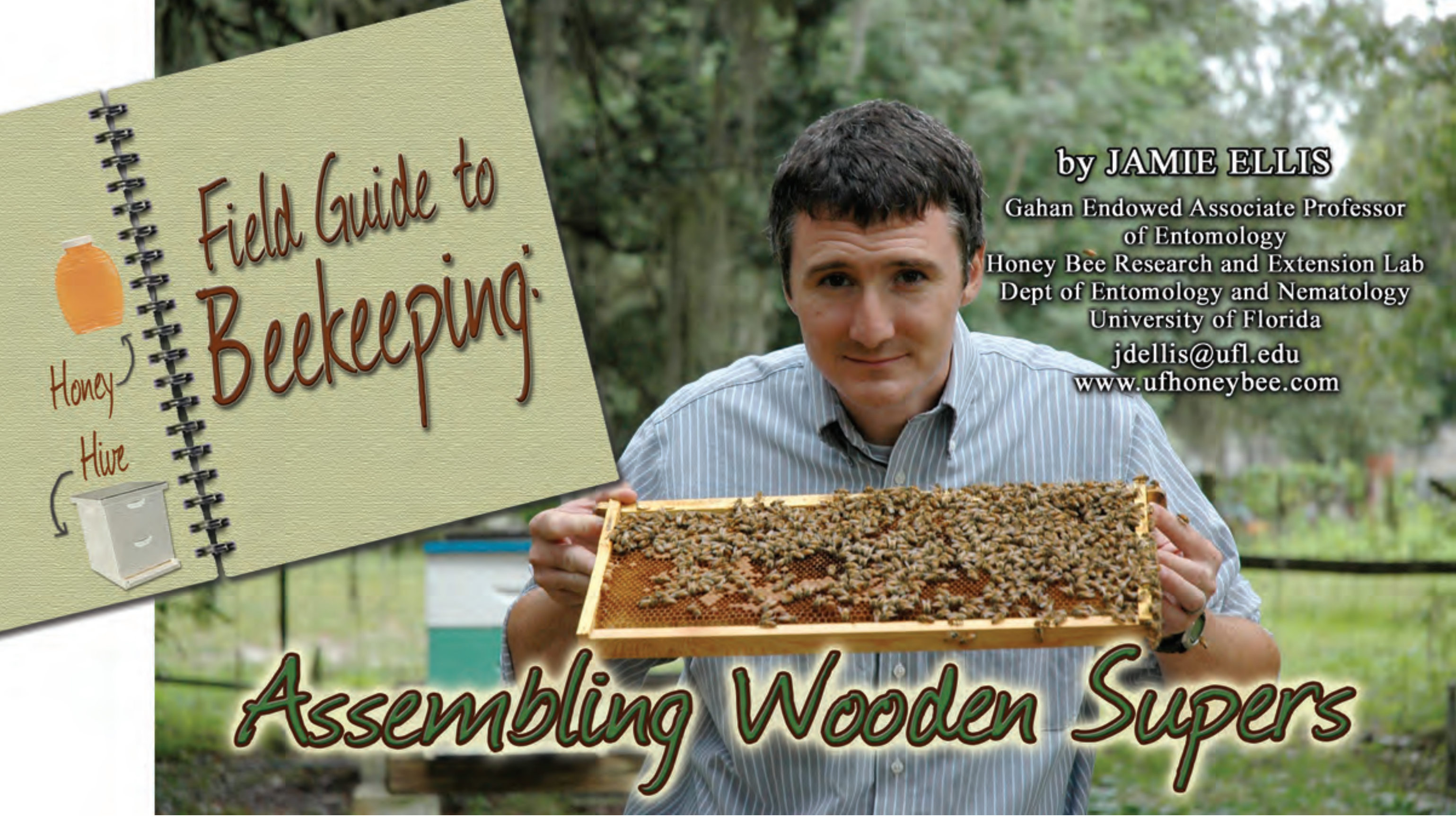

Assembling Wooden Supers

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The Langstroth hive is simple in design. It is based on the use of one-to-three, roughly cube-shaped boxes, or supers, that form the core of the hive and to which additional supers can be added as the bee colony grows (Figure 1). Most beekeepers use hives made of wood. Of course, other options are available for hive construction materials, including plastic and Styrofoam; yet, wood remains the most popular construction material out of which hives are made.

Figure 1 – A properly assembled super.

The life expectancy of a physical hive (not the bees, or colony, within, but the hive structure in which they live) is correlated with how well the supers, lids, bottom boards, and frames are assembled. Thus, it behooves beekeepers to invest time and energy in assembling hive components right the first time. In this article, I will share with you some pointers to remember when assembling wooden supers. I will follow this article with a step-by-step pictorial guide to assembling supers.

Water: a wooden super's worst enemy

Wooden supers eventually rot and decay, a process brought on by the equipment's exposure to water and microorganisms. Wooden supers are in a race that inevitably leads to their loss of use and functionality. Beekeepers cannot stop the ultimate demise of their supers, but they can do a lot to slow it by focusing on a few key issues that will limit water's ability to age and destroy the super.

1) Use rot-resistant wood. Not all wood is created equal. Pine is a popular wood used in super construction. It generally is light, cheap, and easy to work. I also have seen supers made of spruce, cedar, etc. Some wood, especially old-growth cypress, has rot-resistant qualities while other woods rot at the first sign of moisture. No wood is fully immune to the impact of water and the microorganisms that moisture promotes, but using rot-resistant wood such as cypress certainly helps prolong the life of the super. Rot-resistant wood can be hard to find or expensive. Yet, beekeepers should consider using rot-resistant wood for super construction purposes, given that it will help prolong the life of the equipment. There are a few beekeeping equipment supply companies that specialize in the production of cypress and other rot-resistant woodenware.

2) Be picky about super joints. In carpentry lingo, a joint is where two pieces of wood meet. The Langstroth super has four joints, the corners. The joints form a seam, or crack, that runs the entire length of area where the two pieces of wood touch. The joints are the most water-vulnerable parts of a super. Consequently, you should take care to use joints that minimize the length of the seam and the overall end grain exposed as both make the super vulnerable to water

Figure 2 – The front faces of rabbet- (left) and box- (right) jointed, deep supers. Note that the front face of the rabbet-jointed super needs only 4 screws, contains no wood end grain, and has no visible seam (crack) exposed. The face of the box-jointed super accommodates fives nails (or screws) on this side alone, exposes 5 areas of end grain (wood "boxes" between the nails), and has considerable visible seam (the zigzag crack) exposed. The rabbet-jointed super is made of cypress while the box-jointed super is made of pine.

Figure 3 – The side faces of rabbet- (right) and box- (left) jointed, deep supers. This side of a rabbet joint needs no nails/screws but does have exposed end grain down the entire side (strip of wood to the left of the seam in the super on the right) and includes a visible seam. The box-jointed super accommodates five additional nails/screws on this side, exposes additional areas of end grain (wood "boxes" between the nails), and has a considerable, visible seam (the zigzag crack) exposed.

Figure 4 – A view of the inside surface of the front wall of a rabbet-jointed, deep super. Notice the grooved cut on the left of the board. The side wall of a super fits snugly into this grove.

damage. Take a look at the joints of the two deep supers shown in Figures 2 and 3. Both figures include a super having a "box" joint, where two sides of the super interlock much like fingers in a clasped hand. Box joints are slightly different from "dovetail" joints where the interlocking fingers are tapered. Both figures also include a super having a type of "rabbet" joint which is where one side of the super fits snuggly into a special grove cut into the adjoining side of the super (the special groove can be seen in Figure 4). The end result of a rabbet joint is a joining of the two sides at a simple, straight line, or seam, that is present only on one side of the super. On the other hand, a super with box joint has a seam that zigzags down both faces of the interlocking sides. I have never done the math, but there is easily two-to-three times more surface area to protect on a box joint than there is on a rabbet joint.

Another disadvantage to using a box joint is the amount of end grain that is exposed to the elements. Wood is milled from trees that originally grew in such a way that channels were produced throughout the wood as tree rings were added annually. These channels run up and down through the wood (the tree), and allow the tree to transport nutrients throughout its structure. These growth patterns form the "grain" of the wood. Wood, typically, is cut "with the grain," a process that makes the wood stronger. Consider the common 2×4 for example. A 2×4, before it is cut out of the tree, would run up and down the tree, with the tree's grain. Once hewn from the tree, the 2×4 is strong because it was cut out in a pattern consistent with the growth pattern of the tree. The four long faces of a 2×4 are the most water-resistant parts of the wood, since they run with the grain, making it difficult for water to be absorbed into the wood. On the other hand, the ends of the 2×4 are spongy, being the end of the grain, or the "end grain". The two ends of the 2×4 are more vulnerable to water damage than are the faces of the board. This is why the ends tend to rot first when exposed to the elements.

Similarly, joints on a wooden super contain some end grain, just due to the nature of the way the sides of the supers were milled at the saw mill. Have another look at the joints represented in Figures 2 and 3. You will notice that there is minimal end grain exposed in the rabbet joint relative to that exposed in the box joint. Correspondingly, the rabbet joint is easier to protect and slower to rot.

3) <u>Take extra care to protect the joints.</u> This is done easily after the super is assembled by applying a layer of caulk over both exposed sides of the joint, targeting the end grain and seams. I tend to be liberal with my application of caulk on the joints. Be sure to use a safe, outdoor-use, non-toxic caulk on the supers. It is not necessary to caulk the joint from inside the super. The bees will seal that on their own using propolis. Caulk is relatively cheap and thus, a good investment that will prolong the life of the super.

4) <u>Should you treat the wood?</u> Like the joints, the faces of all sides of a super are susceptible to water/microorganism damage. Many beekeepers, especially commercial beekeepers, treat the supers with a wood preservative prior to painting them. You should not construct supers out of pretreated wood. A lot of pretreated wood is treated with compounds that may be toxic to bees. Instead, beekeepers can treat the supers with a compound especially recommended for use on bee hives. The active ingredient of the product is copper naphthenate, though the product trade name can vary. Many beekeeping supply companies sell the wood preservative. Most beekeepers who treat their supers prior to assembly have big vats of wood preservative in which they dip the super parts prior to assembly. Some beekeepers paint the preservative on the super walls, both inside and out, when needing to treat only a small number of supers.

If you feel that you must treat the wood prior to assembling and using it, I recommend that you only paint the walls of the super that will face the outside of the colony, the upper and lower rims of the super, and the super's joints. These same areas should be painted after the preservative dries, thus eliminating bee contact with the wood preservative.

There are alternatives to treating with the copper-based product. I am aware of a few "eco-friendly" wood preservatives. Admittedly, I do not know much about them. However, they may be worth using. Certainly, it is helpful to speak to the manufacturer about the product's possible toxicity to bees prior to treating supers with it. Generally speaking, I think people can get around using wood preservatives if they use rot-resistant wood, protect the super joints with caulk, and keep their supers painted regularly.

5) <u>Paint your supers.</u> Painting the supers is the best way to prolong their life. I recommend painting the outside faces of the supers. I also recommend painting the top and bottom rims of the super, simply because water can collect in this area when supers are stacked together. It is not necessary, or advisable, to paint the inside walls of the supers.

You are free to paint supers any color you choose. The traditional color choice is white, probably because it reflects the sun's heat rather than absorbing it. However, supers do not have to be white and can be painted any color. Some beekeepers prefer to paint their hives darker colors if the hives are going to be hidden among the bushes or trees. This helps disguise/camouflage the colonies, thus keeping them out of public view. That is OK as long as the hives will not be in full sun during the day. I recommend that supers not be painted dark colors if they are going to be located in full sun for most of the day. Regardless of the color you choose, I recommend that you paint your supers with a paint rated for outdoor use. Many beekeepers have discovered that one often can purchase cheap paint at the hardware stores if one asks the sales associate in the paint isle if they have any cheap, premixed paint. Some call this "oops" paint since many people return paint when they purchase it and later discover that they are unhappy with the color (oops!). Doing this, though, means that you will have to be somewhat flexible with the color you get.

Though not a water-related problem, I briefly want to mention other threats to wooden supers, namely a host of insect pests. These pests include some ants, termites, and even wax moths, among other critters. Treating and painting the supers helps guard against the wood-destroying nature of these insects. However, most beekeepers combat ants and termites by keeping their colonies off of the ground, rather than treating the wood itself. As such, I will cover this topic in greater detail in a future article.

Invest in proper super assembly

All supers, and for that matter lids and bottom boards, should be assembled using wood glue and screws, period. Most equipment manufacturers/suppliers will provide a bag of nails with each super sold. Nails are the traditional items used to hold the super walls together. However, I much prefer to use screws to assemble supers; they simply are a better choice. You are going to need a drill in order to drive the screws into the wood. Most any drill will work although some are made better than are others.

The basic anatomy of a screw is a metal shaft (or shank) wrapped with an inclined plane (the real power of the screw) and topped with a head (Figure 5). The inclined plane of the screw has the "teeth" or "thread" that cut into both pieces of wood, thus securing the screw's hold. The inclined nature of the inclined plane pulls both pieces of wood together while the screw is being driven. I find that screws secure wood together tighter than do nails, and screws cannot back their way out of the hole over time as can nails.

Figure 5 – A wood screw. The basic wood screw has a head and a shaft (or shank), the latter of which is about 2/3rd wrapped with an inclined plane. The underside of the screw's head is shaped like a wedge that tapers from its widest point just under the head to its narrowest point at the beginning of the shaft. The head of the screw contains a grooved pattern in which a drill bit fits, thus allowing the screw to be turned. Screws are sized by the diameter of the shaft (a measurement called the "gauge") and the length of the overall screw. Shaft diameters get larger as their gauge numbers increase.

The surface of the screw's head contains a shaped grove or slot (the "female" end) that is made to accommodate a bit or tip (the "male" end) of a screwdriver or drill. Common screw types include the Phillips head, or cross-point (the traditional "+"-shaped grove, see Figure 6), and the regular head that contains a straight grove (the "-"-shaped groove, sometimes called "slot" or "flathead" screws). I used these types of screws all of my life until I met the star head screw (Figure 6). This screw head has a six-pointed grove that is the best screw type I have ever used. In my experience, the Phillips screws strip easily, especially when one does not use the exact bit needed to drive the screw. "Stripping" happens when the bit is not pushed firmly into the grooves in the screw head or it does not fit together appropriately. Pulling the drill trigger causes the bit to spin loosely in the screw head, thus grinding away the groves in the screw's head. Once the screw's grooves are gone, the bit will not have anything to catch in the screw's head. This makes the screw impossible to drive into the wood since the drill bit turns freely in the head rather than properly mating with the screw head and pushing it further into the wood. I have never had this problem with star bits. Furthermore, every box of star bit screws I have purchased has come with a bit in the box, thus ensuring that you get the right bit for the job. I will never use a Phillips or slot screw again.

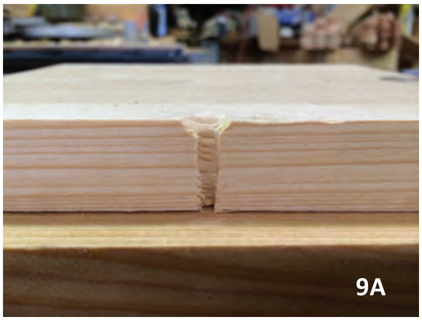
Figure 6 – The head patterns of two screws. The screw on the right accommodates the more common Phillips head bit (the "+" pattern) while the screw on the left accommodates a star bit.

A closer look at the head of the screw will reveal that the underside of the head is tapered from the surface of the head, where the taper is widest, to the shaft of the screw, where the taper of the head is narrowest (Figure 5). This taper helps the wide screw head fit gently into the wood. As a general rule, the harder the wood, the more likely the screw is to split the wood on its way in since the tapered head can act as a wedge going into the wood. To combat this, you should drill pilot holes and countersink the screws when assembling supers.

A pilot hole is a hole through which the screw shaft will travel as it goes through the first piece of wood and into the second piece of wood. A powerful drill can spin a screw quickly through the wood. This force can cause the wood to split as the screw travels through it. Drilling a pilot hole in the wood first gives the screw a path through which it can travel, thus lessening the chance that the screw will split the wood. Pilot holes are easy to create. You simply need to find a drill bit that is about the same length and diameter of the shaft of the screw that you are using (Figure 7). It is important not to use a drill bit that is the diameter of the shaft + the inclined plane. It should ONLY be the same diameter of the shaft, not taking into account the in-

Figure 7 – Drill bits used to drill pilot holes should be the same diameter, or slightly smaller, than the shaft of the screw (without including the thread, or inclined plane, of the screw).

Figure 8 – A screw (left) and the various bits used to drill and/or countersink pilot holes. The bits in the middle and on the right do both while the bit on the left only drills the countersink hole. The bit on the right is for illustrative purposes only. It drills a pilot hole that is too big for the screw shown in the picture.



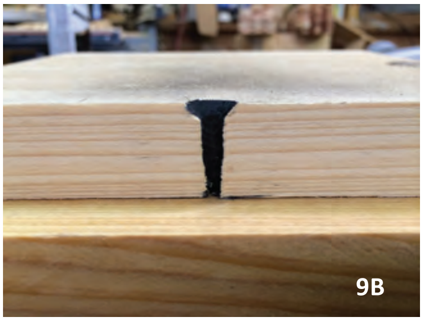


Figure 9 – A side view of a properly countersunk pilot hole (a) and with black paint added (b) to highlight the resulting pattern.

Figure 10 – A screw drilled correctly through a pilot hole. The pilot hole is too big for the screw, this done on purpose so that both could be seen. Notice how the head of the screw fits flush in the countersunk pilot hole and how the teeth (or inclined plane) of the shaft cut into the walls of the pilot hole.

clined plane. Drilling a pilot hole the size of the diameter of the screw, inclined plane and all, will make it where the screw has nothing to grip on its way through the wood.

I find that drilling pilot holes alone is not good enough to eliminate wood splits. Therefore, I countersink the pilot holes prior to driving the screws. Countersinking means that you widen the top of the pilot hole so that it can accommodate the entire screw head. When properly countersunk, the surface of the screw head will be flush with the face of the super wall into which it has been driven. The countersink hole accommodates the screw head perfectly, thus minimizing splits (unless you elect to force the screw straight through!).

I show in Figure 8 a few types of countersink bits, two of which also contain a drill bit that creates the pilot hole simultaneously. These are great to use because some, like the bit shown in the middle of Figure 8, allow you to change the drill bit being used, thus allowing you to use the right drill bit needed to create the appropriately sized pilot hole. This particular bit also comes outfitted with a "stop" (the large, metal platform above the drill bit – it is circled by a black ring) that keeps the operator from driving the drill bit and countersink further into the wood than it should be driven. Figure 9a shows a piece of wood in which a pilot hole was drilled and countersunk. The hole is cross-sectioned and painted black in Figure 9b so that you can see it more clearly. Noticeably visible are the tapered hole created by the countersink and the long pilot hole that follows. Figure 10 shows a screw properly driven into the countersunk pilot hole.

Assembling supers with screws is important, but you also should use wood glue to hold the joints together even better. I highly recommend using wood glue on all super joints, prior to fastening the sides together with screws. The wood glue provides added reinforcement to the super's joints, which will be under considerable pressure in the typical beekeeping operation.

Conclusion

Assembling supers becomes quite easy once you have assembled a few. I am not going to describe the assembling process for hive lids and bottom boards. However, you would follow the same recommendations I make for assembling supers: (1) use wood glue, (2) drill and countersink pilot holes, (3) assemble the equipment with screws, (4) caulk the joints and (5) paint all surfaces that are exposed to the elements. Properly assembled supers and other woodenware should provide years of service in the field. It is worth the effort and extra time to assemble these important pieces of the hive correctly.

STEP-BY-STEP INSTRUCTIONS FOR ASSEMBLING A WOODEN SUPER

1) Collect the following equipment/supplies:

- Wood glue
- Shop towels – These are used to clean up any mess made with the glue and/or caulk.
- Decking screws – I recommend using #8 or #9 (i.e. 8 or 9 gauge), 2 ¼ - 2 ½ inch decking (or wood) screws, with star heads. Hardware stores sell screws by the pound, so you get more screws per pound when you purchase shorter screws or screws with lower gauges. You should not use screws that are shorter than 2 ¼ inches. A star-shaped drill bit *should* come with the box of screws. Read the box before purchasing it as it should indicate the presence/absence of a bit.
- 2 clamps (shown in use in Figure 5)
- 2 drills – The job is easier when two drills are used. One drill, a standard one, can be used to drill and countersink pilot holes while the second can be used to drive the screws. A dry wall drill works well for the latter purpose, but any drill will do. I prefer to use battery-powered, cordless drills. It is OK to use only one drill to do both jobs. It is easy to change drill bits in today's drills.
- 1 pilot hole drill bit (same diameter, or slightly smaller, as the shaft of the screw you elect to use)
- 1 countersink bit (can be part of a pilot hole bit assembly)
- Caulk gun
- Canisters of caulk – non-toxic, outdoor use
- Super assembly jig – This is a device you can make that will hold the walls of the supers together while you assemble them. See the homemade device in use in Figure 4.
- Paint – non-toxic, outdoor use paint
- Paint brush, roller, or sprayer – used to apply paint.
- Supers to assemble

2) Apply copious amounts of wood glue to all corners of the super (Figure 1). You will know you have used enough glue once you screw the super walls together because a little bit of wood glue will be forced out of the joint (Figure 2). This can be smeared down the joint and allowed to dry.

Figure 1

3) Place the super walls in the jig (Figure 3). It is important that supers are assembled on a level surface. They must be level across the top and bottom once assembled. This is where a jig comes in handy. The jig in the picture provides a level surface on which the super can be assembled. This homemade jig can be used to assemble supers of various sizes. Place all four sides of the super in the jig (Figure 4).

Figure 2

Figure 3

Figure 4

Figure 5

4) Clamp the supers together (Figure 5). Make sure that the handles on the super walls are pointing toward the outside of the super (reversing them is a common mistake). Also, make sure all handles are oriented in the same direction. It is very easy to put super walls on upside down and inside out, especially when using supers that have rabbet joints. Care must be taken to avoid this.

5) Drill and countersink a pilot hole at the top of the box (Figure 6 – ready to drill; Figure 7 – the drill bit is driven firmly into the super wall). A properly drilled and countersunk pilot hole is shown in Figure 8. Many equipment manufacturers pre-

Figure 6

drill pilot holes to accommodate the nails that come with the supers. However, these holes sometimes are too small to accommodate the screws that you use. Thus, you may need to widen the hole. You certainly will need to countersink the hole. At other times, supers will come to you with no pilot holes at all. In this case, you need to mark the super prior to drilling pilot holes. This will help you make sure you are putting pilot holes where they need to be. An example of a ready-to-drill marked super is shown in Figure 9.

Figure 7

Figure 8

Figure 9

6) Drive a screw through the pilot hole (Figure 10). A dry wall drill is used to drill the screw in this figure. The drill will stop moving once the black shaft on the end of the drill is depressed, which happens once the black shaft contacts the super wall. This ensures that the screw is not driven too deeply into the wood. Notice how the top of the properly driven screw is flush with or just below the surface of the wood (Figure 11).

7) Unclamp the super.

8) Flip the super over in the jig and secure it with a clamp (Figure 12).

9) Drill and countersink the rest of the pilot holes (Figure 12). You only need to use four screws per corner for supers having rabbet joints. You need to use considerably more (up to 10) for supers with box joints.

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Figure 10

Figure 12

Figure 11

Figure 13

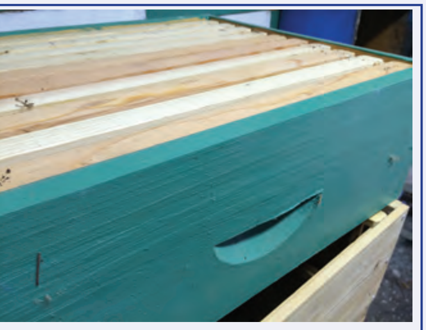

Figure 14

10) Drive screws into the remaining pilot holes.

11) Apply caulk to all joints of the super (Figure 13), including the end grain and seams at the joints. Remember that the seam continues to the top surface of the super. This, too, should be caulked. The caulk needs to dry before paint can be applied.

12) Paint the super. Apply paint to the faces of the super walls and the top/bottom rims of the super (Figure 14). The latter is especially important since water can collect between supers in the field. You always want a layer of paint between any exposed wood and water.

Notice in my instructions for assembly that I did not include a step for treating the super with a wood preservative. If you elect to do this, you would do it prior to beginning step two outlined above. I, personally, do not think it is necessary to treat the wood in most instances. Properly protected joints and regularly painted supers (every 3 years or so) will protect supers adequately under most circumstances.