wedge in tight. I then go around the boat and tighten up all the poppets. Then back to the wedges. Eventually, the wedges are in as far as they can go. I then add new, larger, wedges beside the old ones, and continue. A couple of wacks on the new wedges frees up the old ones so I can remove them.

The pic below shows the later stages of this wedging process.

Note that at this point I have enough clearance between keel plank and ballast to insert a 3.5"x3.5" beam. I then use a pair of bottle jacks on either side to help lift the keel off the ballast. Unfortunately, one beam is not enough to handle the load. If I had more jacks and beams, I might be able to eliminate the wedges and things would move along much faster. But as it is the wedges are still necessary.

Currently the wedges are supporting the weight of the boat, but once the ballast is free and the wedges removed, I'll need an alternative. The poppets provide some vertical support but they are primarily there for balance. So I provide some blocking under the keel plank. The first pic shows the blocking aft and the second the blocking forward.

This pic shows the ballast as it comes free of the keel plank. With the help of a bottle jack, I can now lower the ballast onto Hillman rollers and move the ballast out of the way.

It's amazing how well these rollers work. The ballast weighs almost 6000 pounds, but I was able to push it by hand (with some effort).12/15/2011

The top surface of the ballast keel was never painted, so there is quite a bit of scale. The surfaces that were painted are in bad shape - lots of coats of paint that are now chipping, in some cases down to the lead. So I've decided to clean up the ballast and protect it with epoxy.

To remove the scale, I decided to use sand blasting. To contain the inevitable mess, I build a temporary spray booth around the keel.

I then borrowed a Harbor Freight sand blaster from my neighbor, bought special blasting sand (Black Diamond) from Tractor Supply and went to work. What a fiasco! After carefully reading the (rather limited) instructions, I loaded the tank with sand, applied air pressure, and opened the nozzle. All was well for about 2 minutes when the nozzle plugged. What to do? Nothing in the instructions addresses this problem (which I find out later, is quite common!). So I disconnect the air, vent the tank, and take the nozzle apart. The heart of the nozzle assembly is a ceramic cone with a small hole in the center, which is now packed with sand. I'm able to clear the obstruction with a steel rod. I reassemble everything, apply air pressure, but it immediately clogs again. After a couple of cycles of this, I realize that when the nozzle clogs the hose feeding it fills with sand, which perpetuates the problem (air has to be flowing before introducing the sand). Eventually, I come up with a procedure for efficiently clearing the nozzle: (1) Disconnect the air and vent the tank; (2) Shut off the supply of sand to the feed hose; (3) Use the steel rod to clear the nozzle without disassembling the nozzle assembly; (4) Slowly apply air pressure to clear the feed hose of residual sand; (5) Apply full air pressure while opening the feed value. While this procedure works, it's far from convenient. Keep in mind that for safety I'm wearing heavy gloves, respirator, hear protection, and a hood.

I should mention that a commercial sand blaster would probably not have these problems, but the rental cost was quite high, the unit was very heavy, and I would also need to rent a commercial air compressor (my 2HP unit just doesn't generate enough air flow). So I'm stuck with what I've got!

Ok, back to sand blasting ...

I soon learn that even with all the stoppage, it doesn't take long to go through a 40 lb. bag of sand. And I only bought one bag just to see if it was going to work. So back to the store to buy 5 more bags. Ok, but now they're aren't 5 bags on the shelf. So I ask the clerk if they have more in the back - oh, sure, but what they have isn't the same grit. My first bag was fine but what they have is course. Ok, no problem I'll just use the course - probably works better anyway.

Well I load up the new sand and voila the nozzle plugs instantly. And I can't keep it unplugged. So now it's back to the store to return the bags I haven't opened. Now on more careful inspection, the clerk finds a skid of fine grit sand, so I'm back in business - I think! But I find that I have to completely disassemble the sand blaster to remove every trace of the course sand, for just a few stray grains plugs the nozzle. During all this, I learn that there are different size nozzles. But even the largest nozzle will not take the course sand.

Finally, I get the system clean and the fine sand added with the larger nozzle and things go a lot better. It turns out that 6 bags was still not enough, so ultimately I decided to recycle some of the sand. The problem with recycling is that any dirt will lead to more nozzle clogs. So I used a window screen to screen the recycled sand - worked well, even separated the course sane from the fine.

The ballast after blasting is shown below. Note that I did not try to use blasting to remove the paint. I figured that a disk sander would better.

I finished up by coating the top surfaces with three coats of epoxy with a low density filler (hence the red color).

Finally I used an disk sander with 36-50 grit disks to remove the old paint and then coated the surface with three coats of epoxy. Much less filler was required on this surface because the lead was in good shape.

Cleaning up the ballast provided some additional insight as to how the keel bolts were installed. If you look carefully at the pic above you can see places where lead plugs were inserted into the side of the keel. It appears that the keel bolts (except for those that were through bolted) were installed after the keel was poured. Holes were drilled for the bolts and transverse rectangular holes were cut into (or cast into) the side of the ballast to insert nuts. The holes were then plugged with lead. These holes are referred to as galleries.